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Higher-Order Thinking Skills Improvement in Geography Learning on Material of Atmospheric Dynamic

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Abstract
This article was written to analyze the effectiveness of the EXO OLO TASK Learning Model application in Geography learning on material of atmospheric dynamics. The effectiveness was reviewed from higher-order thinking skills improvement and the quality of student learning activities. This type of research is experimental research with the *pre-post test group design* which was applied in two senior high schools in Padang. The population of the research was all class X students who study Geography in these two schools. The selection of sample classes was done by simple random technique. The XIS 2 class was selected in SMAN 3 Padang and class XA for SMA PB. The number of students involved was 62. The application of the model was implemented in one basic competency. Data on higher-order thinking skills were collected by learning outcomes tests and data on the quality of learning activities obtained by the observation sheet. Data is analyzed by percentage techniques. The results showed that, 1) there were significant differences between the learning outcomes of the experimental class and the control class in the two schools. 2) the improvement in student learning outcomes is higher in the experimental class than the control class in both schools, 3) an improvement in the quality of learning activities marked by more students getting a score of 3 both in basic learning activities and advanced learning activities.

Keywords: Higher Order Thinking Skills, Learning Activities, EXO OLO TASK Learning Model, Geography Learning

Introduction

The world is changing faster. Now humans are entering a new development called the Era of The Fourth Industrial Revolution which is characterized by the emergence of three new literacies in human life, namely data, technology and human literacy. Not only that, in the context of education, Marzano & Heflebower (2012) published a 21st century learning framework in the form of learning skills and life skills. Then, Dyer & Christensen (2009) initiated a scientific approach and developed a "silent revolution" in learning practices in developed countries such as Japan, South Korea and Hong Kong (Sato, 2012).

These changes have been adopted by Indonesia into the 2013 curriculum and become the main theme in the Indonesian Partnership for 21st Century Standard Skill/ IP-21CSS known as 4K and HOTS Learning (Nofrion, 2018). Although 4K and HOTS learning has been the national education agenda since 2016/2017, the practice in the field (in class) is not as expected. 4K learning which is characterized by; 1) creative and innovative, 2) critical thinking and problem solving, 3) communication, 4) collaboration has not been realized. It is the same with HOTS learning which is marked with; 1) analysis, evaluation and creation, 2) logical reasoning, 3) critical consideration and thinking, 4) problem solving and creative thinking (Brookhart, 2010) has also not yet been implemented. At least, this fact is a finding in Nofrion's research (2017); Nofrion (2018) in Padang

City where Geography learning in high school is still often focused on LOTS and MOTS learning, learning activities are still in the form of basic learning activities (observing, asking questions, trying/ searching), and still lack of dialogue, interaction and communication in learning.

To overcome this problem, Nofrion (2018) in his dissertation developed a learning model named EXO OLO TASK Learning Model aimed at developing higher-order thinking skills of students. This model is characterized by four syntaxes, namely; 1) strengthening of concepts, 2) LOTS and MOTS levels questions (C1-C3), 3) HOTS levels questions (C4-C6) and 4) reflection. The application of this model is also supported by arrangement of student learning activities in the form of individual, in pairs and groups learning activities according to the difficulties of the questions presented. One basic thing that needs to be understood is that this learning model is not a learning model that focuses on mere questions or exercises, but the questions presented in the syntax model are useful as a trigger for the emergence of student learning activities. Challenging and difficult questions are one of the characteristics of effective and collaborative learning (Heinich et al, 2002; Sato, 2012) and teamwork trains the students to be able to work alone (Johnson, Johnson, Holubec, 1998). Then, the difficult question is how to encourage students to learn as long as they are still in ZPD (Vygotsky, 1978; Sato, 2012). This learning activity is triggered by challenging questions. Silbermen (2006: 9) suggests that one indicator of learning activities running effectively and efficiently is the availability of many tasks that challenge students to use the brain to think hard. Through the application of the EXO OLO Task learning model, it is expected that the higher-order thinking skills of students will develop based on effective learning activities (Nofrion *et al*, 2019).

Review of Related Literature

HOTS is more than just memorizing/ recalling, restate, remember and refer without changing and processing (recite). *The Australian Council for Educational Research (ACER)* states that higher-order thinking skill is a process of: analyzing, reflecting, arguing (reasoning), applying concepts to different situations, composing, creating (Widana, 2017), is one of the important competencies in the modern world, so it must be owned by every student (Widana, 2017), ability involves analysis, evaluation and creation (Pohl, 2000). Stein & Lane (1996) defines HOTS as the use of complex thinking and uses different approaches, the ability to complete tasks with many solutions (Senk et al., 1997 in Lewy et al., 2009) and requires effort to find structures or solutions (Resnick, 1987; Splitter, 1991 in Lewy et al., 2009).

Brookhart (2010) states that HOTS is, 1) analysis, evaluation and creation, 2) logical reasoning, 3) consideration and critical thinking, 4) problem solving and creative thinking. As illustrated in the following Revised Bloom's Taxonomy (2001):

Table 1. The Cognitive Process Dimension

No	Cognitive Level	Dimension	Information	Operational Verbs (KKO)	Category	**Level**
1	C1	Knowledge	Remember	Remember, list, drill, imitate	*LOTS*	1
2	C2	Comprehension	Describe ideas/concept	describe, classify, accept, report	*MOTS*	
3	C3	Application	Apply information on different domains	apply, demonstrate, operate		2
4	C4	Analysis	Specifying elements /aspects	compare, examine, criticize, test		3
5	C5	Evaluation	Taking final decision	evaluate, assess, refute, decide and choose and support	*HOTS*	
6	C6	Create	Creating ideas	Construct, develop		

Source: Kemdikbud RI (2017)

Higher-order thinking skills can be interpreted as the potential of one's thinking that can be used to interpret, analyze and manipulate information (Mohamed, 2006; Ea, Chang, & Tan, 2005), the highest level in cognitive processes and can occur when someone gets new information, store it in memory and compile then use this information to reach a goal or solve a complicated problem (Philip, 2004), the core of 21st century conceptual frame of thinking in Indonesia, called the Indonesian Partnership for the 21st Century Standard Skills (IP-21CSS) which cover, 1) thinking of creativity and innovation, 2) critical thinking and problem solving, 3) communication and collaboration, 4) information skills, media and technology, 5) life and career skills (Ariyana et al, 2018), 1) transfer of knowledge, 2) critical and creative thinking and problem solving (Afandi & Sajidan, 2017).

Based on several expert opinions that have been described previously it can be concluded that higher-order thinking skills are the highest skills in the process of thinking/cognitive which is characterized by students' ability to analyze/ reason, evaluate, create and solve a problem based on information that has been owned correctly and efficiently and collaboratively.

Many ways can be done to develop higher-order thinking skills in learning. One of them is by preparing HOTS category questions with characteristics; 1) transfer one concept to another, 2) process and use information, 3) search for different information, 4) use information to solve problems and examine ideas and complete information (Setiawati, 2018). The HOTS question is also marked by dialogue and collaboration between students through collaborative learning (Sato, 2012) and also the ability of students to solve problems with limited time (Phillip, 2004). In addition, related to the assessment of Higher Order Thinking Skills/ HOTS, Brookhart (2010: 24) suggests managing the level of difficulty of the questions correctly is the characteristic of HOTS learning.

Furthermore, the students study or not can be seen from two aspects, namely; 1) changes in oneself, 2) learning activities that is shown. Learning activities are all activities carried out by students in the learning process, starts from physical activities to psychological activities (Hamalik, 2010: 171), as well as all activities carried out in the interaction process (teachers and students) in order to achieve learning goals (Hamalik (2010: 28). Related to learning that is oriented to HOTS, the expected learning activities are advanced learning activities which contain: 1) processing/ analyzing, 2) communicating/ dialogue, 3) discussing/ collaborating. The involvement of students in learning by doing advanced learning activities is expected to develop higher-order thinking skills/ HOTS.

Method

The type of research used is quasi-experimental research with a quantitative approach and using *pre-test and post-test control group design*. The population of this study is class X at SMAN 3 Padang (Class X IS1, X IS2, X IS3 and Cross-Major Class MIA1) and Padang State University Laboratory High School (class XA, XB, XC, XD). Sampling is done by simple random technique. With this technique, class X IS1 at SMAN 3 Padang is chosen as the experimental class and class X IS2 as the control class. Whereas in Padang State University Laboratory High School, class XA is chosen as the experimental class and the control class is class XB. The pre-test was given to the experimental class and the control class to determine the initial state. Then, the experimental class was treated using the EXO OLO TASK Learning Model while the control class studied with conventional learning models or lecture methods. After completing the treatment, the two classes were given a post-test which aimed to measure the learning achievement of students for the treatment given. The experimental design in this research is shown in the following Table:

Table 2. Design of EXO OLO TASK Research

Class	Pre-Test	Treatment	Post-test
Experimental	O1	Implement the EXO OLO Task learning model	O2
Control	O3	Conventional learning/ lecture	O4

Data on higher-order thinking skills are known by test techniques using valid learning outcomes tests that are given at the beginning and at the end of the learning. The number of questions is 20 items with material distribution in the Basic Competence of Atmospheric Dynamics and Its Impact on Life. Before the hypothesis test in the form of differences in learning outcomes between the experimental class and the control class is done, the analysis requirements test was carried out, namely the normality test using the Kolmogorov-Smirnov test and the Homogeneity test using the Levene test. Hypothesis testing is done by the "t" test.

Results and Discussion

Research Results

In accordance with the research objectives, the data to be analyzed are student learning outcomes obtained from the implementation of the pre-test and post-test in experimental class and control class. In the first part, the data on the results of the tests for normality, homogeneity and data from different test results will be described.

1. Data Normality Test

Table 3: Data Normality Test Results

No	Class	Data	Sig	Information
1	Experimental	Post Test SMAN 3	0,200	Normal
2		Post Test SMA PB UNP	0,072	Normal
3	Control	Post Test SMAN 3	0,086	Normal
4		Post Test SMA PB UNP	0,066	Normal

Table 3 shows all data values above 0.05, which means the data are normally distributed in both the experimental class and the control class in both schools.

2. Data Homogeneity Test

Table 4. Data Homogeneity Test Results

No	Class	Data	Sig	Information
1	Experimental	Pre dan Post Test SMAN 3	0,488	Homogeneous
2		Pre dan Post Test SMA PB	0,241	Homogeneous
3	Control	Pre dan Post Test SMAN 3	0,001	Inhomogeneous
4		Pre dan Post Test SMA PB	0,216	Homogeneous

Table 4 shows that all homogeneity test results have value above 0.05 except the homogeneity test results for the *pre and post test* data of the control class whose significance value is 0.001 or inhomogeneous.

3. Learning Outcomes in Padang State University Laboratory High School

The following table presents the data on the average value of the pre-test and post-test of the experimental class in the Padang State University Laboratory High School.

Table 5. Average Score of Padang State University Laboratory High School Experiment Classes

No	Data	Average Score
1	Pretest	35
2	Posttest	69

Table 5 shows the data that the average score of the post-test of the experimental class is 69, while the average score of the pre test is 35. The difference in the average score is almost doubled. To find out the significance of the data, a paired sample test was carried out as shown in the following table;

Table 6. *Paired Sample Test* Padang State University Laboratory High School

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest_Eksperimen_PB - Posttest_Eksperimen_PB	-3.43548E1	8.24034	1.48001	-37.37742	-31.33226	-23.213	30	.000

The results of the *Paired Sample Test* show that the sig value. 0,000. Thus the value of t count is smaller than the value of α 0.05. That is, there are differences in student learning outcomes between before and after the application of the EXO OLO TASK Learning Model. These results also prove that the learning model that is applied is effective if viewed from student learning outcomes.

Table 7. Recap of Gain Score Padang State University Laboratory High School

No	Class	Gain Score
1	Experimental	0,539
2	Control	0,291

Table 7 shows that the experimental class n-gain score is 0, 539 and the control class n-gain score is 0.291. It means that the average value improvement of the experimental class is higher than the control class. To find out whether the data is significant or not, an independent sample t test is performed. Showing as in the following table:

Table 8. Different Test Results Padang State University Laboratory High School

	SMA PB
Mann-Whitney U	123.000
Wilcoxon W	619.000
Z	-5.040
Asymp. Sig. (2-tailed)	.000

The results of different tests show a significance value of 0,000. This value is smaller than the value of t table at the level of significance 0.05. That is, there are significant differences between the learning outcomes of the experimental class and the control class.

4. Learning Outcomes at SMAN 3 Padang

The following is the average score of the experimental class pre-test and post-test at SMAN 3 Padang.

Table 9. Average score of the experimental class SMAN 3 Padang

No	Data	Average Score
1	Pretest	35
2	Posttest	72

The data in table 9 shows that the average value of the post test is 72 and the average pre test value is 35. The difference in the increase in value is 37. Next, to find out the significance of the data, a paired sample test is performed as shown in the following table:

Table 10. *Paired Sample Test* of SMA 3 Padang

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest_Eksperimen_SMA3 - Posttest_Eksperimen_SMA3	-3.72581E1	10.47527	1.88141	-41.10042	-33.41571	-19.803	30	.000

The results of the Paired Sample Test show that the sig value. 0,000. Thus the value of t count is smaller than the value of α 0.05. That is, there are differences in student learning outcomes between before and after the application of the EXO OLO TASK Learning Model in class X IS 2 of SMAN 3 Kota Padang. These results also prove that the learning model that is applied is effective if viewed from student learning outcomes.

Table 11. Recap Gain Score SMAN 3 Padang

No	Class	Gain Score
1	Experimental	0,575
2	Control	0,358

Table 11 shows the experimental class n-gain score is 0, 575 and the control class n-gain score is 0.358. That is, the average increase in the value of the experimental class is higher than the control class. To find out whether the data is significant or not, an independent sample t test is performed. The results are as shown in the following table:

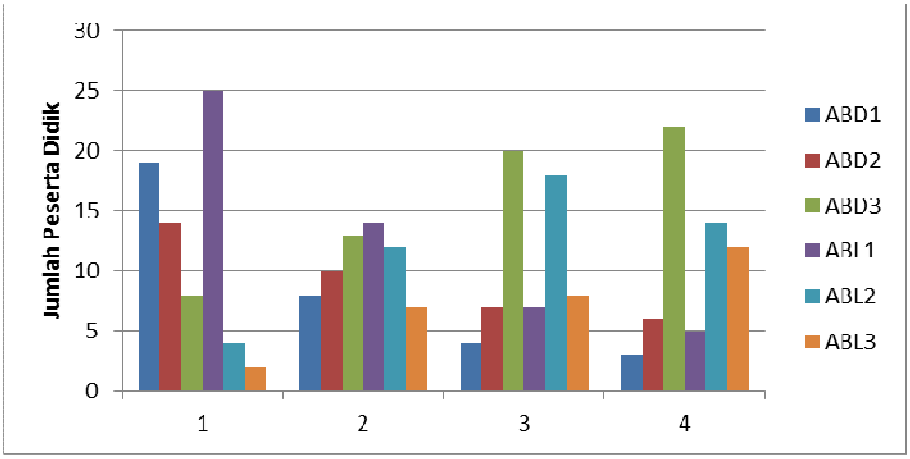
Table 12. Different Test Results SMAN 3

	SMA 3
Mann-Whitney U	144.000
Wilcoxon W	640.000
Z	-4.742
Asymp. Sig. (2-tailed)	.000

The results of different tests show a significance value of 0,000. This value is smaller than the value of t table at the level of significance 0.05. That is, there are significant differences between the learning outcomes of the experimental class and the control class.

5. Development of Learning Activities for Experimental Class Students at SMAN 3 Padang

Data on the development of experimental class student learning activities is needed to get an idea of what learning activities occur and improve in learning.



Picture 1. Development of Learning Activities
for Experimental Class Students at SMAN 3 Padang

In picture 1, the number of students showing basic learning activities (observing, asking, trying, searching, collecting) with a value of 1 decreases in the four learning meetings. In contrary, the number of students who scored two and three increased. That is, the application of the EXO OLO Task learning model is able to encourage an improvement in the quality of students' basic learning activities. The same trend also occurs in aspects of advanced learning activities or HOTS learning activities which include; 1) analyze, 2) communicate, 3) dialogue, 4) collaborate. From these data it can be concluded that the application of the model can improve the quality of learning activities both basic learning activities and advanced learning activities.

Discussion

The results of the study show important data, namely;

1. The n-gain value of the experimental class in both schools is almost double than the n-gain value of control class. This proves that the application of EXO OLO Task Learning Model on material of Atmospheric can improve student learning outcomes in the form of higher-order thinking skills/ HOTS. Higher-order thinking skills of students were tested with the ability of students to answer 20 HOTS questions.
2. The results of different tests show that there are significant differences between the learning outcomes of the control class and the experimental class.
3. Management of learning activities based on the syntax of learning turns out to be quite effective for improving higher-order thinking skills.

EXO OLO Task learning model is a model that is developed based on constructivist learning theory that emphasizes the construction of new knowledge by students as a learning outcome. This learning model has four learning syntaxes namely, 1) strengthening of concepts with keyword methods, 2) EXO Task, which is the presentation of questions on LOTS and MOTS levels (C1-C3) to students and questions done in pairs. The paired work arrangement gives students the opportunity to dialogue and communicate their findings and ideas about a problem, 3) OLO Task, which is the

presentation of HOTS (C4-C6) levels. This level of question is done by students in groups. The goal is to create collaboration between students in groups and between groups (Nofrion, 2018).

The development of higher-order thinking skills has become a necessity in current learning practices. This is in line with the 21st century learning framework proposed by Marzano & Helfebower (2012) known as "learning skills" and "life skills". HOTS learning have also become a national agenda in Indonesia through the application of the 2013 curriculum characterized by 4K and HOTS learning on all subjects in the structure of the primary and secondary education curriculum (Nofrion, 2018).

The essence of learning is learning and teaching activities. Students show learning activities is the easiest way to find out if they are learning or not. Many ways can be done to encourage the emergence of student learning activities. In the EXO OLO Task learning model, the driver of the emergence of student learning activities is the presentation of multilevel and challenging questions according to the cognitive level of the Revised Bloom Taxonomy (2001) version. The choice of questions as a trigger for the emergence of learning activities is based on the theory presented by Heinich *et al* (2002) and Sato (2012) in his School Reformation called the "silent revolution". In addition, challenging and difficult questions are one of the characteristics of effective and collaborative learning (Heinich *et al*, 2002; Sato, 2012) and collaborative work trains for self-work (Johnson, Johnson, Holubec, 1998). Then, the difficult question is how to encourage students to learn as long as they are still in ZPD (Vygotsky, 1978; Sato, 2012). This learning activity is triggered by challenging questions. Silbermen (2006: 9) suggests that one indicator of learning activities running effectively and efficiently is the availability of many tasks that challenge students to use the brain to think hard.

The arrangement of student seating and management of learning activities in the form of individual learning activities, in pairs and groups is a way to optimize the process of developing students' potential. The opportunity to interact with other people and work in an atmosphere of mutual care and respect and personal responsibility is a collaborative learning practice that can develop the potential and strength of students as learners. This model facilitates the occurrence of these activities in the classroom (Joyce & Weil, 2011; Gerlach, J. M., 1994 & Laal, Laal., 2012). Togetherness in learning that is based on specific types of learning will also help achieve better learning outcomes (Perkin, 2006).

Furthermore, learning activities developed in the application of the EXO OLO Task learning model are learning activities that refer to the development of higher-order thinking skills. If viewed from a series of learning experiences in 2013 Curriculum known as the 5M pattern, then the activities focused in this model are the development of that learning experience which is divided into basic learning activities and advanced learning activities.

Basic learning activities are basic and initial activities in learning in the form of observing (seeing, hearing), asking questions, trying, searching and gathering (in a simple context). While advanced learning activities include learning experiences in the form of activities processing, analyzing, dialogue, communicating and collaborating. Communication is a basic element of 21st century learning and will help to form creativity, self-expression, teamwork, and work world skills (Hobbs & Frost, 2015). Collaboration in this context is defined as an activity of mutual care, mutual respect and mutual reinforcement and sharing. By collaborating, students get the best solution to a problem that is the result of discussion with various perspectives (Leahey & Reikowsky, 2008). Collaborative learning also synergizes with 21st century learning skills, improves communication skills, and supports critical thinking skills and creativity in learning (Uzi & Spiro, 2005).

Conclusions

1. The application of EXO OLO Task Learning Model on material of Atmospheric Dynamics proved to be able to improve students' higher-order thinking skills which were marked by the learning outcomes of experimental class students higher than the control class students.
2. The use of EXO OLO Task Learning Model is also able to improve the quality and quantity of student learning activities in learning.
3. Learning activities shown by students during learning are also relevant to the level of achievement of better learning outcomes. The higher the learning activities of students, the learning outcomes also increase.

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