

Efforts to Improve Students' Learning Outcomes through Performance Assessment on the Concept of Environmental Pollution

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ABSTRACT

This research was motivated by the low student learning outcomes, as evidenced by an average mid-term exam and daily test score of 70 in biology, which falls below the minimum passing criterion of 75. Therefore, this study aimed to implement a learning approach that utilizes performance assessments to improve these outcomes. Performance assessments were chosen for their authentic and comprehensive nature, with the expectation that their application would better enhance students' cognitive potential. The primary objective of this study was to determine the improvement in student learning outcomes through the use of performance assessments. A quasi-experimental method was employed, and the research instruments included a performance assessment rubric and a post-test to measure student learning outcomes. The subjects consisted of 37 Grade X students at SMAN 1 Singaparna, selected using a cluster random sampling technique. Based on the research findings and discussion, it can be concluded that there was a significant improvement in the learning outcomes of Grade X students following the implementation of performance assessments. The results indicate that performance assessments have a moderately positive effect on student learning outcomes.

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Introduction

The use of performance assessment is closely linked to improving student learning outcomes (Gijbels et al., 2005; Lile & Bran, 2014). Haka (2013) states that "Implementation of Performance Assessment can improve students' Habits of Mind and Concept Mastery." When assessing student work, performance assessment covers various aspects, including selection, tool usage, student work procedures, and the technical and aesthetic quality of student output (Arter & McTighe, 2001). This type of assessment also provides more comprehensive information about students' abilities, encompassing both their process and product. It's also used to enhance learning motivation in understanding and applying scientific concepts (Winahyu in Haka, 2013). Initial observations at SMA Negeri 1 Singaparna revealed relatively low learning outcomes in Biology for Class X students. This school was specifically chosen because the average scores from the Mid-Semester Exam and Daily Tests for Class X Biology students were 70, which is below the Minimum Completion Criteria (KKM) of 75. These low learning outcomes indicate specific challenges within the current learning process, suggesting that existing approaches may not be optimally supporting students in achieving expected competencies.

Given this problem, we are interested in developing a learning approach that connects with students' real-life environments and incorporates performance assessments to improve student learning outcomes. Performance assessment was chosen because it is an "authentic and comprehensive assessment whose final results will be able to improve students' potential skills, attitudes, and cognitive abilities better" (Haka, 2013). Through this approach, we hope students will not only improve their academic outcomes but also develop environmental awareness attitudes in their daily lives, acquiring skills relevant to graduate competency standards. This forms the foundation of our research, which aims to cultivate a young generation that is intelligent, creative, and responsible in maintaining, managing, and preserving the environment. Therefore, the main objective of this study is to determine the improvement in student learning outcomes through the implementation of performance assessments.

Methods

This section is dedicated solely to the research methodology, excluding any charts or flowcharts. It details the precise manner in which the research was conducted. Key components of this section include the specific type of research method employed, a full disclosure of the data collection instruments and techniques, the format of these instruments, and

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a comprehensive description of the research subjects. For studies involving tools and materials, their specifications must be provided. Tool specifications should describe the sophistication of the equipment, while material specifications should detail the types of materials utilized.

The research employed a quasi-experimental design. To minimize bias in the research findings, the researcher replicated the treatment in a class focusing on environmental pollution material. Learning outcomes were measured through both pretests and posttests, thus utilizing "The One-Group Pretest-Posttest Design."

Table 1. The One-Group Pretest-Posttest Design

O1	X	O1
Pretest	Treatment	Posts

Source: Fraenkle & Wallen (2009)

Information:

O1 : Pretest/posttest with questions that equivalent

X : Implementation of performance assessment

Participants

The research was conducted at SMAN 1 Singaparna. The population for this study included all tenth-grade students during the even semester. From this population, 37 students from class X MIPA 1 were selected as the sample using a cluster random sampling technique. This method was chosen because the students were considered to have similar characteristics.

Data Collection and Analysis

Upon completion of the research, both quantitative and qualitative data were collected. The quantitative data consisted of pretest scores, posttest scores, and N-gain values. This data was analyzed with the aid of Statistical Package for Social Sciences (SPSS) 24 for Windows software. Qualitative data, on the other hand, was gathered from performance assessment sheets and field notes, which were then analyzed descriptively to draw conclusions from the study.

Pretest and Posttest Scoring

Students' pretest and posttest scores on the environmental pollution and preservation material were analyzed using the Normalized Gain (N-gain) formula, as outlined by Meltzer (2002):

$$N \text{ gain/Indeks Gain} = \frac{\text{skor posttest} - \text{skor pretest}}{\text{skor maksimal} - \text{skor pretest}}$$

Information:

N-gain : markgainnormalized (N-gain) of both approaches

Spontaneously : final test score

Spread : initial test scores

Smax : maximum (ideal) score from the initial test and final test

Table 2. N-gain Index Category

N-gain Index Value	Category
>0.7	Tall
0.3-0.7	Currently
<0.3	Low

Source: Meltzer (2002)

Then the results of the percentage are interpreted in terms of achievement in the recapitulation of learning outcomes and indicators of students' environmental awareness. To determine the significance of the data, the N-gain score is tested using a one sample test with a standard value of 0.31 in the SPSS version 24 for windows program.

The data from the student performance observation sheet was analyzed to determine the percentage of students in each category of learning outcomes formed during learning activities, namely: practicums, discussions, presentations, and products using the Sudjono formula (Haka, 2013):

$$NP = \frac{R}{NS} \times 100\%$$

Information:

- NP : The percentage value sought or expected
 R : The number of scores obtained by students
 NS : Maximum total score

From the data, it is known the learning outcomes that are trained during the learning process. Then the percentage of achievement results that have been obtained is calculated as an average value by matching the criteria referring to the assessment guidelines according to Purwanto (Haka, 2013). The criteria are shown in table 3.

Table 3. Presentation Category Learning Outcome Achievement

Mastery Level	Category
86-100%	Very good
76-85%	Good
60-75%	Enough
55-59%	Not enough
≤ 54%	Not enough

Hypothesis test of correlation and contribution of correlation data is obtained by correlating each component of performance assessment with N-gain of student learning outcomes and N-gain of student environmental awareness questionnaire. To calculate the correlation using Pearson/Kendal and Spearman correlation formulas found in SPSS 24 for windows. According to Sarwono (2009) for the degree of significance of two variables can be analyzed with the following provisions:

1. If the probability or significance > 0.05 then the relationship between the two variables is not significant.
2. If the probability or significance < 0.05 then the relationship between the two variables is significant.

As a guideline for providing interpretation, researchers use the correlation coefficient criteria in Table 4 below:

Table 4. Correlation Coefficient Criteria Table

Coefficient Interval	Relationship Level
0.00 – 0.019	Very low
0.20 – 0.399	Low
0.40 – 0.599	Currently
0.60 – 0.799	Strong
0.80 – 1,000	Very strong

(Source: Sugiyono, 2009)

Data Collection and Assessment

This study primarily used quantitative data to evaluate students' understanding of environmental pollution. This data was collected through pre- and post-tests, specifically designed to measure cognitive learning outcomes following the implementation of performance assessments.

In addition to the tests, group discussion assessment instruments were utilized. These included a student worksheet (LKS), which was distributed to groups before their discussions on environmental pollution and preservation. Students completed this LKS collaboratively, and teachers provided oral feedback. Both individual student and group performance indicators were evaluated using a rubric on the performance assessment sheet.

The learning outcome tests themselves were multiple-choice questions with five options. This format aligns with Nitko (2007)'s explanation that such questions are effective in identifying students who have achieved a sufficient grasp of the learning targets.

Results and Discussions

This section presents and discusses the results of the data analysis, connecting them to relevant learning theories and previous research. Only the "clean" results are reported here, focusing on the outcomes of the analysis and hypothesis testing without detailing the statistical calculation processes. Tables and figures are used to clarify the presentation of results and are accompanied by a thorough discussion.

The primary findings regarding learning outcomes are presented as the average achievements for the pretest, posttest, and N-gain. The average normalized gain score specifically describes the increase in student learning outcomes. A recapitulation of these results is provided in Table 5.

Table 5. Recapitulation of Comparison of Average Values of Student Learning Outcomes

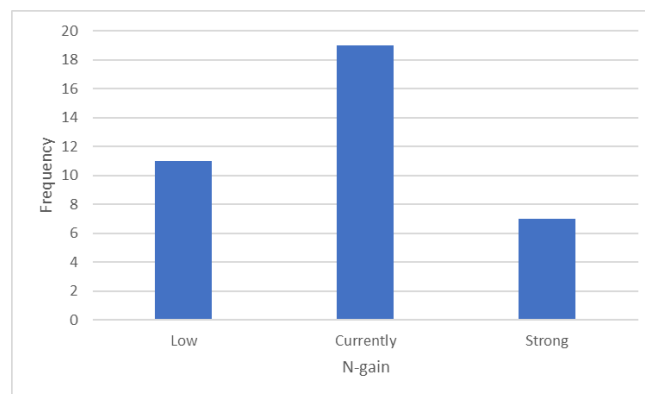
	<i>pretest</i>	<i>posttest</i>	<i>Gains</i>	N-gain	Criteria
Number of Students			37 Students		
Average value	60.9	75.8	14.9	0.4	Currently

Table 5 shows that the average pretest score for the concept of pollution and environmental preservation was 60.9, which increased to an average posttest score of 75.8. Based on these figures, student learning outcomes improved with a moderate N-gain category, indicated by an average N-gain score of 0.4. The frequency of N-gain for student learning outcomes is further detailed in Table 6.

Table 6. Statistical Data on Frequency of N-Gain Values of Student Learning Outcomes

N-gain	Frequency	% Frequency
Low	11	29.73%
Currently	19	51.35%

For more detailed frequency statistics data on N-gain of student learning outcomes through performance assessment on the concept of environmental pollution and preservation, refer to Figure 1.

**Figure 1.** N-Gain Diagram of Student Learning Outcomes

Based on Figure 1, a significant increase in student scores was observed after the implementation of performance assessment on environmental pollution and preservation material. The N-gain value quantifies the extent of this improvement. This increase is largely attributable to the active engagement and practical application fostered by performance assessment, which aligns well with constructivist learning theory (Arifin et al., 2025). Constructivism posits that learners construct knowledge and meaning from their experiences. By training student performance and providing appreciation for their efforts, the learning process encouraged students to actively build their understanding of environmental concepts. Performance assessment guides students to optimize their abilities, preparing them to apply these skills in daily life.

The moderate N-gain category (0.4) suggests that while the performance assessment method showed sufficient effectiveness in improving student learning outcomes, there is still room for improvement to achieve a "high" category. This finding is consistent with studies by Apriani et al. (2022), which also found moderate gains when implementing similar authentic assessment strategies. The strength of this moderate gain, when supported by a performance assessment-based learning design, lies in its ability to foster not just rote memorization but also deeper understanding and practical application of knowledge. The design encourages students to engage in real-world problem-solving, which is a hallmark of effective learning for complex topics like environmental preservation.

In addition to the N-gain data from the learning outcome test, student learning outcomes were also analyzed based on question indicators that refer to Bloom's Taxonomy of Cognitive Processes (Nasir et al., 2019; Widiarti et al., 2021; Rosiana et al., 2023). Figure 2 illustrates the average N-gain for each Bloom's Taxonomy indicator.

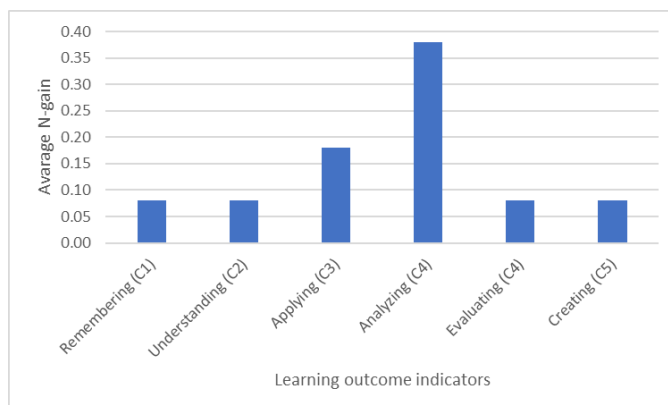


Figure 2. Average N-Gain Diagram of Each Student Learning Outcome Indicator

Based on Figure 2, the highest N-gain value between pretest and posttest results for student learning outcomes is found in the fourth indicator, C4 (analyzing), with an average N-gain value of 0.4, falling into the moderate category. This suggests that performance assessment was particularly effective in developing students' analytical skills, which aligns with its focus on practical application and problem-solving. Conversely, the lowest N-gain is in the sixth indicator, C6 (creating), with an average N-gain value of 0.05, placing it in the very low category. This indicates that while students showed improvement in lower-order thinking skills, their ability to create new solutions or products in the context of environmental pollution still requires significant development (Suriansyah & Agusta, 2021). This finding highlights a potential area for further instructional design improvements, perhaps by integrating more open-ended project-based learning tasks that specifically target creative problem-solving.

The analysis of the influence of performance assessment on student learning outcomes began with normality and homogeneity tests of pretest and posttest values to determine the appropriate statistical test (parametric or non-parametric). The hypotheses for these preliminary tests were: H0 : the data is normally distributed, and H1 : the data is not normally distributed. If the significance value (p-value) is less than the alpha level (α), then H0 is rejected. The results of the normality and homogeneity tests are presented in Table 7.

Table 7. Recapitulation of Normality and Homogeneity Tests

Statistics	Probability Value	Hypothesis
Pretest normality test	P-value = 0.100 > 0.05	H ₀ is accepted
Posttest normality test	P-value = 0.179 > 0.05	H ₀ is accepted
Homogeneity test	P-value = 0.656 > 0.05	H ₀ is accepted

Based on the table, it can be seen that the analysis of the influence of performance assessment on student learning outcomes is normally distributed and homogeneous, then continued with the parametric z test. The following are the criteria for hypothesis testing:

H₀ = no significant effect performance assessment of student learning outcomes

H_a = there is a significant influence of performance assessment on student learning outcomes

The decision rule was: If the probability value (Sig. 2-tailed) > 0.05, then H₀ is accepted; if the probability value < 0.05, then H₀ is rejected. The results of the performance assessment influence test are shown in Table 8.

Table 8. Test of the Influence of Performance Assessment on Student Learning Outcomes

One Sample Test						
Test Value = 0						
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
pretest	42.097	36	.000	60.946	58.01	63.88
posttest	40.681	36	.000	75.811	72.03	79.59

From these data, specifically the Sig. (2-tailed) value of 0.000 for both pretest and posttest, which is considerably less than 0.05, it can be concluded that the null hypothesis (H₀) is rejected and the alternative hypothesis (H_a) is accepted. This indicates a significant influence of performance assessment on student learning outcomes. The p-value of 0.000 signifies that the observed difference in learning outcomes is statistically significant and highly unlikely to have occurred by chance. This result strongly supports the effectiveness of performance assessment in improving student learning outcomes.

The implementation of performance assessment unfolds across several indicators, beginning with "willingness to respond," where students are expected to demonstrate a desire for real action. This progresses to "satisfaction in response," where students are able to take action and feel content afterward. The third stage is "acceptance of a value," signifying students' interest in learning about environmental pollution and preservation. Following this is the "tendency towards value" (preference for a value), where students develop specific preferences related to environmental issues, such as planning solutions for pollution problems. The fifth stage is "commitment," where students show determination and dedication. The final stage is "conceptualization of value," where students internalize a value that benefits the environment.

Conclusions

This study evaluated the usability of the web-based learning resource center, Kumatalibi.com, using the System Usability Scale (SUS) method. Involving 101 preservice biology teacher students, the assessment yielded an average SUS score of 73, categorizing the website as "Good" in terms of usability and placing it in the 70th percentile. However, the platform received a grade of C with a "Marginal" acceptability rating and a "Passive" Net Promoter Score (NPS). This indicates that while Kumatalibi.com is generally usable, there's a clear need for improvements to enhance user satisfaction and engagement.

These findings underscore the importance of continuous enhancement for web-based educational platforms. By addressing identified usability issues, such as potential navigation complexity and responsiveness across devices, Kumatalibi.com can significantly improve the learning experience for preservice biology teachers. Furthermore, a more user-friendly interface coupled with personalized features could lead to greater user satisfaction and, consequently, improved learning outcomes. Future studies should focus on conducting detailed qualitative user feedback sessions and further usability testing to pinpoint specific areas for improvement, ensuring the platform effectively meets the diverse needs of its users.

While the general trend suggests good usability in educational technology platforms, it's crucial to recognize that usability is not the sole determinant of user satisfaction and preference. Other factors, including functionality, seamless integration with existing systems, and specific user needs, also play significant roles. Additionally, while personality traits and educational stages can influence perceived usability, these factors may be less modifiable than demographic characteristics, suggesting a need for personalized approaches in educational technology design and implementation to maximize their effectiveness.

Acknowledgment

Based on this research, we conclude that performance assessment improves student learning outcomes on the concept of environmental pollution, evidenced by an N-gain value of 0.4, placing it in the moderate category. Performance assessment is highly recommended for evaluating student activities during learning. While it can effectively serve as a formative assessment tool, its successful implementation requires habituation, continuity, and patience. Consistent use of performance assessment during learning is crucial due to its numerous benefits, including fostering self-regulation, providing feedback for progress, facilitating goal planning, enhancing learning outcomes, promoting creative thinking, and increasing students' environmental awareness. Given its moderate contribution to student learning outcomes, we suggest socialization, training, and ongoing habituation of performance assessment. Additionally, controlling external variables and carefully considering the timing of assessments are necessary to maximize its impact.

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