STUDENT WORKSHEETS BASED ON DISCOVERY LEARNING COMBINED WITH ASSESSMENT FOR LEARNING HIGHER ORDER THINKING SKILLS (AfL HOTS) TO FOSTERING HIGH LEVEL THINKING SKILLS OF STUDENTS

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ABSTRACT
This study aims to describe the effectiveness of student worksheets based on discovery learning combined with assessment for learning higher order thinking skills in fostering high-level thinking skills of students especially in human circulatory system material. True experimental research design is a type of pretest-posttest control group with subjects consisting of two groups of eighth grade students of junior high school taken by random sampling. The research instrument in the form of student worksheets based on discovery learning combined with assessment for learning higher order thinking skills results of development with the feasibility of having guaranteed expert team validation and limited trials. Data collection research was conducted using observation sheets of high-level thinking skills and higher order thinking skills oriented cognitive test questions. The research data were analyzed descriptively qualitatively and quantitatively using t test. The results of data analysis showed the results of observations student behavior in the experimental class 1 and experimental class 2 which corresponded to the indicators of high-level thinking skills categorized as "very high" that is 80,83% analyzing, evaluating 81,90% and creating 82,33% while the results of the analysis response data of students' answers to higher order thinking skills cognitive test questions using the t test obtained sig (2-tailed < 0,05), namely sig (2-tailed) = 0,000. Thus the student worksheets based on discovery learning combined with assessment for learning higher order thinking skills in learning specifically on human circulatory system material is declared to be effective in fostering students' high-level thinking skills.
Keywords: student worksheets based on discovery learning, assessment for learning higher order thinking skills, high-level thinking skills.

INTRODUCTION

Improving the 2006 curriculum into the 2013 curriculum is a strategic step by the government in preparing student competencies to face the challenges of the globalization era and the demands of life in the 21st century. The implementation of the 2013 curriculum in the learning process adheres to the principle that knowledge cannot be transferred directly from the teacher to students. Students in the 2013 curriculum are seen as students who have various basic abilities and knowledge to achieve teaching goals. In this regard the teacher needs to facilitate learning experiences for students so that various potential basic abilities can develop into high-level thinking skills.

High-level thinking habits can arise in students when they are often trained in high-level thinking skills patterns (Saido, et al., 2015: 14). High-level thinking encourages students to be able to connect and apply a variety of knowledge into concepts that have not been thought of and have never been taught (Brookhart, 2010: 5) and involve complex thinking beyond the ability to remember facts to enable students to store information as a solution to problem solving (Ramos, et al., 2013: 49). High-level thinking process skills need to be applied in teaching Natural Sciences (Salbiah, et al. 2015: 1340) which can be developed through active and meaningful learning involving a variety of hands-on and minds-on activities (NRC, 2003: 2).

The fact reveals the success of Indonesian State Junior High School students in applying high level thinking skills is not satisfactory. As released by the data analysis of the International Mathematics and Science Learning Tendency (TIMSS) study on the 2015 mapping revealed that scientific literacy of Indonesian students ranked 45th out of 48 participating countries with a gain of 387 (Mullis, et al. 2015: 127). This data indicates that with science learning that has been done so far shows the results of junior high school students in Indonesia have not been skilled in solving TIMMS questions which generally require high-level thinking process skills, contextual characteristics, require analysis, argumentation, and creativity.

To grow high-level thinking skills in students, it is necessary to design an appropriate and sustainable learning process (Suyatna, 2017: 49). But when designing the learning process of course the characteristics of science

subjects that are more seeking understanding of natural phenomena through the process of finding facts and building concepts must be the focus of the teacher's attention (Tawil & Liliasari, 2014: 7). In connection with this, one of the efforts that can be done by the teacher is to provide learning media that are able to meet the needs of students in the process of finding and thinking at high levels through the implementation of student worksheets based on discovery learning combined with assessment for learning higher order thinking skills in science learning activities which is then abbreviated as student worksheets based on discovery learning combined with AfL HOTS.

But so far based on the results of the analysis of literature studies it has been revealed that there are no studies that have implemented student worksheets based on discovery learning combined with AfL HOTS in learning. Most of the research that has been carried out is more focused on implementing students worksheets based on discovery learning and is not concentrated in developing high-level thinking skills (Susanti, et al., 2017: 12; Maulana, et al., 2017: 6; Estuningsih, et al., 2013: 30; Nurhayati & Angraeni, 2017: 124). High-level thinking skills include life skills competencies that must be possessed by someone facing the complexity of competition and challenges in changing life patterns in the 21st century era so that it is deemed necessary to develop high-level thinking skills in learning through implementation of student worksheets based on discovery learning combined with AfL HOTS.

The presentation of learning materials in the student worksheets based on discovery learning combined with AfL HOTS is not displayed in the final form so students are expected to organize (Mc Donald, 2011: 5). AfL HOTS which is integrated in the student worksheets based on discovery learning is not focused on the final results of the assessment but rather is aimed at understanding the concept of knowledge, the application of doing something, and understanding how to achieve learning goals (Stiggins, 2002: 5). In order to optimize the successful implementation of AfL HOTS which is integrated in the student worksheets based on discovery learning the teacher uses the strategy of giving feedback directly so that potential strengths and weaknesses of student learning can be immediately known (Black & Wiliam, 2009: 2). Through student worksheets based on discovery learning combined with AfL HOTS a variety of information is compared, categorized, analyzed, integrated, and organized by students to be able to make learning conclusions (Kemdikbud, 2014: 36).

Student worksheets based on discovery learning combined with AfL HOTS is able to direct student learning through activities and high-level thinking processes. The learning process of implementing student worksheets based on discovery learning combined with AfL HOTS can encourage students to identify things they want to know through the process of finding, build construction of understanding with observations and experimental activities based on their own initiative, and develop thinking skills up to the level of analysis (C4), evaluate (C5), and creative (C6) (Narayanan & Adithan, 2015: 2). Student worksheets based on discovery learning combined with AfL HOTS implies physical and mental activities of students so it is very possible to create science learning that is characterized by students-centered. The implementation of student worksheets based on discovery learning combined with AfL HOTS in science learning is believed to be able to fostering high-level thinking process skills of students.

Based on the background above a study on the implementation of student worksheets based on discovery learning was combined with AfL HOTS in science learning to foster high-level thinking skills in junior high school students.

METHOD

This research was conducted in the odd semester of the academic year 2017/2018 at SMP Negeri 16 Bandar Lampung, one of the schools in Lampung Province of Indonesia. Research subjects including 2 groups of students from 10 groups of class VIII by random sampling. The study design used true experimental type pretest-posttest control group (Creswell, 2012: 307). The research design is shown in Table 1.

Table 1. Study Design Pretest-Posttest Control Group Design

Group	Total of Students	Pretest	Treatment	Posttest
Experimental 1	29	O_1	X	O_2
Experimental 2	29	O_3	X	O_4

Description: O_1 = pretest experimental class 1; O_2 = posttest experimental class 1; X = treatment; O_3 = pretest experimental class 2; O_4 = posttest experimental class 2

The research instrument consists of learning devices and data collectors. Instrument learning devices include learning implementation plans and student worksheets based on discovery learning combined with AfL HOTS while data collection instruments in the form of observation sheets of high-level thinking skills and cognitive test questions oriented HOTS.

The student worksheets based on discovery learning instrument combined with AfL HOTS used in this study is the result of development research with guaranteed feasibility through the stages of material, media, and language validation by three expert teams and first has been tested on a limited basis to students. The instrument student worksheets based on discovery learning combined with AfL HOTS has an average achievement of expert team validation of 97,99% with the criteria of "very adequate" and the achievement of student learning responses by 95,50% with the criteria "very interesting and very practical". For this research activity the instrument student worksheets based on discovery learning combined with AfL HOTS was implemented in five learning meetings.

The instrument of data collection in the form of a high-level thinking skill observation sheet is a likert scale observation list including five answer choices. This observation instrument adapted from the indicators of high-level thinking skills Krathwohl (2002: 216). Filling out the observation sheet is done by the observer teacher by giving a checklist (√) to the answer choices as shown in Table 2.

Table 2. Sheet Observation of Higher Level Thinking Skills

Indicator	Observation Aspect	Scoring Scale				
		VL (1)	L (2)	M (3)	H (4)	VH (5)
Analyze	Analyze the information entered and divide or structure information into smaller parts to recognize patterns or relationships					
	Able to recognize and distinguish the causes and consequences of a complicated scenario					
	Identify and formulate questions					
Evaluate	Provide an assessment of solutions, ideas and methodologies using suitable criteria or existing standards to ensure the value of effectiveness or benefits					
	Make hypotheses, criticize, and test					
	Accept or reject a statement based on predetermined criteria					
Creative	Make a generalization of an idea or perspective on something					
	Design a way to solve problems					
	Organizing elements or parts into new structures that have never existed before					

Note= VL (very low), L (low), M (medium), H (high),VH (very high). (Source: Modification of Krathwohl, 2002: 216)

Analysis of high-level thinking skills observation data was carried out descriptively with a qualitative approach. The results of the analysis data are then interpreted using percentage price interpretations as shown in Table 3.

Table 3. Criteria for Higher Level Thinking Skills

The Interval	Criteria
81,00 – 100,00	Very High
61,00 – 80,00	High
41,00 – 60,00	Medium
21,00 – 40,00	Low
00,00 – 20,00	Very Low

(Source: Modification of Arikunto, 2011: 245)

The research data collection instrument in the form of HOTS-oriented cognitive test questions was used to measure the value of the pretest and posttest of high-level thinking skills of students in terms of cognitive understanding aspects. This HOTS cognitive-oriented test instrument is a HOTS question from the development research whose feasibility as a HOTS assessment instrument has been tested through the expert team's theoretical validity test and empirical validity involving 174 junior high school students (Khoiriah, et al., 2018: 19).

RESULTS AND DISCUSSION

The results of the study in the form of observation data of high-level thinking skills were obtained from analyzing the data on the observation sheet instruments of high-level thinking skills of students. Observation activities are carried out during the learning process by observing behaviors that arise in students according to indicators of high-level thinking skills. The results recapitulation observation data high-level thinking skills of students in the experimental class 1 and experimental class 2 are shown through Table 4.

Table 4. Results Recapitulation of Observation Data High Level Thinking Skills of Students in Experimental Class 1 and Experimental Class 2

Indicator	Observation Aspect Sub Indicator	Observation Averages High Level Thinking Skills of Student (%)		Average
		Exp. 1	Exp. 2	
Analyze	Analyze the information entered and divide or structure information into smaller parts to recognize patterns or relationships	82,00	80,20	81,10
	Able to recognize and distinguish the causes and consequences of a complicated scenario	81,60	78,60	80,10
	Identify and formulate questions	79,20	83,40	81,30
Evaluate	Provide an assessment of solutions, ideas and methodologies using suitable criteria or existing standards to ensure the value of effectiveness or benefits	80,40	81,40	80,90
	Make hypotheses, criticize, and test	83,20	84,20	83,70
	Accept or reject a statement based on predetermined criteria	80,80	81,40	81,10
Creative	Make a generalization of an idea or perspective on something	81,40	82,60	82,00
	Design a way to solve problems	81,60	81,80	81,70
	Organizing elements or parts into new structures that have never existed before	82,80	83,80	83,30
Average Observation of Higher Level Thinking Skills (%)		81,44	81,93	81,69
Observation Criteria High Level Thinking Skills		Very high	Very high	Very high

Based on Table 4, it can be seen that the average observation of the behavior of students in the experimental class 1 and experimental class 2 which corresponds to the indicators of high-level thinking skills is categorized as "very high" (Arikunto, 2011: 245). Referring to Table 4, it can be seen also the results of the analysis of observation data in students of the experimental class 1 and experimental class 2 for each indicator of high-level thinking skills as shown in Table 5.

Table 5. Results Recapitulation of Data Observation High Level Thinking Skills in Students Experimental Class 1 and Experimental Class 2 for each Indicator

No.	Indicator	Observation Averages High Level Thinking Skills of Student (%)				Average	Criteria
		Exp. Class 1	Criteria	Exp. Class 2	Criteria		
1.	Analyze	80,93	Very High	80,73	Very High	80,83	Very High
2.	Evaluate	81,47	Very High	82,33	Very High	81,90	Very High
3.	Creative	81,93	Very High	82,73	Very High	82,33	Very High

Based on Table 5, it can be seen that the results of the average behavioral observation of students in the experimental class 1 and experimental class 2 which correspond to each indicator of high-level thinking skills are categorized as "very high" (Arikunto, 2011: 245).

The quantitative testing hypothesis in the study includes: (1) H_0 = student worksheets based on discovery learning combined with AfL HOTS is not effective in fostering students 'high-level thinking skills and (2) H_1 = student worksheets based on discovery learning combined with AfL HOTS effectively fostering students' high-

level thinking skills. The quantitative testing criteria include: (1) If the results of t-test parametric statistics are obtained sig (2-tailed) > 0,05 then the test can be concluded as accept H_0 while (2) If the results of t-test parametric statistics are obtained by price sig (2-tailed) < 0,05 so the test can be concluded reject H_0.

Data from quantitative research results obtained from the pretest and posttest values of students' high-level thinking skills were measured using HOTS-oriented cognitive test questions. Analysis of pretest and posttest data on high-level thinking skills was carried out using t-test parametric statistics or the independent sample t test using the SPSS version 21.0 software program. But first the data normality test was carried out using the Shapiro Wilk test and data homogeneity test with Levene test (Creswell, 2012: 187). The data recapitulation of the results of testing the normality and homogeneity of pretest and posttest data on high-level thinking skills is shown in Table 6.

Table 6. Recapitulation of Data on Test Results for Normality and Homogeneity of Pretest and Posttest Data at High Level Thinking Skills for Students in Experimental Class 1 and Experimental Class 2

Data group	Class	Normality Test		Homogeneity Test	
		N	Sig	Levene Statistic	Sig
Pretest High Level Thinking Skills	Experimental 1	29	0,069	0,224	0,638
	Experimental 2	29	0,118		
Posttest High Level Thinking Skills	Experimental 1	29	0,114	0,546	0,463
	Experimental 2	29	0,144		

Based on Table 6, it can be stated that the pretest and posttest data of students' high level thinking skills in the experimental class 1 and experimental class 2 were normally distributed and had the same variance (with sig normality and homogeneity test > 0,05).

While the recapitulation of the test data from the independent sample t test (t test) data on the pretest and posttest high-level thinking skills of students in the experimental class 1 and experimental class 2 can be seen through Table 7.

Table 7. Recapitulation of t Test Results Data Pretest and Posttest Data High Level Thinking Skills Students Experimental Class 1 and Experimental Class 2

Class	Data group	N	Mean	Standar Deviation	t	df	Sig (2-tailed)
Experimental 1	Pretest High Level Thinking Skills	29	15,52	5,877	-40,363	56	0,000
	Posttest High Level Thinking Skills	29	81,38	6,532			
Experimental 2	Pretest High Level Thinking Skills	29	16,55	6,139	-36,748	56	0,000
	Posttest High Level Thinking Skills	29	82,07	7,382			

Referring to the data analysis in Table 7, it can be seen that from the results of t-test parametric statistics obtained the sig (2-tailed) price < 0,05 which is sig (2-tailed) = 0,000 then testing the quantitative hypothesis can be concluded reject H_0 and accept H_1. This means that the student worksheets based on discovery learning combined with AfL HOTS effectively fosters students' high-level thinking skills in the experimental class 1 and experimental class 2.

Based on the results of qualitative and quantitative data analysis revealed the implementation of the student worksheets based on discovery learning combined with AfL HOTS effectively fostered high-level thinking skills of students in the experimental class 1 and experimental class 2. This can be seen through observations of student behavior during the learning process in accordance with indicators of level thinking skills high (Table 4) and known from the pretest and posttest values of high-level thinking skills (Table 7).

Observation data on student behavior in accordance with the indicators of high-level thinking skills during the learning process in the experimental class 1 were categorized as "very high" which showed an average behavior of 80,93% analyzing, evaluating 81,47% and creating 81,93%. Meanwhile the observation of the behavior of

students in the experimental class 2 that corresponds to the indicators of high-level thinking skills also shows the category of "very high" that is with an average behavior of 80,73% analyzing, evaluating 82,33% and creating 82,73%.

The pretest and posttest of high-level thinking skills of students in the experimental class 1 had a mean value of 15,52 and 81,38 while the students of the experimental class 2 were 16,55 and 82,07. The quantitative analysis results of the pretest and posttest high-level thinking skills were obtained sig (2-tailed) < 0,05 which is sig (2-tailed) = 0,000 which means the student worksheets based on discovery learning combined with AfL HOTS effectively fostered students' high-level thinking skills.

Factors suspected of influencing the results of this study are because the student worksheets based on discovery learning combined with AfL HOTS support teachers in developing high-level thinking process skills during learning process. The implementation of the student worksheets based on discovery learning combined with AfL HOTS means the same as involving the process of discovery and high-level thinking in learning.

The student worksheets based on discovery learning combined with AfL HOTS facilitates teachers to raise issues related to learning material. Guided students play an active role in the process of finding concepts and facts of learning and finding solutions to problem solving. This learning experience is proven to be able to improve learning behavior and thought processes in students which gradually develop into HOTS.

As based on the results of this study it was revealed that 81,70% of the behaviors of students were able to design a way to solve the problem. As the results of the study of Dalgarno, et al., (2014: 18) suggest discovery learning provides freedom of exploration so that it arises the desire to investigate matter more broadly. This is in line with the results of the Suphi & Yaratan (2016: 829) that discovery learning supports teachers to carry out learning that encourages students to develop learning activities and increase cognitive levels to the categories of analyzing, evaluating, and creating. Furthermore Saab, et al., (2009: 217) asserted discovery learning has positive consequences for changes in the process and student learning outcomes.

The student worksheets based on discovery learning combined with AfL HOTS in learning trains students to ask questions related to the results of observations. Students are guided to form hypothetical questions related to learning material. Students are directed to seek knowledge from various sources of information. Learning conditions like this are proven to be able to encourage students to actively find the relationship between information that has been found so that the longer the process of thinking analysis is growing.

As based on the results of this study, it was revealed that 80,90% of behaviors appeared that students could provide an assessment of solutions, ideas, and methodologies using suitable criteria or existing standards to ensure the value of effectiveness or benefits. This is in line with the results of the study of Ardianto & Rubini (2016: 33) that discovery learning provides opportunities for students to learn analytical thinking that influences the achievement of thinking competencies and increases understanding of scientific literacy. The results of the Steuter & Doyle (2010: 76) study also reveal discovery learning encourages student involvement in building concepts, improving research skills and high-level thinking processes. Furthermore, the results of Yuliani & Saragih's research (2015: 122) reported that out of 39 students who participated in discovery learning 84,62% were interpreted as having good conceptual understanding and 76,92% categorized as capable of critical thinking.

The student worksheets based on discovery learning combined with AfL HOTS encourages students to evaluate with friends. The existence of feedback giving strategies in the implementation of student worksheets based on discovery learning combined with AfL HOTS gives the opportunity for students to immediately know the strengths and weaknesses of learning. This situation allows students to conduct evaluative thinking processes so that the longer the desire to improve learning behavior. As Hargreaves (2013: 229) affirmed that AfL with the teacher-feedback strategy is able to create interactive learning communication that can automatically become the main source of controlling student learning.

Student worksheets based on discovery learning combined with AfL HOTS invites students to actively develop skills in interpreting data so that sharpness of thinking is sharpened which certainly has a positive impact on the process of developing high-level thinking skills. This activity builds a collaborative learning climate, sharing and exchanging information, and listening to or using ideas that come from other students.

As based on the results of this study it was revealed that 81,10% of behaviors emerged students could accept or reject a statement based on established criteria. As the results of Mc Donald's research (2011: 19) discovery

learning able to bring students to the atmosphere of collaborative learning by sharing information (52%), ability to cooperate (75%), and interactive learning processes (100%). This is in line with the results of Lieu's research (2015: 152) discovery learning encourages students collaborate to discuss ideas in groups.

The student worksheets based on discovery learning combined with AfL HOTS in learning asks students to do a careful examination so that there is no mistake when proving the truth of a hypothetical question. In the event of proof of discrepancy, the student worksheets based on discovery learning combined with AfL HOTS encourages students to continuously build problem solving skills.

As based on the results of this study it was revealed that 83,70% of the students' behaviors appeared to be able to make hypotheses, criticize, and test. This fact of learning encourages students to develop creative thinking processes that can gradually become high-level thinking skills. As the results of Lubis's research, et al. (2017: 96) report students with discovery learning experience have a better average value of thinking skills (83,13) than direct teaching (60,53). Furthermore, the results of Widhiyantoro's study (2012: 97) emphasized that discovery learning significantly improved aspects of creative thinking skills including elaboration (88,05%), flexibility (86,56%), originality (86,56%), and fluency (83,25%).

The student worksheets based on discovery learning combined with AfL HOTS in learning invites students to actively compile and present the learning outcomes that have been done so that it has the potential to foster learning motivation and creativity. When compiling reports on student learning, students carry out self-construction according to the learning experience by paying attention to the principles of the results of proof to obtain a general concept as a generalization product. This fact makes students more challenged and keeps trying to show better learning performance.

As based on the results of this study, it was revealed that 82,00% of behaviors appeared to be able to generalize an idea or perspective on something. This is as confirmed by Balim (2009: 2) discovery learning encourages students to arrive at the concluding stage based on learning activities and observation activities carried out independently. Furthermore, the results of the study of Eidelman & Shwart (2016: 297) confirm that the habit of finding yourself in discovery learning results in students' efforts to realize learning progress.

CONCLUSION

Based on the results of research and discussion, it can be concluded that the student worksheets based on discovery learning combined with AfL HOTS can be declared effective in fostering high-level thinking skills of students especially in human circulatory system material. This can be known through the average observations of student behavior during the learning process that are in accordance with the indicators of high-level thinking skills and the value analysis of the posttest pretest of high-level thinking skills. The behavior that appears in students is in accordance with the indicators of high-level thinking skills in the experimental class 1 and the experimental class 2 is categorized as "very high" with an average score of 80,83% analyzing, evaluating 81,90% and creating 82,33% while the results value analysis of the posttest pretest of high-level thinking skills using the t test was obtained by sig (2-tailed < 0, 05), namely sig (2-tailed) = 0,000.

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