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44 Application of performance assessment in STEM-based biological learning to improve student's science process skills

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Abstract. The purpose of this study first of which examine the differences in activity students who applied performance assessment in STEM-based biology learning to sensory system material, secondly reviewing the differences in the improvement of the results of science process skills students who applied performance assessment in STEM-based biology learning to sensory system material, and third reviewing student responses to performance assessment in STEM-based biology learning in sensory system material. The research approach that has been used is a quantitative approach. The sampling technique that has been used is the type of random sampling. The samples that have been are two classes for the experimental class and the control class. Data collection techniques used were written tests, observation sheets, questionnaires, and projects. The results of this study indicate that among other things there are differences in student learning activities between the experimental class and the control class secondly there are differences in the improvement of students' significant science process skills after the implementation of performance assessment in STEM-based biology learning with the experimental class N-Gain is 0.90 and the control class is 0.45 and the third was a strong positive response result of 74%.

1. Introduction

Nations invest in innovation to promote sustainable economic growth. While many countries are suffering from the effects of global economic difficulties, such as rising unemployment and soaring public debt, the role of labor input is decreasing in the 21st century economy. Only innovation-driven growth has the potential to create value-added jobs and industries. Because innovation is largely derived from advances in the science, technology, engineering, and mathematics (STEM) disciplines [1]. The use of performance assessment can't be separated from the learning process. One suitable learning approach using performance assessment is the study of STEM (Science Technology Engineering Mathematics) with the performance assessment in STEM education, we can assess every phase in STEM approach [2], and STEM activities in the classroom endeavor to improve the quality of the learning process as well as learning outcomes [3], and the assessment not only assess aspect of knowledge, but also aspect of the psychomotor and attitude, as well as a through assessment during the learning process.

All skills have to be used in some context and scientific process skills are only scientific if they are applied in the context of science. Otherwise they are general descriptions of logical and rational thinking

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which are used in many areas of human endeavor [4]. This study determined Jamaican high school students' level of performance on five integrated science process skills and if there were statistically significant differences in their performance linked to their gender, grade level, school location, school type, student type and socio-economic background (SEB) [5]. Research findings showed that the percentage of students' scientific concept mastery is moderate in general. Their creativity in making a cell model design varied in category (expressing, emergent, excellent, not yet evident). Student's collaboration varied from excellent, fair, good, less once, to less category in designing cell model. It was found that STEM based learning can facilitate students conceptual change, creativity and collaboration [6].

In this study, the assessment of performance is implemented in the practicum learning based on STEM inquiry. There is a problem or issue that can be made from this material to be solved through STEM based instruction, such as the how does the eye work for seeing, the ear for hearing, the skin for feeling, the living for smell, and the tongue for taste. The study was conducted in a senior high school which enable implementing STEM based instruction. This is because to produce learners who are experts in their chosen fields to compete professionally, both in terms of knowledge and technology.

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2. Methods

The research was conducted in one of the Islamic High School in Cirebon. This research inved 33 students at grade XI as an experimental group and 31 students in the same grade as a control group. The design of this research uses the pre-test post-test non-equivalent control group design. Quantitative research methods. The research technique uses four instruments, including observation sheets, tests, polls, and projects. Observation is a systematic, logical, objective, and rational observation and recording process of various phenomena both in the actual situation and in artificial situations to achieve certain objectives [7]. Tests as data collection instruments are a series of questions or exercises that are used to measure the skills of knowledge, intelligence, abilities, or talents owned by individuals or groups [8]. The implementation of the test method aims to determine learning outcomes by using performance assessments in STEM-based biological learning on the sensory system material. Analysis of the data on this study uses statistical methods, since the type of research used is quantitative research. The phases of the analysis and the formula used are as follows: 1) instrument analysis, namely the validity test of the test problem, test reusability test, the difficulty index, and differentiation power is carried out using the software Anates description. 2) N-Gain test. 3) Statistical test.

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3. Result and Discussion

Student learning activities applied Performance Assessment in STEM-based biological learning and unapplied performance Assessment in STEM-based biological learning in the Sub-concept of the sensory system. Assessment of student learning activities is conducted by four people's observers and is observed during the two learning process meetings. The results of the observation that has been done in the biological learning process by applying performance assessment in STEM-based biological learning are obtained from the variable data of student learning activities. Students' learning activities in the experimental and control classes can generally be seen in the 1 figure below.

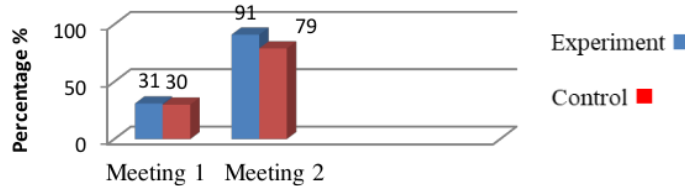


Figure 1. Diagram of the average percentage of student activity observations generally in the experimental class and in the control class [9].

Figure 1 shows the average value of students' activity at experimental and control classes. The increasing average learning activity of the experimental class students included sufficient criteria of 61, while the control class showed a difference of 6.5 which was included in the criteria enough. The experimental class shows the highest value at the second meeting of 91 and the value of the low student activity on the experiment class is shown at the first meeting with a value of 31. Science process skills are techniques that children use in getting the first experience of information from activity or student learning activities. One form of learning that can provide learning experience is practice activities [10]. One biological material whose learning process is oriented to practicum is on the material of the senses system by using uniqueness guided. The results of the research Mayangsari [11] show the results of students' activity that the average percentage of student activity in cycle I with active category, while in cycle II with the very active category. Learning activities can be increased due to experimentation, giving students the opportunity to build their own knowledge through observations from the experiments it performs. Regarding the connections between cognition and interpretation, the approach to simulation-based PA described here suggests new possibilities for making sense of student performance on assessment tasks aligned to force and motion learning progressions [12].

Student process skills (SPS) improvement difference between experimental and control class. Increased SPS of students between experimental classes and control classes obtained through the results of the posttest pretests in the form of problems that have been developed with the Science Process skills Indicator (SPS) according to Depdiknas [13]. The following is described in more detail on improving science process skills (SPS) of students on experimental classes and classes of control and analysis of improved science process skills (SPS) students of experimental and control classes. Activities conducted to measure science process skills (SPS), among them 1) observe; 2) measure; 3) classify/categorize; 4) Ask questions; 5) Drafting hypotheses; 6) Planning experiments; 7) Identifying variables; 8) determine the working step; 9) Conducting experiments; 10) interpreting information; 11) Apply the concept; 12) conclude, and 13) communicating. The average value of the pretest-posttest between the experiment class, and the control class can be seen in the figure below.

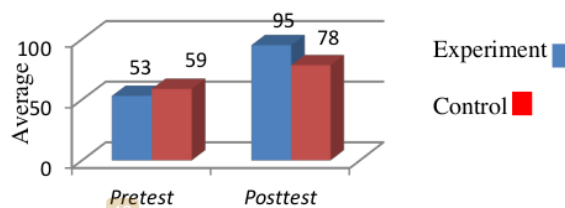


Figure 2. Diagram of the pre-tests value and post-test of science process skills (SPS) between experimental classes and control classes [9].

Figure 2 shows that the difference between the pre-tests and post-test values between the control class and the experimental class. The average control class pre-test value is 59 while the value of the experimental class pre-tests is 53. Based on the results of the data interpretation in Figure 2 indicates

the difference between the control class pre-test value and the experimental class. This shows control-class skills higher than the experimental class. The average difference between a controller class and an experimental class is 4. The average experiment class post-test value is higher than the control class. The difference in post-test value between the experimental class and the controller class is 17. The difference in the value of N-Gain Science process Skills (SPS) students between the controller class and the experimental class. The N-Gain value of the experimental class is worth 0.90 with the highest criteria, while the N-Gain value of the controller class is worth 0.45 with the criteria being medium. The value of N-Gain science process skills in the experimental class is higher than the control class where the difference between the two is 0.45 with a ratio of two to average N-Gain the experiment class while the one for the average N-Gain control class.

Table 1. Results Test N-Gain prerequisites in general

Data	Class	Normality Test		Homogeneity Test	
		Sig.	Description	Sig.	Description
Gain	Eksp	0.000	-	0.009	-
	Control	0.200	Normal		

Table 1 showed that the test results of normality and test homogeneity based on the results of N-Gain data. Based on the test results of N-Gain data normality in the experimental class showed that the data was not as a normal distribution because the value of the rate of 0.000 is smaller than 0.05, while the test of data normality N-Gain control class generates a value of sig. 0.200 greater than 0.05 so that the N-Gain data of the control class is normal distribution. The test result of N-Gain data homogeneity indicates that the data is not homogeneous due to the value of sig. $0.009 < 0.05$.

Table 2. Result N-Gain difference in general

Data	Different Test	Sig.	Description
N-Gain	Mann-Whitney	0.000	Significantly Different

Table 2 shows that the different test results from N-Gain data in general. The significance value of N-Gain is based on the Mann-Whitney Test, a test of 0.000 which means that H_0 is rejected and H_a is accepted. Based on the data it can be concluded that there is a significant increase in student science process skills between experimental classes and control classes. Student response to the implementation of performance Assessment in STEM-based biological learning. Student's responses to the implementation of the performance assessment in STEM-based biological learning of the sensory system material can generally be seen in the figure 3. That figure supposedly because during the learning process there is feedback from teacher to students, as stated by Earl [14]. This is that assessment for learning can help students understand the subject. Besides the learning experience directly in accordance with the nature of science that not only trains students in knowledge but also skills and attitudes [15], as well as another study showed that vocational school students' scientific process skills in STEM-based learning assessed with performance assessment were in good category [16]. Performance assessment might provide the students with opportunities to demonstrate their implementation of skills and meaningful knowledge [6].

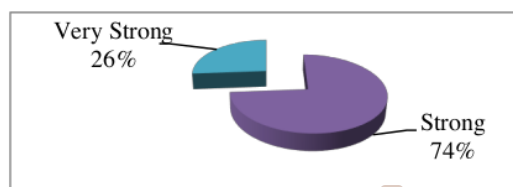


Figure 3. Student Response percentage diagram on performance assessment implementation in STEM-based biological learning [9]

Figure 3 shows that the students' response percentage diagram results on performance assessment, implementation in STEM-based biological learning. The results interpreted that no student response showed very weak, and adequate criteria for the outcome of the performance assessment in STEM-based biological learning. Students who respond very strongly are 26% indicating that students respond well to the implementation of performance assessment in STEM-based biological learning and students who respond strong to the implementation of the performance assessment in STEM (Science, Technology, Engineering, and Mathematics) -based biological learning of 74% indicating that students respond very well to the implementation of the performance assessment in STEM (Science Technology, Engineering, and Mathematics) based on biological learning.

4. Conclusion

Based on the results of research and discussion, it can be concluded that there is a difference in student learning activities and the improvement of significant science process skills between classes that applied performance assessment in STEM-based biological learning (experimental classes) with classes that have not applied performance assessment in STEM-based biological learning (control class), there is a significant increase in the students' science process skills after a performance assessment in STEM-based biological learning by looking at the results of the average N-Gain value. The experimental class is 0,90 while the controller class is 0,45 as well as the students' response from the experimental class students that students respond positively to the performance assessment study in STEM-based biological learning.

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