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Research Article

Learning Effectiveness of ESD-Oriented Natural and Social Science Projects in Realizing Pancasila Student Profiles for Vocational High School Students

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Abstract.
The objective of this research is to assess the effectiveness of ESD-oriented Natural and Social Sciences Project (IPAS Project) learning in achieving the Pancasila student profile of critical reasoning dimensions. This research employs a quasi-experimental approach with a pre-test and post-test control group design. The research sample consisted of two groups: the experimental class and the control class. According to Ennis, a validated critical thinking test serves as the measurement instrument to assess the increase in students' critical reasoning abilities after learning intervention. An observation sheet is also utilized to observe the Pancasila student profile in the critical reasoning dimension. The results of the research show that ESD-oriented natural and social science project learning is moderately effective in achieving the Pancasila student profile regarding the critical reasoning dimension. The average N-Gain score for the experimental class (ESD-oriented learning) is 63.51%, falling within the moderately effective and average category. The average N-Gain score for the control class (non-ESD-oriented learning) is 56.05%. Based on the observations of Pancasila student profiles of students engaging in ESD-oriented natural and social science project learning in the critical reasoning dimension, it is evident that some students in all elements of critical reasoning can attain the developing category as anticipated, according to the phase. These findings indicate that the ESD approach in learning natural and social science projects can effectively realize the Pancasila student profile of critical reasoning dimensions.

Keywords: IPAS project (natural and social sciences project), ESD (education for sustainable development), Pancasila student profile; critical reasoning

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1. Introduction

Education is the foundation for forming individual character and personality, including Pancasila values [1,2]. The characteristics of Pancasila students align with the objectives and goals outlined in the Ministry of Education and Culture's vision and mission as articulated in the 2020-2024 strategic plan for the Ministry of Education and Culture

[3]. Pancasila students represent Indonesian students who are committed to lifelong learning and possess global competency while upholding the values of Pancasila, with six main characteristics: faith, devotion to God Almighty, and noble character; global diversity; working together; independent; critical reasoning; and creative [4]. The IPAS project has great potential to integrate Pancasila values into learning. Education for Sustainable Development is also an essential focus in education today, which aims to produce individuals who care about the environment and society [5,6].

To realize the Pancasila student profile, implementing this character education must be integrated with all subjects, including the science and science project, aspects of substances, and their changes. With ESD-oriented project-based science and science learning, it is hoped that it will be able to accommodate the dimensions of the Pancasila student profile, namely critical reasoning. Based on teacher observations and conversations with colleagues and students, there appears to be a limited manifestation of the Pancasila student profile among the student body. Following the Covid-19 pandemic, there has been a noticeable decline in students' character, with values such as courtesy, caring for the school environment, critical thinking abilities, discipline, accountability, self-reliance, and teamwork showing signs of diminishing importance.

Vocational High Schools play a crucial role in preparing young individuals for a successful transition into the workforce [7]. Therefore, it is essential to ensure that vocational school students not only have technical competence but also understand and internalize the values of Pancasila and have an awareness of environmental sustainability. The ability to think critically is one of the essential skills that must be possessed by every individual, especially vocational school students who will enter the world of work [8,9]. Critical thinking allows students to analyze problems, make wise decisions, and contribute to positive societal change [10,11]. As a result, fostering the development of critical thinking abilities holds significant importance within the educational journey at vocational schools.

The results of observations of students at SMK Negeri 3 Jepara show that students' sustainable lifestyles are low. Sustainable attitudes and lifestyles have not been thoroughly ingrained in students. There is still a lot of rubbish scattered in the school environment and the classroom. Likewise, with an energy-saving attitude, students do not turn off fans and lights when leaving the classroom. Sustainable development indicators are closely related to life's sustainability on planet Earth [12]. Discussion of knowledge about nature and society is described in the IPAS project subjects. The closeness between environmental indicators from the concept of sustainable development and the content of the Science and Technology Project subjects is a strength for incorporating

sustainable development values into the Science and Technology Project lessons at the vocational school level. Most objectives for sustainable development pertain to environmental, energy, and health matters. [13,14]. These issues are close to the science and science project subjects at the vocational school level. The urgency of infusing ESD values into subjects is following the direction of UNESCO, which calls on countries to transform the values of curriculum content towards sustainable development [15]. Apart from that, the IPAS Project, subject to aspects of substances and their changes, is expected to accommodate the value of ESD to transform the view of IPAS objects from just objects of observation to objects related to the life of living creatures and the sustainability of the Earth as its environment.

UNESCO has introduced the Education for Sustainable Development (ESD) approach as an educational approach emphasizing the importance of understanding, respecting, and promoting sustainability principles in the curriculum and learning [16]. ESD includes understanding environmental, social, and economic issues and invites students to think critically about these challenges. However, even though ESD offers excellent potential to improve students' critical thinking skills, there has not been much research that specifically examines the effectiveness of ESD-oriented science project learning in vocational school environments. Therefore, this research aims to examine the effectiveness of ESD-oriented Science Project learning in realizing the Pancasila student profile of vocational school students with critical reasoning dimensions. The application of ESD in the IPAS Project subjects is expected to integrate Pancasila values, build environmental awareness, and develop a caring attitude towards sustainability for vocational students. This research will involve developing and implementing a curriculum that combines aspects of substances and their changes with the student profile of Pancasila and sustainability.

With a deeper understanding of how ESD-oriented science and science project learning can influence the Pancasila student profile of the critical reasoning dimension of vocational school students, we can improve the quality of education in vocational schools and help create a young generation who is not only technically competent but also has a solid social and environmental awareness, and understand and respect the fundamental values of the Indonesian state, namely Pancasila. Through this research, it is hoped that empirical evidence can be found supporting or refuting this learning approach's effectiveness. The results of this research will provide valuable information for educators, educational policymakers, and all parties involved in the educational process at vocational schools. Apart from that, this research can also be a basis for

developing curriculum and learning methods that are more effective in preparing vocational school students to become individuals with critical thinking skills and awareness of sustainability issues. Thus, it is hoped that this research can positively improve the quality of education in vocational schools and support sustainable development.

2. Method

The subjects in this research were class X students at SMKN 3 Jepara. Sampling was carried out using a cluster random sampling technique, which resulted in class X AKL4 (Institutional Accounting and Finance) as the experimental group and class X AKL3 as the control group, with 36 students in each class. Students carry out ESD-oriented science and science project learning to test the effectiveness of ESD-oriented science and science project learning to realize the Pancasila student profile of students with critical reasoning dimensions. The assessment of how well ESD-focused science education and science project-based learning achieve the development of student's critical thinking skills in alignment with the Pancasila student profile is accomplished by employing a tool comprising 20 multiple-choice questions. These questions are designed to gauge critical thinking abilities based on the criteria established by Ennis [17], which include (1) providing a simple explanation, (2) building basic skills, (3) making inferences, (4) making further explanations, and (5) set strategy and tactics. Apart from the test, an observation sheet was also made to find out the profile of Pancasila students in the dimensions of critical reasoning during learning. The teacher will fill this observation sheet in project-based learning, making products developed from the concept of substances and changes to the topic of separating mixtures.

Data analysis using N-gain is used to determine whether or not there is an increase (Gain) in the profile of Pancasila students in the critical reasoning dimension for students whose learning is ESD-oriented (experimental class) and students whose learning is not ESD-oriented (control class). Data obtained from the results of students' pre-test and post-test with the following N-gain formula:

$$Gain\,(g) = \frac{post - test\ score\ -\ pre - test\ score}{maximum\ score - pre - test\ score}$$

The critical reasoning ability test instrument assessment criteria are as in Table 1.

3. Result and Discussion

TABLE 1: N-gain Effectiveness Criteria [18].

Percentage (%)	Category
>76	Effective
56 – 76	Effective enough
40 – 55	Less effective
< 40	Ineffective

3.1. Results

3.1.1. The assessment of how well science and science project-based learning with an emphasis on Education for Sustainable Development (ESD) contributes to the development of critical reasoning skills in students who embody the Pancasila student profile is accomplished through the utilization of evaluation tools that align with the KBK indicators as outlined by Ennis. The average value of critical thinking skills can be seen in Figure **1**.

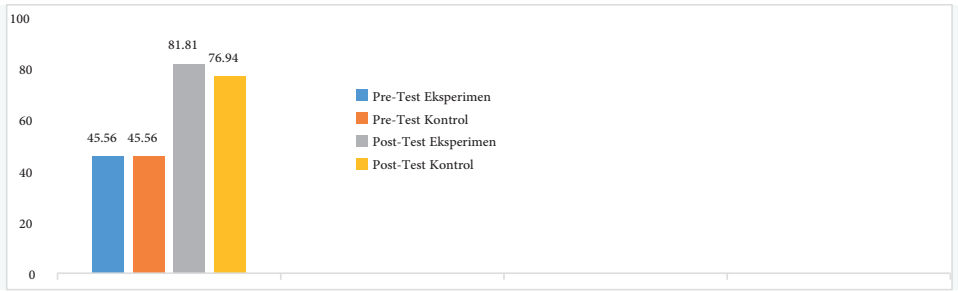

Figure 1: Average Value of Critical Thinking Skills.

TABLE 2: Independent Sample t_Test.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
KBK	Equal variances assumed	3.865	.053	2.214	70	.030	4.861	2.195	.483	9.239
	Equal variances not assumed			2.214	62.797	.030	4.861	2.195	.474	9.248

From the data presented in Figure 1, it can be seen that the average pre-test CBC score for the experimental group and the control group is the same, namely 45.56. Meanwhile, the average post-test KBK value for the experimental group was 81.81, and the average KBK value for the control group was 76.94. Next, a t-test is carried out to compare the averages of two samples (control class and experimental class), which are unrelated, to determine whether the two samples have differences.

From Table 2 t-test results for post-test data, the value of t-count = 2.214 and t-table = 2.030 with a significance of 0.030 can be seen that the value of t-count > t-table and sig probability (sig. 2-tailed) is less than 0.05 So it can be said that there is a significant difference in the profile of Pancasila students in the critical reasoning dimension between students who learn using the ESD-oriented Science Project and those who are not ESD-oriented.

Subsequently, an N-Gain assessment was conducted to ascertain whether there was a noticeable improvement (Gain) in the critical reasoning skills of Pancasila students who underwent learning with ESD-focused teaching materials (experimental group) in comparison to those who did not use ESD-focused teaching materials (control group).

From Table 3, the results of the N-gain score test calculation show that the average N-gain score value for the experimental class (ESD-oriented learning) is 63.51%, including in the quite effective category, with a minimum N-gain score value of 22.22% and a maximum 90%. Meanwhile, the average N-gain score for the control class (non-ESD-oriented learning) is 56.05%, included in the quite effective category with a minimum N-gain score of -12.5% and a maximum of 100%. So, it can be concluded that using ESD-oriented and non-ESD-oriented learning is quite effective in increasing the profile of Pancasila students in the critical reasoning dimension in the Science and Science Project subject, aspects of substances, and their changes. Still, the N-gain value of the experimental class is higher than the control class. These results provide evidence that ESD-oriented science and science project learning is more effective in realizing the Pancasila student profile with critical reasoning dimensions than learning that is not ESD-oriented.

Students who engage in critical thinking can impartially assess qualitative and quantitative data, establish connections among diverse pieces of information, scrutinize data, assess, and draw conclusions [19]. From Table 4, the results of observing the profile of Pancasila students in the critical reasoning dimension in the experimental class from 36 students data was obtained on the element of obtaining and processing information and information ideas, the sub-element of asking questions, it was found

TABLE 3: N-Gain Score Test Calculation Results.

No	Experimental Class	No	Control Class
	N-Gain Score (%)		N-Gain Score (%)
1	22.22	1	50
2	80	2	53.85
3	83.33	3	40
4	78.57	4	33.33
5	62.5	5	75
6	84.62	6	80
7	50	7	72.73
8	57.14	8	60
9	73.33	9	71.43
10	66.67	10	92.86
11	66.67	11	58.33
12	53.85	12	52.94
13	28.57	13	55.56
14	50	14	50
15	75	15	61.54
16	50	16	37.5
17	50	17	62.5
18	76.47	18	25
19	60	19	30
20	78.95	20	83.33
21	82.35	21	66.67
22	87.5	22	27.27
23	90	23	66.67
24	75	24	75
25	64.29	25	44.44
26	88.89	26	76.92
27	50	27	50
28	88.24	28	33.33
29	37.5	29	78.57
30	42.86	30	50
31	46.15	31	100
32	57.14	32	55.56
33	40	33	62.5
34	63.64	34	-12.5
35	66.67	35	60
36	58.33	36	37.5
Average	63.51	Average	56.05
Minimum	22.22	Minimum	-12.5
Maximum	90	Maximum	100

Table 4: Observation Results of Pancasila Student Profiles on Critical Reasoning Dimensions.

Element	Sub-Elements	Started to Develop	Is Developing	Developing According to Expectations	Very Developed
Obtain and process information and ideas.	Asking question	-	4	30	2
Obtain and process information and ideas.	Identify, clarify, and process information and ideas.	-	7	27	2
Analyze and evaluate reasoning and procedures	State the reasons for the choice or decision	2	5	29	-
Reflection of thoughts and thought processes	Reflect and evaluate one's thinking	4	10	20	2

that four students were developing, 30 students were developing according to expectations and two students were significantly developed. In the element of obtaining and processing information and ideas, the sub-element of identifying, clarifying, and processing information and ideas found that seven students were developing, 27 were developing according to expectations, and two were developing very well. The sub-element states the reasons for the decision to analyze and evaluate reasoning and procedures. Two students were starting to develop, five were developing, and 29 were developing according to expectations. In the reflection of thought element and the thought process sub-element of reflecting and evaluating one's thinking, it was found that four students were starting to develop, ten students were developing, 20 students were developing according to expectations, and two students were developing very well.

3.2. Discussion

ESD-oriented science and science project learning can improve critical thinking skills because the local and global issues presented can ignite students' reasoning power to find sustainability solutions actively. The global issue presented in this theme, namely the threat of a water crisis, motivates students to find solutions for water purification. This follows ESD-oriented learning research to improve students' critical and creative thinking, which can be done using the Project Based Learning (PjBL) method [20]. The implementation of ESD-oriented science and science project learning is quite effective in improving the critical thinking skills of vocational school students because it encourages

changes in knowledge, skills, values, and attitudes to enable a more sustainable and just society for all. Knowledge is expressed in teacher and student reading materials, namely aspects of substances and their changes. This reading material can help students understand the material content better so that learning outcomes improve.

From the results of observing the profile of Pancasila students in the critical reasoning dimension in the experimental class, most students in all critical reasoning dimensions in all elements and sub-elements reached the developing category according to expectations according to their phase, namely phase E. This shows that the critical reasoning dimension can be realized in learning IPAS project aspects of substances and their changes.

4. Conclusion

This research shows that ESD-oriented science and science project learning is reasonably practical in forming the Pancasila student profile of the critical reasoning dimension of vocational school students. The research results showed an increase in students' critical thinking skills after receiving ESD-oriented learning. From the observation results, it was also found that the majority of students in all elements of critical reasoning were able to reach the developing category according to expectations according to their phase, namely, phase E. ESD-oriented science and science project learning allows students to learn actively, apply their knowledge in real situations, and develop critical thinking skills through water purification projects. The interaction between students, teachers, and the learning environment that encourages understanding scientific concepts and awareness of the social and environmental impacts of the Science Project learning materials has helped students develop their critical thinking skills. The implication of the results of this research is the need to increase the application of learning methods that integrate ESD values in IPAS projects to form a generation of students who have a deep understanding of natural science while also having strong Pancasila characters and values.

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