

Development of HOTS (High Order Thinking Skill) Oriented Learning Through Discovery Learning Model to Increase The Critical Thinking Skill of High School Students

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ABSTRACT: The aim of this research is to produce HOTS (High Order Thinking Skill) lesson through a valid, practical, and effective discovery learning model for class XI high schools to improve students' critical thinking skills. This research is a development that refers to the Borg & Gall model. The subject trials for grade XI students of SMA Negeri 2 Sangatta Utara, East Kutai. Validity and practicality analysis techniques used percentage of descriptive techniques. The effectiveness analysis technique is by looking at the percentage of increase in students' pretest-posttest results. The result of this research in the form of development of learning tools which included: Syllabus, teaching materials, LKPD, and assessment instruments. The result showed that learning tools that have been developed meet the validity with a validity percentage of 99.66% which is categorized as very valid. The practicality of the lesson plan produced is very practical, this is indicated by the assessment of students as research respondents about 85.93%. HOTS (High Order Thinking Skill) lesson plan through Discovery Learning model to improve student's critical thinking skills that are produced are able to provide the effectiveness learning, it looked through an increased in learning between pretest and posttest about 33%.

Keywords: Development, Lesson plan, HOTS (High Order Thinking Skill), Discovery Learning Model, Students' Critical Thinking Skill

INTRODUCTION

Education quality is the mandate of the whole people of Indonesia that is stipulated in Law No. 20 in 2003 about System of National Education, which is hinted about education as a conscious and planned effort to create learning atmosphere and the process of learning so that learners can increase their potential actively.

The process of learning is a very important thing, where the process is going on in the student's thinking. Student involvement in the teaching and learning process is an implementation of student activity in a classroom. Students can contribute actively by doing activities that can support the process of learning, including discussion, reading and understanding of the lesson, do the tasks which are commanded by a teacher or look for sources of other material that able to assist them in understanding a lesson. Learning that involves student actively, it requires students to develop their thinking skill, with develop thinking skill, it is expected to support the level of achievement in understanding what is learned [4].

The information result that is obtained after doing the observation, interview and questionnaire toward teachers of biology who there is in 3 Senior High Schools in Regency of Kutai East about the analysis of necessity school. The teacher has used 13 curriculums based on the government command, the teachers explained the lack of student response in understanding the material of the Human Motion Tool System because the teachers feel difficulty in explaining the understanding of subject matter deeply and memorable for material that was abstract. The lack of students learning activity that relates with all the activity that is going on, either in the physical and nonphysical, so that students have a tendency to forget what that was given.

One of the efforts to optimize student critical thinking is to know the students' way of learning, such as

understanding, solving of problems, connection and communication, also others ability will be owned well by students [3]. If students are able to realize what they do have right, conclude what were supposed to do when experience failure, and evaluate what has been done. In other words, the result of good learning are gained by effort or thought which are expressed in mastery, knowledge and base skill that are contained in any aspects of life, so there is a change in individual self to achieve of learning goals [7].

Related theory that becomes a reference to develop discovery learning model that oriented by HOTS (High Order Thinking Skills) is a constructivism view in learning, cognitive theories of learning which includes the Jerome Bruner's theory of discovery, Piaget's development of intellectual theory, Ausubel's meaningful theory and Vigotsky's study theory [6].

HOTS (High Order Thinking Skill) Learning Development. States that competence of thinking can be classified according to Bloom's Taxonomy, as in Table 1 below [1].

TABLE 1. Classification of thinking competencies according to Bloom's Taxonomy

Bloom's Taxonomy	Levels of Thinking	Review
Knowledge (C1)	Lower-order	Remembering
Comprehension (C2)	Lower-order	Understand
Application (C3)	Higher-order	Apply
Analysis (C4)	Higher-order	Analyze
Synthesis (C5)	Higher-order	Create
Evaluation (C6)	Higher-order	Evaluate

Discovery learning model is a learning theory which is defined as the process of learning that occurs when the process is not presented with the final lesson, but it is expected the students able to organize themselves to gain a new knowledge that delivered indirectly teacher, partially or wholly obtained from the learning that has studied before [5]. Discovery learning model in the classroom can be seen in Table 2 as follows.

TABLE 2. Stages in the Implementation of Discovery Learning

Stages	Teachers Activity
Stimulation	Given the problem that stimulates the desire to investigate.
Problem Identification	Given the opportunity to identify problems as much as possible. Then choose one to formulates in a hypothesis.
Collection of Data	Gather as much data to proves right or wrong the hypothesis.
Data Processing	Process all data and information that is obtained by the students.
Evidence	Make checks accurately to prove right or wrong the hypothesis that defined earlier with alternative findings.
Draw conclusions	The process of drawing conclusions that can be used as a general principle and apply to all same events or problems, with shows verification result or evidence.

Critical thinking is an effort that is deliberately done actively, systematically, and follows the principles of logic, also considers any point of views to understand and evaluate information with the aim of whether the information was received, rejected or suspended its assessment.

Learning tools development is designed with using the development of Borg and Gal model. Research and development are modified from 10 steps of research and development from Borg and Gall [9]. In a great line developed over four phases, namely: 1) Pre- Development Phase, 2) Early Development Phase, 3) Stage Development Model, and to 4) Implementation Phase.

According to Borg & Gall the model outlines the general steps in research and development can be seen in the following Figure 1.

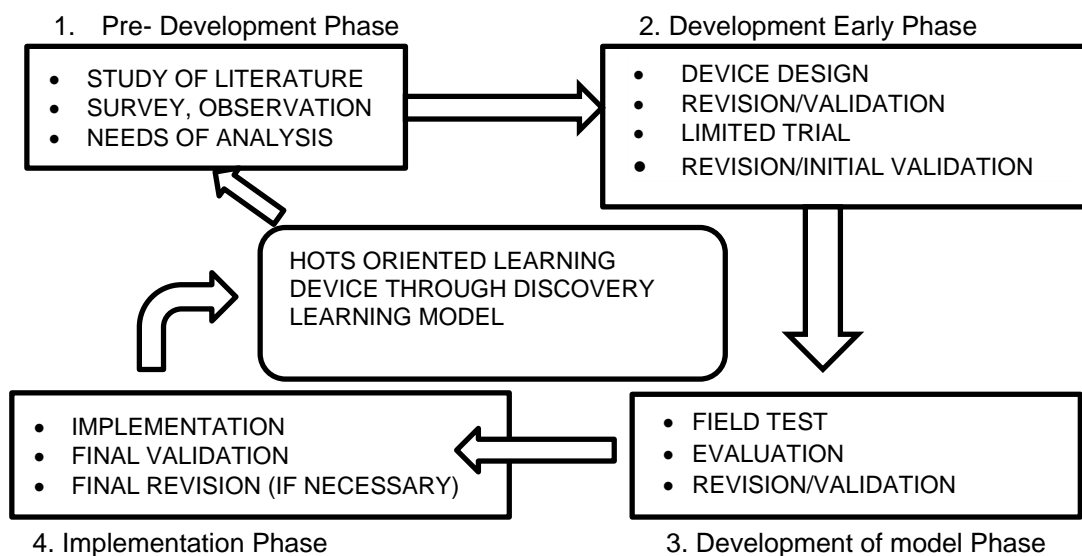


FIGURE 1. Development Procedural Research According to Borg and Gall

METHODS

Place of this research process is in SMAN 2 North Sangatta East Kutai, East Kalimantan in the class of XI SMA. This research was conducted in middle semester to October 2019-March 2020. Kind of this research uses development research or Research and Development (R & D).

Data Analysis Techniques

Analysis Data Technique has done to get tools of a learning product that qualified to assess the validity of learning tools, the practicality of the learning tools and the effectiveness of learning tools.

1. The validity of learning tools

Analysis of the data is carried out in several stages:

- a. Tabulate of data that is obtained for each assessment and items of media aspects from each assessor. Each item assessment tools which stated assessment criteria can be seen in Table 3 below:[2]

TABLE 3. Expert Validation Questionnaire Score

Score	Criteria
4	Very valid
3	Valid
2	Quite valid
1	less valid
0	invalid

- b. Calculate the average of total score in each expert validation assessment by using descriptive percentage technique with the formula:

$$K = F / (N \times I \times R) \times 100\%$$

Information:

K = Tools validity (%)

F = Total of respondents' answers

N = Highest score

I = Total of items

R = Total of respondents

- c. The result of a validity calculation learning tools (%) subsequently can be matched with a range of percentages and qualitative criteria test of a validity learning tools that are presented in Table 4. [8]

TABLE 4. Percentage Range and Qualitative Criteria Test for the Validity of Learning Tools by Experts

Value Scale (100%)	Criteria
81.26 -100	Very valid (not revised)
62.51 - 81.25	Valid (not revised)
43.76 - 62.50	Quite valid (not revised)
25.00 -43.75	Less valid (revised)
<25.00	Invalid (revised)

Learning Tools Practicality

The data is in the form of response scale towards learning tools that consists of 5 Thurstone scale. The five Thurstone scale can be seen in Table 5 below.

TABLE 5. Student Response Questionnaire Score

Score	Criteria
5	Very good
4	Good
3	Enough
2	Less
1	Very less

Each statement was given a score according to statement form, then score total result of assessment analyzed based on this phase:

- a. Calculate the total score of student's answers by using the formula:

$$P = F / N \times 100\%$$

Description:

P = Percentage score

F = Total scores were obtained

N = Maximum number of scores

- b. Convert a score that is obtained into qualitative practicality tool criteria by responses of students with a reference table which is adapted Rosginasari as that presented in Table 6. [8]

TABLE 6. Range of Percentage and Qualitative Criteria of Test into Practical Devices by Students

Percentage Range	Qualitative Criteria
80.01% - 100%	Very practical
70.01% - 80.00%	Practical
60.01% - 70.00%	Quite Practical
50.00% - 60.00%	Less practical
<50%	Unpractical

Effectiveness of Learning Tools

The effectiveness of the learning tool, in the form of an assessment of students pretest and posttest as outlined in a test. To know whether there is an increase in student critical thinking skill, it needs to be seen the percentage of pretest and post-test increase in a test try usage class.

RESULTS AND DISCUSSION

Design Validation by Experts

After identifying teacher's and student in SMA N 2 North Sangatta problems subsequently carried out the design of learning and produced draft 1 form tools that oriented by HOTS (High Order Thinking Skills) through a discovery learning model to improve the students critical thinking skill. To get suggestions and improvements, validation is done by experts. Results of recaps validation assessment toward learning tools can be seen in appendix 4 or as quick can be seen in Table 7 below.

TABLE 7. Evaluation Data by Validator

NO	Product Description	Validator Rating			Average
		Learning	Theory	Language	
1	Syllabus and RPP				
2	Teaching Material	196	196	194	99.66
3	LKPD				
4	Evaluation				
Criteria					Very Valid

Revised Design and Test Try Products

Learning tools that have been validated and revised by validation team then tested for limited to students of class XI IPA 2 / Volta (hereinafter will be referred to as class treatment). As to see the difference of tools, so a teacher at school is requested to teach the same material in class XI IPA 1 / Rutherford (hereinafter will be referred to as control class) and the results of the assessment are used same with the class trial test of a product that is pretest and posttest grade.

The determination of these two classes in this research based on student's ability that are almost identical or homogeneous. The choice of homogeneity test used by researchers to find out which samples will be examined is homogeneous or not, so the F test is carried out.

$$F_{\text{arithmetic}} = \frac{\text{Big variants}}{\text{Small variants}}$$

Based on the homogeneity data calculation, the pretest and posttest grades XI 1 obtained $10.13 > 0.47$ where F_{count} larger than F_{table} so it can while the calculation of homogeneity calculation, the pretest and posttest grades XI IPA 2 obtained $7,34 > 0.47$ where the F_{count} is larger than the F_{table} so it can be concluded that the pre-test and post-test grades data are not homogeneous. The results of the calculation of the two classes (control and treatment) can be seen in Appendix 11.

After knowing there is a difference or improvement of each class toward pretest and posttest grades, subsequently carried out the data analysis with two parties hypothesis to see if classes are taught by teachers use the school's tools (XI IPA 1) equal or not equal with the class that is taught by the researcher that uses learning tools that have been developed (XI IPA 2). Analysis using T test combination, the stages

of this analysis is in accordance with research methodology that is described by Koyan (2009). Results T_{count} is -3.56 it is obtained because one of the formulas used $(\bar{x}_1 - \bar{x}_2)$ where \bar{x}_1 is the average of classes grade that are taught by teachers with using the learning school tools so that the results were obtained minus (-). Next step is determine t_{table} by using the formula $-\frac{t\alpha/2}{\sqrt{\frac{s^2}{n_1+n_2-2}}} < t < \frac{t\alpha/2}{\sqrt{\frac{s^2}{n_1+n_2-2}}}$, the result of which is obtained is $-\frac{t\alpha/2}{\sqrt{\frac{s^2}{n_1+n_2-2}}} = \alpha (0,025)$, t table 40 = -2,021 $\frac{t\alpha/2}{\sqrt{\frac{s^2}{n_1+n_2-2}}} = \alpha (0,025)$, t table 40 = 2,021. From the results it can be known the location of $t_{arithmetic}$ towards t_{tabel} was $-2,021 > -3,56 < 2,021$ so that H_0 is rejected and has a sense of class that taught by teachers to use school's tools (XI IPA 1) is not equal towards a class that taught by the researcher that uses learning tools that have been developed (XI IPA 2). For more details, this calculation can be seen in Appendix 11.

Presentation of the pretest and posttest average grades can be seen in Figure 2 as follows:

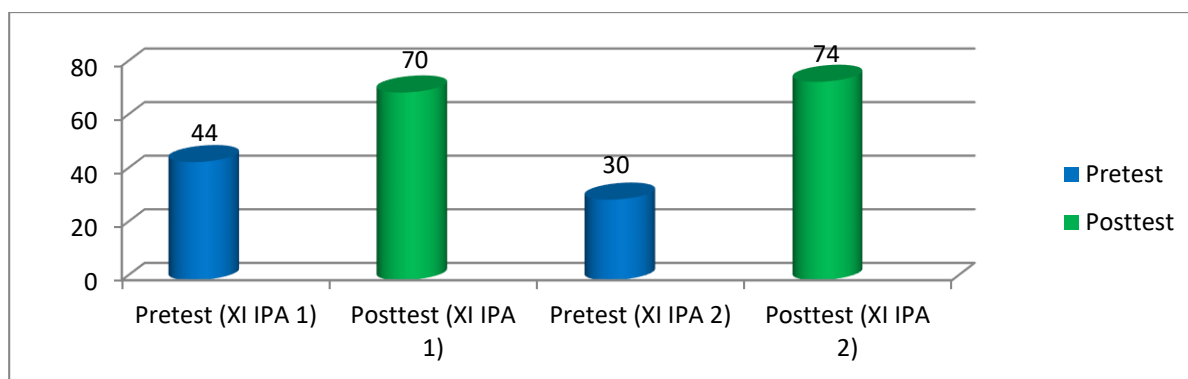


FIGURE 2. Graph Results The average pretest and posttest Class XI and XI IPA1 IPA2 (Trial Test Products)

Based on the average of the *pre-test* and *post-test* grades in the graph above it can be seen that the results of student learning increases after by the learning tools that oriented HOTS (High Order Thinking Skill) through discovery learning model on the material system tool motion of humans when compared with directly learning (teacher-centered).

Revised Products I and Test Try Use

At the product revision stage I, the researcher conducted an analysis of the product development. Test staged to try to use it is done on a limited basis to students of class XI IPA 3/Faraday SMAN 2 North Sangatta, the result of data research includes of pretest and posttest grades.

Presentation of the pretest and posttest average grades can be seen in Figure 3 as follows:

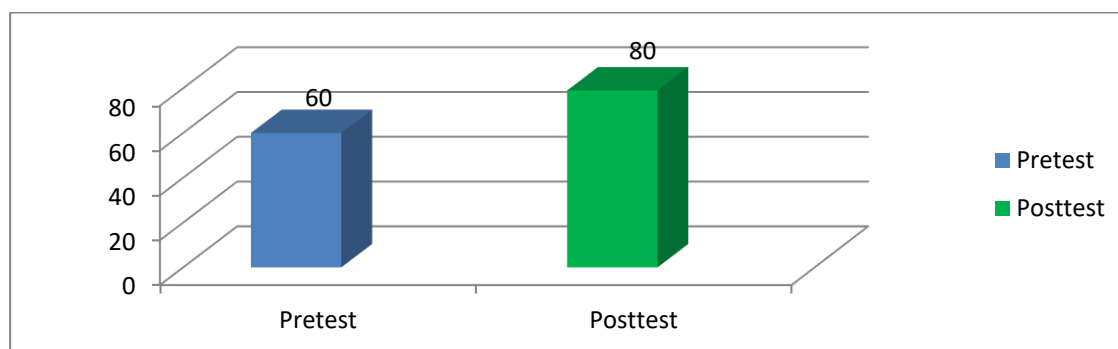


FIGURE 3. Graph Results The average *pretest* and *posttest* Class XI IPA3 (Test Try Use)

Percentage Analysis of Increase/Usage Test

Grade's students increase is obtained by subtracting the results posttest and pretest were obtained, it is 20. After getting the grade's students increase, the next step is divided the grade's students increase

with a grade before pre-test. The result is 0.33. The final step to determine the percentage of increase in learning is to multiply the grade of 0.33 to 100, the result which was obtained was 33%.

Analysis of Student Response Results

The results of student responses data analysis toward 21 students were then converted into percentages and were obtained the result of about 85.93%.

Teacher Response Questionnaire Analysis

Teachers provide feedback and suggestions to add material particular, for example in structure and function parts by adding the image on each sub materials are discussed.

Product Revision II

Based on the teacher's input and suggestions on the teacher's response questionnaire, the researcher made some improvements with considering the capacity of the image content to be proportional towards systematic learning tools (Hand out and LKPD) without reducing points on the learning objectives.

Based on the observation result, the researcher considers the learning model and effort to solve the problem. Effort that can be done is by doing development as a material reference, consideration and sample for teachers to be able to undertake the development of the tool later. While the chosen model is Discovery learning model because of student's needs in learning. Students tend to not make early steps to identify and make hypotheses to prove a learning result. It is caused by less of student ability and students were not used to make the formulation of the question and problem-solving. Students also reluctant to think critically, because of used to given test that makes them only memorize and determine without use thinking abstract with SMA's student competence to think.

By applying the methods of discovery learning repeatedly, it will increase the invention ability of individuals self that concerned. The use of development learning tools that oriented to HOTS (High Order Thinking Skills) through a discovery learning model wants to change the conditions of learning which is passive into active and creative. Change the learning that is teacher-oriented to student-oriented. Changing the mode of expository students only receive the information as a whole from the teacher to the mode of student's discovery who find the information themselves.

Learning software development oriented to HOTS (High Order Thinking Skills) through discovery learning model in class XI SMA Negeri 2 North Sangatta in 2019 /2020. Based on the test results and analysis of the assessment, so that development of products was very valid, practical and effective and can be used in a whole school, so it can improve the students critical thinking skill.

CONCLUSION

Learning tools design oriented to HOTS (High Order Thinking Skills) through discovery learning model to improve the students critical thinking skill in class XI SMAN 2 North Sangatta, 2019/2020 in the form of a syllabus, planning of the learning implementation, Handouts, LKPD, evaluation and assessment instruments. Fulfil a validity as a learning tool with a percentage the average rating of learning experts, subject matter experts and language experts by 99.66%, the criteria are very valid. Fulfil the practically by a percentage 85,93% based on student responses are proven effective to use in learning activities, it looked from the result of student increase in learning.

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