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The effect of higher order thinking skills (hots) learning and learning motivation on student learning outcomes

Bambang Siswanto[1,*], Achmad Noor Fatirul[1], and Djoko Adi Waluyo[1]

[1]PGRI Adi Buana Surabaya University - Indonesia
[*]Corresponding author: bambangsiswantobasis@gmail.com

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ABSTRACT This study aims to describe or determine the difference between HOTS learning and expository learning in improving student learning outcomes, to determine the difference between high and low motivation on learning outcomes, and to describe the interaction between learning methods and learning motivation on student achievement. Higher-order thinking skills (HOTS) are essential things and are now a critical issue in education. Learning development oriented to HOTS is a program developed by the Ministry of Education and Culture through the Directorate General of Teachers and Education Personnel (DITJEN GTK) to improve the quality of learning and graduates. Motivation is also critical in managing students' interactions in learning. The results showed that HOTS learning effectively improved students' achievement in mathematics. It is known from the significance score of learning at the SPSS output of the 2-way ANOVA test. The score is $0.000 \leq 0.05$, which indicates a different achievement of the two types of learning. Meanwhile, the effectiveness of the two learnings can be derived from descriptive statistics, which indicates that students with HOTS learning have higher achievement than students with expository learning. High learning motivation also affects student achievement. The SPSS output resulted in a significance score of $0.018 \leq 0.05$. It indicates that there is a difference in achievement between students who have high learning motivation and students who have low learning motivation. The descriptive statistics also confirm that students with high learning motivation achieve better than those with low learning motivation. In addition, the interaction between learning and learning motivation to improve student achievement was absent, as it was indicated by the SPSS output in the motivation and learning line; the significance score was 0.466, which is greater than 0.05

1. INTRODUCTION

People are now living in a new era, the era of digital industrialization, where industrial activities are integrated through the massive use of wireless technology and big data. Currently, various kinds of human needs have implemented the support of the internet and the digital world as a vehicle for interaction and transactions. Likewise, in the current pandemic era, humans do not need to gather to carry out an activity. Information technology does not only help in all sectors but also challenges as well as threats. The report on the results of a McKinsey's study on Das et al. (2019) the field of jobs in Indonesia shows that more new jobs will be created in 2030 and some other jobs lost due to automation; about 27-46 million new jobs will be created and 10 million of them are types of jobs that have never existed before. Skills in technology, social-emotional and higher-order thinking, such as creativity and problem solving are skills that are needed in this era of automation. Opportunities and threats in this era need to be properly addressed by the world of education.

Technological developments are increasing rapidly and competition among countries in various fields is also getting tougher. However, the problems that arise are also increasingly numerous and complex. This requires the younger generation to be creative, productive and competitive.

This condition also requires thinking skills that are not only applying what is already understood, but also requires ability to: analyze, evaluate and synthesize a problem to get the best solution to the problem. In the world of education, analyzing, evaluating and applying these are included in higher order thinking skills.

The results of the 2018 Program for International Student Assessment (PISA) survey, which was published in March 2019, took a snapshot of Indonesia's education problems. In the categories of reading, science, and math skills, Indonesia got low score, it ranked 74th out of 79 countries.

PISA is a survey to evaluate the world's education systems by measuring the performance of secondary school students. This assessment is carried out once every three years and is divided into three main points, namely literacy,

mathematics, and science. The results in 2018 measured the abilities of 600,000 children aged 15 from 79 countries.

Some time ago, the Organization for Economic Co-operation and Development (OECD) announced the results of the 2018 Program for International Student Assessment (PISA). As in previous years, Indonesia's ranking was unsatisfactory.

According to data published by the OECD from the 2009-2015 survey period, Indonesia consistently ranks in the bottom 10. Of the three competency categories, Indonesia's score is always below average. The main reason why Indonesia always gets a low rating is the education curriculum that is implemented.

Again, the 2018 survey placed Indonesian students in the ranks of the lowest scores on measurements of reading, mathematics and science. In the literacy category, Indonesia got the 6th rank from the bottom (74) with an average score of 371, down from the 64th in 2015. Then in the mathematics category, Indonesia got the 7th rank from the bottom (73) with a score average 379, down from rank 63 in 2015. While in the science performance category, Indonesia got the 9th rank from the bottom (71), with an average score of 396, down from rank 62 in 2015. This survey placed China and Singapore in the top two countries. China has a score of 555, while Singapore has 549 for reading comprehension scores at various levels of difficulty. These two countries achieved scores of 591 and 569 respectively for their students' math ability, and 590 and 551 for science scores. The world's mean scores for literacy were 487, math 489 and science 498.

When it is compared, the ability of Indonesian students in literacy, math, and science are still below the world average. As reported by Antara, Indonesia has participated in this assessment for 18 years, since 2000. However, during that time the student's ability scores have never been above average.

In 2000, when PISA was still participated by 41 countries, Indonesia got the 39th rank for reading and mathematics ability, while science ability was 38th. In 2003, Indonesia's students' reading ability had risen to the 29th, while mathematics and science remained ranked 38th. The last three survey periods, namely in 2009 when PISA was followed by 65 countries, students' reading competence in Indonesia got rank of the 57th, 61st in mathematics, and 60th in science. Then in 2012, the ranking fell again to number 61 in the field of literacy, as well as a rating of 65 for math and science.

In 2015, the number of countries participating in PISA rose to 72, but Indonesia's literacy skills is still in the 66th rank, math in the 65th, and science in the 64th. This means that for eighteen years, students' ability in reading comprehension, counting, or thinking scientifically has not changed much.

In 2018, the National Examination' questions in Indonesia began to use Higher Order Thinking Skills (HOTS). The Minister of Education and Culture at the time, Muhadjir Effendy was worried that Indonesia's PISA score would decline if it did not adapt. According to the Minister of Education and Culture at that time (Muhajir Efendi), the level of difficulty for questions of examinations in Indonesia, is still below the PISA standard—which was already HOTS based. This is because the OECD founding countries (organizations that hold PISA) have implemented Bloom's taxonomy system in their education systems. Meanwhile, the curriculum in Indonesia does not apply this system at all, except for the national exam. When the HOTS system National Examination was implemented (2018-2019), students in Indonesia complained that they could not answer the questions. They think the material is too difficult and has never been taught in school.

Higher order thinking skills (HOTS) are important and are currently becomes a concern in the field of education. In fact, higher-order thinking skills have become curriculum objectives internationally (Yen & Halili, 2015). The Partnership for the 21st Century Skills (P21) also states that HOTS such as critical and creative thinking can help students succeed in their future careers (Alismail & McGuire, 2015).

The role of professional teachers in learning is very important as the key to student learning success and producing quality graduates. Professional teachers are teachers who are competent in building and developing good and effective learning processes so that they can produce smart students and quality education. This makes the quality of learning becomes the focus of the attention of the central government and local governments in improving the quality of education, especially regarding the quality of graduate students.

Development of learning oriented towards higher order thinking skills is a program developed as an effort by the Ministry of Education and Culture through the Directorate General of Teachers and Education Personnel (Ditjen GTK to improve the quality of learning and the quality of graduates. This program was developed following the policy direction of the Ministry of Education and Culture which in 2018 has integrated Strengthening Character Education and learning oriented towards Higher Order Thinking Skills (HOTS).

The importance of HOTS for students leads the HOTS to be taught and trained in every lesson at school, including in learning mathematics. Act Number 20 of 2003 concerning the National Education System Article 3 mentions "National education functions to develop and shape the character and civilization of the nation, aims to develop the potential of students to become human beings who believe and fear God Almighty, have noble character , healthy, knowledgeable, capable, creative, independent, and being a democratic and responsible citizen" (Undang-Undang Republik Indonesia No. 20, 2003), it implicitly encourages HOTS to be developed and one of them is through the learning process (Riadi & Retnawati, 2021).

Improving the quality of students, one of which is carried out by teachers who focus on improving the quality of learning in the classroom with an orientation towards higher order thinking skills. The design of improving the quality of learning is an effort to increase the quality of students which ultimately improves the quality of education in Indonesia.

The government through the Merdeka Belajar program launch several programs including the National Assessment (NA). NA covers activities including: minimum competency assessment, character survey, and learning environment survey. In this NA activity, the questions presented are in the HOTS question category. Therefore, teachers need to provide teaching and learning by applying HOTS learning in classroom. However, based on the observations on the lesson plan made by the teachers at SMA Negeri 1 Sukodadi Lamongan East Java, only 20 percent of teachers included

HOTS learning in their lesson plans. The author also observed the students who felt difficult in answering numerical questions of National Assessment. Dinni (2019) said that through high order thinking skills, students will be able to distinguish ideas clearly, argue well, solve problems, construct explanations, hypothesize and understand complex things to become clearer, in which these abilities indicated the way students think. As with literacy, mathematical literacy skills and high order thinking skills are not only limited to the ability to count, but also how to apply mathematics in everyday life to solve a problem, how to communicate it, thus it can be seen how students' thinking processes mathematize .

When it is viewed from the cognitive level of the Revised Bloom's Taxonomy, the top three levels of the cognitive domain such as analyzing (C4), evaluating (C5), and creating (C6) belong to the HOTS category. The three lowest levels, namely remembering (C1), understanding (C2), and applying (C3) belong to the lower order thinking skills (LOTS) category. However, it does not mean that LOTS is not important. LOTS must be passed first to be able to go to the next level (Sumarmo, 2013). In other words, in order to achieve at a higher goal, the lower level must be met first. This level only shows that the higher it is, the more difficult the thinking skills are (Sumarmo, 2013). However, from the assessment of learning outcomes that were mostly made in schools, it turned out that the percentage of the most frequently asked questions only asked students to recite their memorization, students had not been directed to higher-order thinking skills (Musfiqi & Jaelani, 2014). HOTS must be achieved so that the learning process can produce students who are competent in their fields (Sumarmo, 2013). Therefore, students need to be familiar with learning activities that can train students' HOTS (Arifin & Retnawati, 2017).

Motivational variables are also very important part of managing student interaction with learning. Its purpose is to increase student learning motivation. Most subjects are actually interesting to learn, but the learning process fails to use it as a motivational tool. As a result, the subject loses its appeal, and what remains are meaningless collection of facts, concepts and procedures or principles (Degeng, 2018). Therefore, the teacher must be able to make the subjects taught interesting which in turn will be able to increase students' learning motivation.

Some previous researches that strengthen this idea is stated by Nurwahida (2018). It concluded that in general, the Higher Order Thinking Skills (HOTS) approach has an effect on social science learning outcomes in fourth grade students of SD Inpres Bontomanai, Tamalate District, Makassar City. Ma'ruf et al. (2019) said that there was a significant influence between student learning motivation in learning mathematics and the mind mapping model the help of HOTS questions on students' mathematics learning outcomes, resulting in differences in student motivation in the class that was given treatment with the mind mapping learning model assisted by HOTS questions and in the class that was given treatment with the Mind Mapping learning model without the help of HOTS questions. This is because in the special motivation class, students are introduced to HOTS-based questions, so that from the beginning they have been trained in critical thinking, analysis, logic and reasoning. This is of course different from the mind mapping model which is only applied without the help of HOTS questions. It also influences indirectly the existence of significant differences in the results of learning mathematics in the special motivation class and the main motivation.

2. METHOD

2.1 Type of Research

This research is a quasi-experimental research, using quantitative data analysis. According to Riyanto (1996), experimental research is systematic, logical, and thorough in controlling conditions. Meanwhile, Sugiyono (2017) states that experimental research is a research method used to find the effect of certain treatments on others under controlled conditions. From this opinion, it can be concluded that experimental research is research by conducting experiments on experimental groups, each experimental group is subjected to certain treatments with conditions that can be controlled.

Quantitative research methods can be interpreted as a research method based on the philosophy of positivism, used to examine certain populations or samples, sampling techniques are generally carried out randomly, data collection uses research instruments, data analysis is quantitative or statistics with the aim of testing the hypotheses that have been set, while quantitative data is data in the form of numbers, or qualitative data that is estimated Sugiyono (2017). So that in quantitative research, as the name of quantitative implies, that numbers are used in research such as data collection, data interpretation and the results Arikunto (2021).

The design in this research divided the research group into two groups, namely the first group was the experimental group which studied with the HOTS learning method and the second group was the control group which studied conventional learning methods. The design is stated as in Table 1.

TABLE 1. Research Group

Learning Motivation	HOTS(X_1)	Exposiutory (X_2)
High Motivation (Y_1)	(X_1 Y_1)	(X_2 Y_1)
Low Motivation (Y_2)	(X_1 Y_2)	(X_2 Y_2)

2.2 Procedure

The procedure in this research is as follows. First, giving treatment to the class that is used as the subject of research, namely HOTS learning on the topic of Sequences and Number Series. Second, using the expository learning method in the control class. Third, giving a final test of ability (posttest) about the sequence and series of numbers in the control class and the experimental class with the same questions. Fourth, give a questionnaire about learning motivation to each experimental class and control class. Fifth, assessing the test results obtained from the experimental group, namely; an experimental group or class taught using HOTS learning and a control group or class taught using conventional methods, for further data that has been obtained is analyzed and prepared to make a research report. Sixth, processing the results of motivational questionnaires from both control and experimental classes to find out how far learning can increase learning motivation.

2.3 Subject

The population in the study were all students of SMA N 1 Sukodadi Lamongan. While the target population in this study were students of class XI IPA SMA N 1 Sukodadi Lamongan. The sampling technique in this study used the random sampling technique in a random way, namely Class XI IPA 1 and Class XI IPA 3, each of which consisted of 30 people. After selecting 2 sample classes, then the 2 classes were randomized again so that they get a class to be taught with conventional and HOTS learning, here the one chosen to be given HOTS learning is class XI IPA 1 and the other one, namely class XI IPA 3, will be given expository learning.

2.4 Collecting Data and Analysis

The collecting data, the researcher used a test technique. The test in this study is a test in the chapter on sequences and number series, and a questionnaire for learning motivation that is used to determine student motivation.

There are five methods used to analyse the data. First, test the validity of the post-test and learning motivation instruments (test of the validity and reliability of the instrument). The validity test in this study was carried out with the help of the SPSS for Windows Version 26 program. Second, the reliability test of an instrument is reliable if it is trusted to be used as a data collection instrument and because the instrument is good, not tendentious directing respondents to choose certain answers (Arikunto, 2021). Reliability is a test used to find out that the instrument will give the same results if it is used to measure other groups. To find the reliability coefficient of the items used the SPSS application version 26. Third, descriptive analysis is useful for presenting and describing the data of research including the amount of data, minimum value, maximum value, average, standard deviation and others. The researcher uses SPSS application to calculate or proceed the descriptive analysis of this study. Fourth, the normality test is used to determine whether research data is normally distributed because normal data is used as an absolute prerequisite before conducting a two-way ANOVA. If the significance value is ≥ 0.05, then the data is normally distributed. Otherwise, if it is less than 0.05, then the data is not normally distributed. Fifth, the factorial Anava test or often called double Anava, is a parametric statistical technique used to test differences between groups of data originating from of two or more independent variables.

3. RESULT & DISCUSSION

3.1 Validity and Distribution Test

From the results of the analysis of the instrument's validity, it was found that 20 questions were valid and 5 questions were invalid. Thus, 20 valid social problems will be tested for reliability. Test to determine the consistency of the instrument.

Posttest questions were also tested for validity and reliability before collecting data. The posttest questions were tested in class XI IPA 2, which was not included in the experimental or control classes. The post-test questions are in the form of multiple choice 20 questions with five options. The correct answer is given a score of 1, and the wrong answer is given a score of 0.

The output of SPSS 26 from 30 respondents has been inputted in SPSS. The value of Cronbach's Alpha is 0.931. After testing the instrument, it was followed by collecting data using a questionnaire to find out the motivation of students in the experimental group and the control group. The experimental group was represented by class XI IPA 1 with a total of 30 students, while the control group was represented by class XI IPA 3 with a total of 30 students.

After the initial data collection was carried out, it was then followed by giving treatment to both groups. The experimental class was given treatment with High Order Thinking Skills (HOTS) learning and the control class was given an expository learning model.

Both groups were given the same material by the same teacher. After being given the treatment, the posttest was given to both groups. This aims to determine the final ability of students after being given treatment.

Then the data was inputted to the SPSS 26 application. In this case the researcher analyzed it using 2-way ANOVA. Previously, as a prerequisite for 2-way ANOVA testing, the data had to be normally distributed. For this reason, it is necessary to test the normality of the data first.

In the learning achievement data of 30 students with HOTS learning in the Kolmogorov Smirnov normality test, a significance value of 0.351 was obtained. Meanwhile, the learning achievement of students who were given expository learning in the Kolmogorov Smirnov normality test obtained a significance value of 0.286. Whereas in the data on learning motivation in the Kolmogorov Smirnov normality test, a significance value for the high motivation group obtained a significant figure of 0.525. For the group classified as low motivation, a significant score of 0.062 was obtained.

From the output of SPSS, there were 30 data on student achievement who were given HOTS learning, 30 students were given expository learning, a total of 60 students. Then of the 60 students who were given HOTS and Expository learning were categorized by a questionnaire which included 30 students who had high motivation, and 30 students who had low learning motivation. With a significance level of 5% or 0.05 in SPSS 26 output learning, a significance value is obtained. On the motivation was obtained a significant figure of 0.18 and on the motivation and learning were obtained a significant number of 0.466.

3.2 Hypothesis testing

3.2.1 The First Hypothesis

H0 : There is no difference in the learning achievement of students who are given HOTS learning and students who are given Expository learning.

H1 : There are differences in the learning achievement of students who are given HOTS learning and students who are given expository learning

The statistical test used was a two - way ANOVA test with a significance level of 5 %. To find out whether there is a difference in learning achievement or not between students who are given HOTS and Expository learning, the researchers applied the criteria: If the significance value of the test results is less than 0.05, there is a difference in learning achievement between students who are given HOTS and Expository learning. Meanwhile, if the significance number of the test results is more than 0.05, then there is no difference in learning achievement between students who are given HOTS and Expository learning. Then the conclusion that can be drawn is that H0 is rejected, it means that there are differences in student achievement

TABLE 2. Descriptive statistic of Learning

Value	HOTS Learning	Expository Learning	High Motivation	Low Motivation
Mean	81,67	68.83	78,83	71,67
Median	82,50	70,00	80,00	75
Minimum	60	45	55	45
Maximum	100	90	100	90

given HOTS learning and Expository learning. In descriptive statistics, the learning achievement of students who were given HOTS learning and expository learning is presented in Table 2.

3.2.2 The Second Hypothesis

H0: There is no difference in the learning achievement of students who have high motivation and students who have low motivation.

H1: There is a difference in the learning achievement of students who have high motivation and students who have low motivation.

The statistical test used was a two - way ANOVA test with a significance level of 5 %. To find out whether there are differences in learning achievement or not between students who have high motivation and students who have low abilities, the researchers applied the criteria: If the significance number of the test results is less than 0.05, then there is a difference in learning achievement between students who have high motivation and students who have low motivation. Meanwhile, if the significance value of the test results is more than 0.05, then there is no difference in learning achievement between students who have high motivation and students who have low motivation. The test results obtained on the motivation line obtained a significance value of 0.018, less than 0.05. Then the conclusion is that H0 is rejected, it means that there are differences in the learning achievement of students who have high motivation and students who have low motivation. On the descriptive statistics of student learning motivation, the data is presented in Table 2.

In table 2, it can be seen that the mean score of students with high motivation is 78.83 higher than students with low learning motivation, namely 71.67. The median score of students with high learning motivation is 80.00 which is also higher than the median of students with low learning motivation, which is 75. The minimum score for students with high learning motivation is 55, which is higher than students with low learning motivation, namely 45. While the maximum score for students with high learning motivation is 100, and this is also higher for students with low motivation, namely 90. So, students who have high learning motivation have higher learning achievement.

3.2.3 The Third Hypothesis

H0: There is no interaction between learning methods and motivation on student achievement.

H1: There is an interaction between learning methods and learning motivation on student achievement.

The statistical test used was a two - way ANOVA test with a significance level of 5 %. To find out whether there is an interaction between the learning model and learning motivation on student achievement, the researchers applied the criteria: If the significance value of the test results is less than 0.05 then t there is an interaction between the learning model and learning motivation on student achievement. Meanwhile, if the significance value of the test results is more than 0.05, there is no interaction between the learning model and learning motivation on student achievement. The test results obtained on the motivation Learning line obtained a significance value of 0.466, more than 0.05. Then the conclusion is that H0 is accepted, it means that there is no interaction between the learning model and learning motivation on student achievement

From the results of the above data exposure, the results are known as follows. HOTS learning is more effective for improving student achievement compared to expository learning because HOTS learning teaches students to be able to solve problems, think critically, and think creatively. This learning will also encourage students to be active during the learning process and can create a fun learning atmosphere because the learning process is focused on students. Using HOTS learning in mathematics is expected to stimulate students' thinking skills, so that students are more active in the learning process. In short, HOTS learning is effective for increasing student achievement in accordance with the framework of thinking described in the theoretical framework.

The improvement of learning achievement using HOTS is evident from the significant difference from learning using the expository method. HOTS learning can generate students' self-confidence so that this can improve students' higher-level thinking skills, so that the students are more motivated to learn and can be more active in the learning process because high curiosity arises. This is different from using expository learning, students are more passive and students are less motivated in the learning process. Likewise, in the evaluation process, it was very difficult for students to understand HOTS questions. Therefore, the improvement of student achievement using HOTS learning is proven to be higher than that using expository learning. This is in accordance with previous research conducted by Kurniawan (2021) that learning with a discovery learning model that is oriented towards HOTS (higher order thinking skill) based learning can improve student learning outcomes in the Constructed Space Construct material.

Another study was conducted by Nurwahida (2018), it found that the application of the HOTS approach affected student learning outcomes in Social Sciences subjects. Another similar study was conducted by Handayani (2013) in a study entitled the effect of HOTS-oriented problem solving learning on Chemistry learning outcomes in class X. It concluded that HOTS oriented problem solving learning had a positive effect on chemistry learning outcomes, especially subject matter of electrolyte solutions and the concept of

redox. The use of problem solving learning oriented on HOTS contributed to improving learning achievement on chemistry subject with the topic of electrolyte solutions and the concept of redox.

High motivation possessed by students also affects the learning achievement obtained by students. Motivational variables are also a very important part of managing student interactions with learning. Its purpose is to increase student learning motivation. Most of subjects are actually able to attract students to learn, but its learning activities fail to use it as a motivational tool. As a result, the subjects lose their appeal, and what remains is a meaningless collection of facts, concepts and procedures or principles (Degeng 2018). Another similar study was conducted by Setyowati (2007). Based on the results of the study showing that there was a significant effect of learning motivation on the learning outcomes of class VII students of SMPN 13 Semarang which was shown from the simultaneous test with test (F) which obtained a probability of 0.000 $\leq$ 0 ,05. Students who have motivation will be encouraged to learn to achieve goals and objectives because they believe and are aware of the goodness of the interests and benefits of learning. For students, motivation is very important because it can move student behavior in a positive direction so that they are able to face all demands, difficulties and are able to bear risks in their studies. Another similar study was conducted by Nur'afiah (2017) the results of the study were that there was a direct and or indirect effect of the family environment, community environment, school environment and motivation on student learning outcomes.

4. CONCLUSION

From the description above, it can be concluded that student motivation can affect student achievement. As with the ANOVA test that was carried out, the motivation column shows a significance number of 0.018 less than 0.05, which means that there is an average difference between students who have high learning motivation and students who have low learning motivation in learning achievement.

Motivation and learning from the results of research indicated that there is no interaction. The value of significant from motivation and learning, the number 0.466 is greater than 0.05. So, it can be concluded that there is no interaction between learning and motivation on student achievement. As with other research conducted by Janah Fahiratul (2019) Learning and motivation only affect student achievement 6% and 96% are influenced by other factors.

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