The Development of Biological learning Tool

by I G M Sanjaya

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The Development of Biological Learning Tool Based on Scientific Approach to Improve Students' Learning Outcome

Mohammad Sukri[1], Rudiana Agustin[2], I Gusti Made Sanjaya[3]

[1)] *Postgraduate Study of Science Education, postgraduate, Surabaya State University*
[1)] ukrimakara@gmail.com, [2)] rudianaagustini@yahoo.com,
[3)] igmasanjaya@unesa.ac.id

Abstract. This research aims to produce a biological learning tool based on the scientific approach to improve the learning outcome of vocational high school students. This development uses a 4D model, and a trial on this tool has been conducted in the classroom by using one group pretest-posttest design. Results of the research indicate that the validity of the lesson plan, teaching material, worksheet, and assessment sheet can be categorized as feasible with a good category in terms of instrument reliability. The implementation of the lesson plan is very good, with a good category on average in terms of instrument reliability. The prominent activity of the students is making observations. The response of the students to this tool and the learning is good and even positive. The improvement of students' learning outcomes in the knowledge learning outcome (conceptual comprehension) has a score of 0.77 (high gain) on average. Based on data analysis, it can be concluded that this scientific approach based on biological learning tools can improve the learning outcome of students on the ecosystem material.

Introduction

Regulation of the minister of education and culture number 65 year 2013 about standard process states that each educator in the educational unit is obliged to develop a learning plan in a complete and systematic form. This measure is taken so that learning takes place interactively, interactively, inspiring, fun, challenge, motivate learners to participate actively and also provide enough space for the initiative, creativity, and independence according to talent, interest, and physical and psychological development of students. The educational units really need a learning plan and correct strategies to improve efficiency and effectiveness of graduate competence achievement[1].

Efforts to develop academic, personal and social potentials of students to better results need a good learning tool. A good learning tool needs conformity with the spirit, philosophy, and guidance of the applicable curriculum. Learning tool consists of a syllable, learning plan, teaching materials, source, and media of learning and assessment instruments. Each teacher, prospective teacher, and educational researcher should be able to develop a learning tool [2].

Interview with the teachers of the vocational high school of "Wahid Hasyim" Lamongan result in: (1) from the result of the daily test of biology, there are many who have not achieved minimal completeness criteria (MCC) that school has determined. The data was obtained from daily test 1 and daily test 2. From daily test 1, only 20 of 45 students who have been completed with MCC score of 70 while from daily test 2, only 22 from 44 students who have been completed with the same MCC score (source: LHBS score of grade X, vocational high school of "Wahid Hasyim, year 2018/2019); (2) limitations that teachers have in developing an ideal biological learning tool which is appropriate

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with characteristics of the students in the vocational high school of “Wahid Hasyim”; (3) Students are less motivated in biological learning which is only teacher-centered.

Based on the above problems, efforts are needed to improve student learning outcomes, especially at the level of Vocational High School. Improving learning outcomes can be done through the learning activity process in schools, especially in biological learning in Vocational Schools in accordance with the researcher’s materials. The main problem of the results of the study originated from learning in school in which the learning outcome of students on the biological subject is not in line with expectations due to the absence of an ideal biological learning tool, which is appropriate with characteristics of the students. Based on the result of the study [3], they found that biological learning is not enforced or taught following the nature of being possessed, but to transfer knowledge instead. This result shows the gap in learning, so the desired results are not in line with expectations.The obtained learning outcomes are less satisfactory and even have a tendency to decrease and cause human resources to decline.

The solution to improve the learning outcome of vocational high school students in biological subject needs approaches, which is appropriate with the nature of science. The approaches that can improve learning outcome and process skill, which is appropriate with the nature of science is scientific learning approaches. In line with the development of curriculum 2013, which uses scientific approaches through stages of observation, interview, trial, reasoning, forming a network, processing, providing, drawing the conclusion, and creating for all subjects [4]. The referred scientific approach is to provide comprehension to learners in recognizing and understanding various materials by means of scientific approaches where information can come from wherever and whenever learners do not depend only on the teacher to obtain information.

The development of this scientific approach based biological learning tool refers to the development model of Thiagrajan [5], which is the 4D system approach model. This model consists of define, design, develop, and disseminate. The reason why the researcher uses this model is (1) every stage is clear, so it can be followed; (2) Regular, effective and efficient in implementation; (3) on stage 3, that is developed, the result can be implemented or used because it has been validated, revised, and tested; (4) more flexible because each stage has wider scope of provisions.

2. Method of Research

This research is developmental research that is to develop a biological learning tool based on a scientific approach to improve the learning outcome of students. This research implements the experimental design by "the one-group pretest-posttest design" model. This design constitutes the one that only gives treatment on one group only without any comparing group (control class). The development of tools consists of the development of syllable, lesson plan, teaching materials, worksheet, and assessment instrument. The learning tool implemented in this research has passed the validity test stage with a valid statement about the result.

The object of this research is the learning tool of vocational high school by using the scientific approach on the subject of the ecosystem which is implemented on students of grade X of the vocational high school of "Wahid Hasyim" Lamongan, second semester, teaching year 2018/2019 as much as 30 students.

The instrument of research used in this research is to measure the improvement of the learning outcome of students who are using the test instrument of the multiple-choice test consisting of 10 items. This test was delivered in two stages that are pretest and posttest, to know the improvement of the learning outcome of students before and after the learning process takes place. The score of the test of the students then was analyzed descriptively and qualitatively. The learning outcomes of students consist of:

Completeness of learning outcome of students

Based on the regulation of ministry of education and culture of Republic of Indonesia number 104 year 2014 about the assessment of learning the outcome of students by an educator in basic and intermediate

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education, explains that the completeness of learning outcome consists of the completeness of substantial mastery and the completeness of learning in context of certain period. Analysis of completeness of learning the outcome of students is by using criteria reference assessment (CRA). CRA is assessment of competence achievement based on the determined completeness criteria. Criteria reference assessment of learning outcome of students can be reviewed in the following table:

Table of score conversion and competence predicate

Attitude		Knowledge		Skill	
Modus	Predicate	Average score	Letter	Optimal achievement	Letter
4,00	VG (Very Good)	3,85 – 4,00	A	3,85 – 4,00	A
		3,51 – 3,84	A-	3,51 – 3,84	A-
3,00	G (Good)	3,18 – 3,50	B+	3,18 – 3,50	B+
		2,85 – 3,17	B	2,85 – 3,17	B
		2,51 – 2,84	B-	2,51 – 2,84	B-
2,00	A (Adequate)	2,18 – 2,50	C+	2,18 – 2,50	C+
		1,85 – 2,17	C	1,85 – 2,17	C
		1,51 – 1,84	C-	1,51 – 1,84	C-
1,00	D (Deficient)	1,18 – 1,50	D+	1,18 – 1,50	D+
		1,00 – 1,17	D	1,00 – 1,17	D

2.1.1 Individual Completeness

Percentage of completeness of learning outcome of the individual student is calculated using individual completeness formula as follows:

$$\%\ \text{individual completeness} = \frac{amount\ of\ items\ with\ correct\ answer}{Total\ item}\ \text{X}\ 100\%$$

a student is found complete if he/she has mastered basic competency in core competence three and core competence four he/she learned if ≥ 75% of learning indicator has been mastered by students or they obtain score ≥ 2.67 with predicate B -.

2.1.2 Classical completeness

Percentage of completeness of classical learning outcome is calculated using classical completeness formula as follows:

$$\%\ \text{classical completeness} = \frac{amount\ of\ students\ who\ are\ found\ complete}{total\ students}\ \text{X}\ 100\%$$

The completeness indicator for KD-3 and KD-4 classically is found achieved if ≥ 75% of students have achieved the completeness indicator.

2.2 The improvement of the learning outcome of students

Data from the result of pretest and posttest of biological learning of students is analyzed using n-gain formula. n-gain indicates the improvement of the learning outcome of students before and after treatment. The formula is :

$$(g) = \frac{Spost - Spre}{Smax - Spre}$$

Annotation :

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g: score of gain
Spost : score of posttest
Spre : score of pretest
Smax : maximal score

Result of n-gain calculation can be converted into criteria below:

Table of normalized gain criteria

N-Gain Score	Normalized gain criteria
0.70 < N-Gain	High
0.30 ≤ N-Gain ≤ 0.70	Middle
N-Gain< 0.30	Low

[6]

3. Result and Discussion

The improvement of the learning outcome of students by using the test instrument of multiple choice consisting of 10 items. The score of learning outcome of students and improvement of an n-gain score of students is presented in the table below.

Table of n-gain analysis of learning outcome of students of grade X of The vocational high school of "Wahid Hasyim"

No	Student's Initial	Scores			N-Gain	Term
		Pretest	Posttest	Term		
1	MS1	60	100	T	1,00	High
2	MS2	50	90	T	0,80	High
3	MS3	30	90	T	0,86	High
4	MS4	60	90	T	0,75	High
5	MS5	40	90	T	0,83	High
6	MS6	60	100	T	1,00	High
7	MS7	60	80	T	0,50	Middle
8	MS8	50	90	T	0,80	High
9	MS9	60	90	T	0,75	High
10	MS10	40	80	T	0,67	Middle
11	MS11	50	80	T	0,60	Middle
12	MS12	60	100	T	1,00	High
13	MS13	70	80	T	0,33	Middle
14	MS14	70	100	T	1,00	High
15	MS15	50	90	T	0,80	High
16	MS16	60	90	T	0,75	High
17	MS17	60	80	T	0,50	Middle
18	MS18	50	90	T	0,80	High
19	MS19	40	90	T	0,83	High
20	MS20	60	90	T	0,75	High
21	MS21	60	90	T	0,75	High
22	MS22	40	100	T	1,00	High
23	MS23	50	80	T	0,60	Middle

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No	Student's Initial	Scores			N-Gain	Term
		Pretest	Posttest	Term		
24	MS24	40	80	T	0,67	Middle
25	MS25	50	90	T	0,80	High
26	MS26	60	80	T	0,50	Middle
27	MS27	60	100	T	1,00	High
28	MS28	50	80	T	0,60	Middle
29	MS29	60	90	T	0,75	High
30	MS30	50	90	T	0,80	High
31	MS31	50	90	T	0,80	High
32	MS32	30	80	T	0,71	High
33	MS33	60	90	T	0,75	High
34	MS34	60	90	T	0,75	High
35	MS35	50	90	T	0,80	High
36	MS36	40	90	T	0,83	High
37	MS37	60	100	T	1,00	High
38	MS38	30	80	T	0,71	High
39	MS39	30	80	T	0,71	High
40	MS40	50	90	T	0,80	High
41	MS41	40	80	T	0,67	Middle
42	MS42	70	100	T	1,00	High
43	MS43	40	80	T	0,67	Middle
44	MS44	60	90	T	0,75	High
45	MS45	60	90	T	0,75	High
	Average	51,78	88,67	T	0,77	High

Based on data of learning outcome on the table above indicates that the result of the knowledgeability test at the beginning or before learning activity (pretest) is obtained that result of the level of achievement of individual and classical completeness is 0%. It means that all students have not been able to achieve minimal completeness criteria that have been determined according to the applicable curriculum that is 2.67 with predicate B -. Individual and classical completeness is found achieved if ≥ 75% of the developed indicators have been mastered by students, and ≥ 75% of students achieve the indicators. But after learning activity (posttest), it is obtained that the result of the level of achievement of individual and classical completeness is 100%.

Calculation by using the n-gain formula to know the improvement of the learning outcome of students of grade X can be reviewed in the table above. The mean score of obtained n gain is 0.77, with the category of g-high. This indicates that a significant improvement of learning outcomes on students of grade X with high category exists.

4. Conclusion

Based on the result of the research, it can be concluded that the development of biological learning tool based on the scientific approach can be used to improve the learning outcome of students on ecosystem material. This can be proven with individual and classical completeness and improvement of the n-gain score in this research.

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