**THE DEVELOPMENT OF BIOLOGICAL LEARNING TOOL BASED ON SCIENTIFIC APPROACH TO IMPROVE STUDENTS’ LEARNING OUTCOME**

 **Abstract.**This research aims to produce a biological learning tool based on scientific approach to improve the learning outcome of vocational high school students. This tool is developed by using 4D model and trial on this tool has been conducted in the classroom by using one grup pretest-posttest design. Results of the research indicate that validity of lesson plan, teaching material, worksheet, and assessment sheet can be categorized as feasible with good category in term of instrument reliability. The implementation of lesson plan is very good with good category on average in term of instrumen reliability. The prominent activity of the students is making observations. Response of the students to this tool and the learning are good and even positive. The improvement of students’ learning outcome 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 biological learning tool can improve the learning outcome of students on the ecosystem material.

**Keywords:** biological learning tool, scientific approach, learning outcome

**1. 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 manner so that learning takes place interactively, interactively, inspiring, fun, challenge, motivate learners to participate actively and also provide an enough space for initiative, creativity, and independence according to talent, interest, and physical and psychological development of students. The educational units really need 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 spirit, philosophy, and guidance of the applicable curriculum. Learning tool consists of 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 learning tool [2].

Interview with the teachers of the vocational high school of “Wahid Hasyim” Lamongan, result in: (1) from result of daily test of biology, there are many who haven’t 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 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 outcome, especially at the level of Vocational High School.Improving learning outcome can be done through learning activity process in schools, especially in biological learning in Vocational Schools in accordance with researcher’s materials. The main problem of results of the study originated from learning in school in which learning outcome of students on biological subject is not in line with expectation due to the absence of an ideal biological learning tool which is appropriate with characteristics of the students. Based on result of the study [3], they found that biological learning is not enforced or taught in accordance with the nature of being possessed, but to transfer knowledge instead. This results in 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.

Solution to improve 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 network, processing, providing, drawing 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 teacher to obtain information.

The development of this scientific approach based biological learning tool refer to the development model of Thiagrajan [5] which is 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 develop, 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 a developmental research that is to develop a biological learning tool based on scientific approach to improve learning outcome of students. This research implements experimental design by “the one group pretest posttest design” model. This design constitutes the one that only give treatment on one group only without any comparing group (control class). The development of tool consists of development of syllable, lesson plan, teaching materials, work sheet and assessment instrument. The learning tool implemented in this research has passed validity test stage with valid statement about the result.

Object of this research is the learning tool of vocational high school by using scientific approach on subject of 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 learning outcome of students who using the test instrumen of multiple choice test consisting of 10 items. This test was delivered in two stages that is pretest and posttest to know the improvement of learning outcome of students before and after learning process take place. Score of test of the students then was analyzed descriptively and qualitatively. The learning outcomes of students consist of:

**2.1 Completeness of learning outcome of students**

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

* + 1. Individual Completeness

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

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

a student is found complete if he/she has mastered basic competence in core competence 3 and core competence 4 he/she learned, if ≥ 75% of learning indicator has been mastered by students or they obtain score ≥ 2.67 with predicate B - .

* + 1. Classical completeness

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

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

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 learning outcome of students**

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

 (g) = Spost – Spre

 Smax – Spre

Annotation :

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 learning outcome of students by using test instrument of multiple choice consisting of 10 items. Score of learning outcome of students and improvement of n-gain score of students is presented on 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 |
| 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 table above indicates that result of knowledge ability test at the beginning or before learning activity (pretest) is obtained that result of level of achievement of individual and classical completeness is 0%. It means that all students haven’t been able to achieve minimal completeness criteria that has 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 has been mastered by students and ≥ 75% of students achieve the indicators. But after learning activity (posttest), it is obtained that result of level of achievement of individual and classical completeness is 100%.

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

**4. Conclusion**

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

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