

Original Research Article

Development of Biology Modules with Think Pair Share Strategy as an Effort to Improve Cognitive Learning Outcomes of Vocational Students

Husnul Chotimah¹, Herawati Susilo², Mimien Henie Irawati Al Muhdhar², Ibrohim²

¹Teacher of SMKN 13 Malang, Doctoral Program Student of State University of Malang,

²State University of Malang

Corresponding Author: Husnul Chotimah

ABSTRACT

This research and development aims to produce a product in the form of biology learning modules with think pair share strategy as an effort to improve cognitive learning outcomes of vocational students. Research and development method used in this study is Borg & Gall development model. Data collection of cognitive learning outcomes was conducted using cognitive learning test that has met the validity and reliability as an instrument. The results showed that biology modules with think pair share strategy could improve cognitive learning outcomes of vocational students with average gain score in preliminary field testing of 0.77 (high category), main field testing of 0.82 (high category) and operational field testing of 0.83 (high category) so it is recommended to use this module to improve cognitive learning outcomes of vocational students.

Keyword: module, think pair share, cognitive learning outcomes

I. INTRODUCTION

Vocational High School (SMK) Students are the next generation of the nation that needs attention due to the many competencies that must be owned. One component that becomes the aspect of competence is knowledge which is the cognitive learning outcomes. Learning outcome is one measure of the students' success in developing their competence after undergoing the learning process.

The term 'learning outcomes' is composed of two words, namely the word 'outcomes' and 'learning'. According to The Great Dictionary of the Indonesian Language (KBBI), outcomes are defined as something that has been accomplished from what has been done or what has been done previously. Learning is an interaction process and not just an absorption process that takes place without the active effort of the learning individual (Santoso, 2000:39).

Meanwhile Shaleh (2009:207) states that learning is a form of growth or change in a person expressed in new ways of behaving due to experience and practice.

Student cognitive learning outcomes are one of the students' skills that need to be sharpened continuously. Sudjana (2006) suggests that learning outcomes are the abilities that students have after receiving the learning experiences. In line with what is disclosed by Sopah (2000), the learning outcomes are the abilities possessed by students as a result of the learning activities. Meanwhile MoEC (2014) states the learning outcomes are the learners' achievement in the competence of spiritual attitudes and social attitudes, knowledge competencies, and skill competencies conducted in a planned and systematic manner, during and after the learning process. Based on the description of the definition from some experts, it can be said that the learning

outcomes are characterized by a change in behavior that occurs in someone who did it.

There are several abilities related to learning outcomes. Hasibuan (2006) suggests that there are five kinds of ability related to learning outcomes, namely (1) intellectual ability, (2) cognitive strategies, (3) verbal information, (4) motor skills, (5) attitudes and scores, which relate to the emotional direction and intensity that a person possesses known from the tendency to behave towards the person, goods, or outcomes of the event. Sardiman (2007) suggests that the learning outcomes include (1) science and knowledge, in the form of (cognitive) concepts or facts and (2) personal, in the form of (affective) personality or attitude and (3) behavior, in the form of (psychomotor) skills. Cognitive learning outcomes, according to Bloom's Taxonomy (1981) which has been revised by Anderson dan Krathwohl (2001), are divided into six levels: remember, understand, apply, analyze, evaluate, and create.

Biology is a part of science that has two fundamental dimensions, namely the dimensions of processes and products. Biology as a process dimension contains the skills, scores, and attitudes that a person or student must possess to acquire and develop biological knowledge (Efendi, 2013). Biological learning outcomes are a culmination of the learning process, the learning outcomes can occur due to an evaluation conducted by the teacher.

Biology is not a subject that must be studied by all students at the level of Vocational High School (SMK). The subject is only required to be studied by students who choose agribusiness and agrotechnology, fishery and marine, as well as health expertise packages. In each expertise package, the basic competencies studied are also different. The difference leads to biology teachers teaching at the vocational high school level feel more "tired" than teaching at senior high school level. The results of the survey through tests conducted by researchers obtain data on the

average score of cognitive learning outcomes that include the six levels with a score of 56.2 with "low category" so that needs to be improved.

The learning process in Malang Vocational High School so far has not empowered the potential of students as mandated in national education objectives. The applied learning model has not accommodated all the characters of students' academic ability, so that the students' learning outcomes are low. Teachers rarely reflect and evaluate themselves for their ability as learning motivators and facilitators.

One cooperative learning strategy that can create an atmosphere of togetherness in learning biology is think pair share strategy. Learning with think pair share (TPS) cooperative learning strategy is expected to be an alternative in overcoming the problems of learning biology. The statement is in accordance with the opinion of Siksen (2013), that think pair share cooperative learning model is a simple type with many advantages because it can increase student participation and knowledge formation by students. This is in line with the opinion of Phillip J. Kellmandan Christine M. Massey (2013) which states that perceptual learning that emphasizes student involvement has a major role in complex cognitive tasks. Recent opinions on the subject provide clarity on the basics for beginning to understand and explore the role of learners in upper level cognitive tasks.

Biology teaching materials developed in this study are modules. Module is chosen by considering that with the modules, students can learn by themselves about biological materials which will be applied in the world of work, and still can learn biology when doing industrial work practice (prakerin). Modules can assist teachers in realizing qualified learning, because the modules can condition well-planned, independent, and complete learning activities with evident outcomes (MoNE, 2008).

Teachers need to know the learning outcomes that students achieve through assessment. Assessment can be obtained at any time during the activity and may also be held after the students complete a learning program within a certain time. Learning outcomes are assessed by teacher measures, school level and national level. A student may be classified as passing or not passing based on the measures. If the student is classified as passing, it can be said that the student's learning process and the teacher's teaching action "stop" temporarily. If it is not passed, there will be a re-learning process for the student and re-teaching for the teacher (Haling, 2006).

Based on the background above, it can be known the essence of the problem for this study. First, cognitive learning outcome is one of the skills that students need to master. Second, the results of the survey reveal that the cognitive learning outcomes of vocational students have not been optimal for the learning strategies and teaching materials used do not reflect the development of students' cognitive learning outcomes. Research and development of biology modules with think pair share strategy to improve the cognitive learning outcomes of vocational students is therefore necessary. This study aims to produce a product in the form of biology modules with think pair share strategy to improve students' cognitive learning outcomes. In this study, data on the results of validity and reliability tests of instrument and the results of cognitive learning outcome instrument test at preliminary field testing, main field testing, and operational field testing will be presented.

II. METHOD

The research and development of modules used referred to the research and development design of the Borg & Gall development model (1985). The stages consisted of (1) research and information collection including literature review, classroom observation, and report preparation, (2) planning including

determining the skills, mentioning the objectives that determine the learning time, and small-scale feasibility testing, (3) developing the initial form of the product including preparation of teaching materials, manuals and assessment tools, (4) preliminary field testing, conducted on one to three schools using eight people. It is followed by data collection through interviews, observations, and questionnaires, then analyzed, (5) major product revision based on preliminary field testing results, (6) main field testing conducted on 59 people. Quantitative data on pre- and post-lessons are collected, (7) revision of operational procedures, conducted on the basis of primary field testing results, (8) operational field testing conducted on 142 people, (9) final product revision, based on operational field testing results, and (10) dissemination and implementation.

The test subjects were 8 students of SMKN 13 Kota Malang in the preliminary field testing, 59 students of SMKN 13 Kota Malang in the main field testing and 142 students of SMKN 2 and SMKN 11 Kota Malang in the operational field testing. The selection of Vocational High School for field testing was done by purposive sampling. Data retrieval started from July to December 2015.

The data collection instrument included the test of cognitive learning outcomes whose results were analyzed descriptively and quantitatively. The cognitive learning outcomes were measured using the rubric (Hart, 1994) on a scale of 0 – 4. The cognitive learning outcome scores were obtained from the conversion results of the cognitive learning outcome rubric scores. The formula of determining the score of cognitive learning outcomes is as follows.

$$\begin{aligned} \text{The value of cognitive learning outcome} \\ &= \frac{\text{Total scores obtained}}{\text{total scores of question items}} \times 100\% \end{aligned}$$

The increased cognitive learning outcomes in research and development were

integrated with test questions. The cognitive learning outcomes were assessed using the cognitive learning outcome rubric. The cognitive learning outcome rubric was developed with reference to Hart (1994) with a range of 0 – 4, while the cognitive learning achievement criteria referred to MoNE, 2014 as Table 1.

Table 1. Criteria for Cognitive Learning Outcome Assessment

Interval of Score	Criteria
91-100	Excellent
75-90	Good
65-74	Fair
54-64	Poor

(Source: MoEC, 2014)

The increased cognitive learning outcomes of students can also be seen in the normalized gain score. The normalized gain score is the ratio between the average gain obtained against the maximum average gain:

$$\langle g \rangle \equiv \% \langle G \rangle / \% \langle G \rangle_{\max} = (\% \langle S_f \rangle - \% \langle S_i \rangle) / (100 - \% \langle S_i \rangle)$$

, (Hake, 1998)

in which,

$\langle g \rangle$ = The average normalized gain score

$\langle S_i \rangle$ = The average pre-test score

$\langle S_f \rangle$ = The average post-test score

Criteria for gain score according to Hake (1998) can be seen in Table 2 as follow.

Table 2. Criteria for Gain Score

No	Score $\langle g \rangle$	Criteria
1	> 0.7	High
2	$0.7 \geq \langle g \rangle > 0.3$	Medium
3	< 0.3	Low

(Source: Hake, 1998)

III. RESULTS AND DISCUSSION

A. The Results of Needs Analysis

Data on the analysis of the needs of think pair share based biology learning materials are presented in Table 3.

Table 3. The Needs of Think Pair Share Based Biology Learning Materials

No	Components for The Needs of Think Pair Share Based Biology Learning Materials	Percentage
1	Students often find it difficult to find biology source books that fit into the 2013 curriculum	45.5
2	Students always find it difficult to find biology source books that fit into the 2013 curriculum	18.2
3	Students sometime find it difficult to find biology source books that fit into the 2013 curriculum	18.2
4	Students seldom find it difficult to find biology source books that fit into the 2013 curriculum	9.1
5	All teachers of state and private Vocational High School in Malang state that students need to learn independently	100

(Source: Chotimah, 2014)

Based on Table 3, it can be seen that 45.5% of vocational students often have difficulty in finding biology source books that fit the 2013 curriculum. Biology teachers of Vocational High School in Malang agreed that vocational students need to learn independently. It shows that the needs for biology teaching materials which can improve students' cognitive learning outcomes and can be used for self-study are very high. Thus the think pair share based Biology Module becomes the solution to solve the problem. TPS-based Biology Module is needed by vocational students in Malang. This is supported by the absence of learning textbooks for biology subjects at the level of Vocational High School and biology textbook in the form of modules is not yet available (Chotimah, 2014).

Biology module for 10th grade of Nursing with think pair share strategy consists of three parts, namely the initial part, the core part and the closing part which are interrelated and have a role that is able to improve the thinking skill of cognitive learning outcomes of 10th grade students of Nursing at SMK Kota Malang. This is in line with the expectations of the 2013 Curriculum as stipulated in the Minister of Education and Culture of the Republic of Indonesia Regulation No. 65 Year 2013 on Standards for Primary and Secondary Education Process, that the learning principles used must be able to improve hardskill and softskill and develop the competence of spiritual attitude, social attitude, and skills. The results of module assessment scores by Biology Education

experts and biology material experts can be seen in Table 4.

Table 4. The Results of Module Assessment Scores by Biology Education Experts and Biology Material Experts

No	Aspects of the Modules	Assessment Score (maximum of 4)
1	Material organization	3.63
2	Material depth and width	3.75
3	Material upgrades	4.00
4	Material contextuality	3.50
5	Virus	3.75
6	Archaeobacteria and Eubacteria	3.78
7	Fungi	3.71
8	Enzyme	3.86
	Average	3.77

Based on Table 4, it can be said that the overall average score of biology module based on the opinion of Biology Education experts and Biology Material experts is 3.77. It shows that the module is categorized as very appropriate, very clear, very interesting, very easy, and very precise.

The module resulted from this research and development based on Borg & Gall development model is in the form of biology modules for 10th grade of Nursing with think pair share strategy. Modules were generated through a long process involving the assessment of module expert team, biology education experts and biology material experts, field practitioners and student legibility tests in addition to input from the three promoters. Expert team assessment was further examined to the students through three tests. The test was through preliminary field testing to eight students at SMKN 13 Kota Malang, then revised. The revised modules were used in the main field testing to 59 students at SMKN 13 Kota Malang, then re-revised. The revised modules were used in operational field testing to 142 students at SMKN 2 and SMKN 11 Malang. After being revised into final product, the modules were then disseminated to all biology teachers in SMK Kota Malang.

B. The Test Results of Cognitive Learning Outcome Assessment Instrument

Testing the cognitive learning outcome assessment instrument was

conducted to measure the validity and reliability of the instrument. The validity test of the cognitive learning outcome instrument aimed to determine the conformity level of the question in order to measure what should be measured. Validity test concerning the construction validity, content validity, and criteria validity was conducted by experts (supervisor). Field testing which is the empirical validity was used the validity test of the items (Sugiyono, 2007).

Reliability shows the reliability level of something that can be trusted and reliable (Arikunto, 2006). To test the reliability of the instruments, this study used Alpha Cronbach formula (Sugiyono, 2007:184). The calculation was done using SPSS 16 for Windows program. The test results of the instrument which include the validity and reliability test of cognitive learning outcomes are presented in Table 5 below.

Based on Table, 5 it can be seen that the instruments used to measure cognitive learning outcomes are valid and reliable. The results of cognitive biology are the level of actual ability that can be measured in the form of mastery of knowledge, as a result of individual efforts to what is learned. Score is achieved by students after completing biology subject according to predetermined competency standard. In this study, the score was obtained through cognitive tests, consisting of C2 (understand), C3 (apply), C4 (analyze), C5 (evaluate), and C6 (create). Biology cognitive learning outcomes were measured using an integrated cognitive learning outcome rubric in essay test questions with biology materials. Cognitive learning outcome rubric had a range of 0 – 4.

According to Slameto (2003), learning outcomes are influenced by several factors, both internal and external factors. Internal factors are physical, psychological, and fatigue factors (e.g intelligence, attention, interest, talent, motivation, maturity, readiness), whereas external factors include family, school, and community factors (e.g teachers,

curriculum, and learning model). The researchers designed biology modules aiming at influencing students' cognitive

learning outcomes through the think pair share strategy and instruments.

Table 5. Data on the Results of Validity and Reliability Test of Cognitive Learning Outcome Assessment Instrument on Virus, Archaeobacteria and Eubacteria, Fungi, and Enzyme Materials

No	Module Materials	No of Items	Correlation coefficient	Results	Alpha-Cronbach coefficient
1	Virus	1a	0.560	Valid	0.625
		2a	0.691	Valid	
		3a	0.524	Valid	
		4a	0.560	Valid	
		5a	0.691	Valid	
		6a	0.524	Valid	
2	Archaeobacteria and Eubacteria	1a	0.740	Valid	0.854
		2a	0.381	Valid	
		3a	0.910	Valid	
		4a	0.888	Valid	
		5a	0.902	Valid	
		6a	0.749	Valid	
3	Fungi	1a	0.819	Valid	0.874
		2a	0.746	Valid	
		3a	0.709	Valid	
		4a	0.841	Valid	
		5a	0.761	Valid	
		6a	0.817	Valid	
4	Enzyme	1a	0.817	Valid	0.920
		2a	0.920	Valid	
		3a	0.758	Valid	
		4a	0.962	Valid	
		5a	0.708	Valid	
		6a	0.948	Valid	

B. The Results of Cognitive Learning Outcome

The results of cognitive learning outcomes include three stages of field testing, i.e the results of cognitive learning in preliminary field testing, main field testing, and operational field testing. The learning materials presented consist of Virus, Archaeobacteria and Eubacteria, Fungi, and Enzyme.

1. The Results of Cognitive Learning Outcome in Preliminary Field Testing

Data of students' cognitive learning achievement score in preliminary field testing KD 1 with Virus, KD 2 with Archaeobacteria and Eubacteria, KD 3 with Fungi, and KD 4 with Enzyme are presented as graph in Figure 1, while the normalized gain score is presented in Table 6.

Table 6. Gain Score of Each KD in Preliminary Field Testing

No	Name of Learning Materials	Gain Score	Category
1	KD 1 (Virus)	0.71	High
2	KD 2 (Archaeobacteria dan Eubacteria)	0.74	High
3	KD 3 (Fungi)	0.79	High
4	KD 4 (Enzyme)	0.83	High
Average		0.77	High

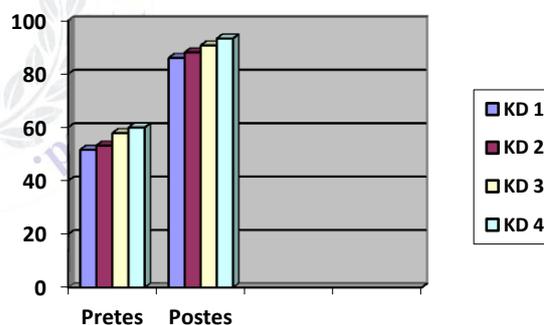


Figure 1. Graph of the Average Cognitive Learning Outcome Score KD 1, KD 2, KD 3, and KD 4 in Preliminary Field Testing

2. The Results of Cognitive Learning Outcome in Main Field Testing

Data of students' cognitive learning achievement score in main field testing KD 1 with Virus, KD 2 with Archaeobacteria and Eubacteria, KD 3 with Fungi, and KD 4 with Enzyme are presented as graph in Figure 2, while the normalized gain score is presented in Table 7.

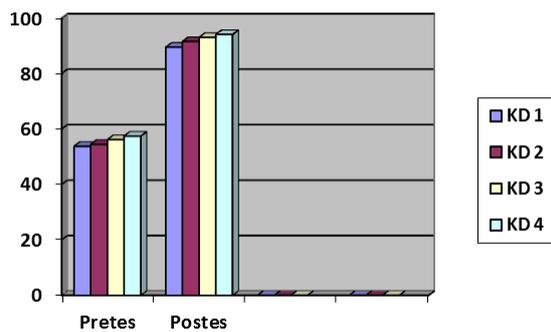


Figure 2. Graph of the Average Cognitive Learning Outcome Score KD 1, KD 2, KD 3, and KD 4 in Main Field Testing

Table 7. Gain Score of Each KD in Main Field Testing

No	Name of Learning Materials	Gain Score	Category
1	KD 1 (Virus)	0.77	High
2	KD 2 (<i>Archaeobacteria</i> dan <i>Eubacteria</i>)	0.81	High
3	KD 3 (Fungi)	0.84	High
4	KD 4 (Enzyme)	0.86	High
Average		0.82	High

3. The Results of Cognitive Learning Outcome in Operational Field Testing

Data of students' cognitive learning achievement score in operational field testing KD 1 with Virus, KD 2 with *Archaeobacteria* and *Eubacteria*, KD 3 with Fungi, and KD 4 with Enzyme are presented as graph in Figure 3, while the normalized gain score is presented in Table 8.

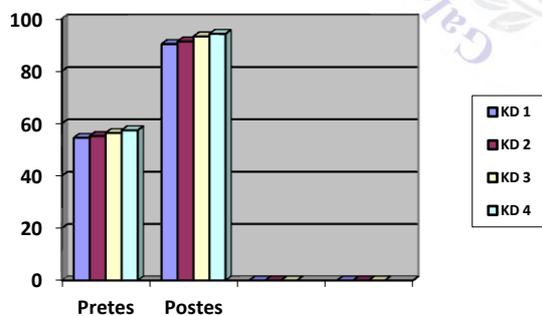


Figure 3. Graph of the Average Cognitive Learning Outcome Score KD 1, KD 2, KD 3, and KD 4 in Operational Field Testing

Tabel 8. Gain Score of Each KD in Operational Field Testing

No	Name of Learning Materials	Gain Score	Category
1	KD 1 (Virus)	0.79	High
2	KD 2 (<i>Archaeobacteria</i> dan <i>Eubacteria</i>)	0.81	High
3	KD 3 (Fungi)	0.84	High
4	KD 4 (Enzyme)	0.86	High
Average		0.83	Tinggi

From the three field testings, the preliminary field testing, the main field testing, and the operational field testing that

have been performed based on Figure 1, Figure 2, and Figure 3, the students' learning outcome scores are in the range of 85 to 100. This means that the development-resulting module is an effective module used as teaching materials and meets the PAP UM. The average gain score in all three field testings is in the high category indicating that think pair share biology module can improve the cognitive learning outcomes of vocational students in Malang.

Module with think pair share strategy can improve cognitive learning outcomes of vocational students in Malang. Students' cognitive learning outcomes are sharpened during the learning process through the stages of the think pair share strategy. Thus the students' cognitive learning outcomes can be taught in schools through the learning process. Learning outcome is a very important thing from the learning process because it is an indicator of the learning success. The cognitive learning outcomes, according to Bloom revised by Anderson and Krathwohl, include: remember, understand, apply, analyze, evaluate, and create. Learning outcomes are the culmination of learning activities resulting in cognitive, dynamic, and measurable (cognitive) attitudes, and (psychomotor) behaviors and can be measured or observed (Huri, 2011). Sudjana (2006) suggests that learning outcomes are the abilities that students have after receiving a learning experience. The learning experiences contained in the module are shown to improve students' learning outcomes both during preliminary field testing, main field testing, and operational field testing.

Biology module for 10th grade of Nursing with well-structured think pair share strategy has been proven to improve cognitive learning outcomes. Besides it also provides many advantages, among others (1) can maximize students' learning activities and teacher activities, (2) students are more active in the learning process because they face a number of problems or activities to be solved, (3) provide a lot of

feedbacks so that students can know the level of learning outcomes, (4) student efforts are directed because the module contains a clear purpose, (5) students can learn without being bound to the teacher, because the materials that have been prepared in the module have been set (Nasution, 2000).

IV. CONCLUSION

Based on the results and discussion above, it can be concluded as follows.

Produce a think-pair-share-based biology module that is valid and feasible to be used for learning biology at Vocational High School.

The think-pair-share-based module can improve the cognitive learning outcomes with the average gain score of 0.77 (high category) in the preliminary field testing, 0.82 (high category) in the main field testing and 0.83 (High category) the operational field testing.

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