



Comparative Study of Effectiveness Between Inquiry Lab and Guided Inquiry Learning Models To Improve Students' Higher Order Thinking Skills

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ABSTRACT

The research aims to describe the improvement of students' Higher Order Thinking Skills (HOTs) and compare the differences in effectiveness between the two levels of the inquiry learning model. Two types of learning model levels were applied in this research, namely the Inquiry Lab and Guided Inquiry learning models. This research took place on Fluid Mechanics material on 11th grade of Islamic Senior High School Samarinda. The samples were 108 students out of all students at school as the population. The data obtained were then analyzed using N-gain and inferential statistics. The results showed that the students' HOTS increased significantly with a significance level of 5% after the Inquiry Lab and Guided Inquiry learning model was applied. Based on the calculation of N-gain, there was an increase for the class of 11th Science 2 with very high category (98%), class of 11th Science 1 with high category (83.62%), and a class of 11th Science 3 with low category (34%). Hence, the 11th Science 3 class was statistically significantly different (consistent). The implications of this research for universities include that the curricula for university courses should focus more on mini-research activities, especially those related to open inquiry. Furthermore, there was a significant difference in the effectiveness between the two levels of inquiry and conventional strategies in improving higher-order thinking skills. There are significant differences between the two levels of inquiry, namely Laboratory Inquiry learning and Guided Inquiry itself. The most significant in improving students' HOTs is Laboratory Inquiry.

INTRODUCTION

Numerous changes and the creation of multiple issues arise in life due to the fast advancement of knowledge and technology. Humans must adapt and overcome obstacles to survive. One of them is inseparable from the role of quality education in realizing quality human resources. Low-quality education will produce competent graduates who reason analytically, methodically, critically, and creatively to prepare a generation to meet the problems of the modern day. It means that the atmosphere of learning must be designed so that critical thinking skills can be developed in any learning process (Nuraida, 2019).

This issue is consistent with the low level of students' Higher Orders Thinking Skills (HOTs) (Swestyani et al., 2018). A previous study stated that HOTs is a generator of delivering innovation in all fields. It is a filter for all types of new information. As a result, pupils with HOTs abilities will adapt to 21st century competitiveness (Ichsan et al., 2020). Especially in the realm of education, where higher-order thinking skills play a critical role in assisting students in constructing knowledge and information that will

result in increased student performance. Numerous studies have established a significant correlation between students' higher-order thinking skills and academic success (Tanujaya et al., 2017).

HOTs are described as a student's ability to analyze ideas and options to make a decision (Apino & Retnawati, 2017). It may be described as a non-algorithmic, complicated method of thinking that yields many answers. The ability to think critically, reflectively, metacognitively, and creatively is included in HOTs (Cao, 2018). Further, according to Ichsan et al. (2020), HOTs was the capacity to solve an issue and come up with a solution. Moreover, critical thinking skills are an effective way to improve students' understanding of mathematical concepts because this ability is supported by interpreting, analyzing, evaluating, and presenting data logistically and sequentially (Chukwuyenum, 2013).

Aspects of HOTs include problem analysis skills, evaluation problems, and creating (Prayitno & Suciati, 2018). Breaking down the material into pieces and determining how the parts are connected is part of the analysis process. Organizing, displaying, and differentiating components or sections are examples of indicators for assessing aspects (Prayitno & Suciati, 2018). Making judgments, expressing views, or judging based on particular criteria is all part of the assessing process. Meanwhile, analyzing, concluding, contrasting, critiquing, interpreting, and determining anything falls under the evaluation indicator area (Prayitno & Suciati, 2018). The creating aspect is the ability to rearrange elements in a new structure or produce a new product. Indicators of items create planning skills, design, and formulate hypotheses (Fensham & Bellocchi, 2013).

According to several studies, Indonesian students' HOTs are bad (Khasanah et al., 2017). In 2018, Indonesian students ranked 74th out of 78 countries from the PISA (International Student Assessment Program) survey (Kumparan Sains, 2019). In comparison to the findings from the previous year's PISA study, it received a rating that was insignificant. Furthermore, based on the data of PISA in 2009 that the Indonesian students were on 57th rank out of 65 countries, while in 2012 was on 64th out of 65 countries, then in 2015 was on 64th out of 72 countries, and in 2018 was on 74th out of 78 countries (Organisation for Economic Cooperation Development, 2019).

These findings suggest that Indonesia's educational system still needs to be improved. The output quality can be used to gauge the quality of national education. The graduates' rate is acknowledged at the national, regional, and worldwide levels. National education, with high-quality graduates, is essential in this environment. Education programs are not viewed as human resources investments to increase competitiveness if they do not produce excellent graduates. Higher thinking skills are critical in the quality skills of Indonesian students. One of the Indonesian scientific education objectives is to improve student quality via increased development. The 2013 curriculum is designed to prepare the nation's future generation to meet the twenty-first century challenges. Meanwhile, curricular needs and the globalization era's development necessitate educational institutions to produce beneficial innovations for 21st-century skills-based education. Therefore HOTS is required in the twenty-first century, and the students must be taught from a young age (Griffin & Care, 2014; Turiman et al., 2012).

HOTs are learned at a young age and become life skills. Furthermore, the abilities might help children obtain better academic results in school. As a result, higher thinking entails various mental processes applied to complicated circumstances and

some factors (King et al., 2015). Making links between data and explanation is critical in science teaching. That is why the Indonesian government continues to be concerned about the issue. Based on these problems to look for alternatives in reducing the gap in HOTs level. Teachers have an essential role in providing learning that can improve HOTs by identifying suitable learning models to improve students' HOTs. It aligns with the difficulties of the twenty-first century, in which instructors must deliver learning that is relevant, engaging, successful, and student-centered. Therefore, it is critical to shift away from the "closed classroom" learning model and toward a student-centered one. In this instance, the teacher establishes learning objectives and then devises a series of activities to assist students in achieving those goals. Meanwhile, the teacher poses the fundamental question and acts as a facilitator. At the same time, students decide on the type of response they will generate and formulate and carry out a process to develop that response (Massouleh & Jooneghani, 2012).

Students will engage in situations that require them to interpret or create meaning from their research, activity, imagination, discovery, interaction, hypothesizing, and personal reflection in an active learning environment. Teachers must have the ability to manage classroom dynamics and promote autonomous learning. Additionally, they must facilitate the discovery and development of new information and skills. Learners in the 21st century must primarily be highly proficient learners. They must respond to a lack of knowledge or skills by understanding where to go to fill the gap, whether by networking or exploring the vast database that is the Internet or library (Blaschke & Hase, 2016).

HOTs can be trained in learning (Jailani & Sugiman, 2018). Students become accustomed to assessing, evaluating, and generating arguments by relying on theoretical truths that can be accounted for and checking whether theoretical ideas are supported through the practice of inductive and deductive thinking (Prabasari et al., 2018). Inquiry learning is a learning paradigm that encourages students to use their fundamental skills, including inductive and deductive thinking, to solve problems. As a result, the steps of Inquiry Learning were developed following the processes of the scientific method (Öztürk, 2016), and the Inquiry model learning approach has the power to raise students' HOTs.

Guided inquiry learning is a method of instruction that combines all students' abilities to search for and study a problem critically, rationally, and analytically. This learning paradigm is capable of confidently locating a response to a question under the leadership of the teacher, demonstrating that guided inquiry learning is identified. It has the potential to improve HOTs (Kuhlthau et al., 2015). Guided inquiry learning can be well received by students and can be further applied to physics learning (Ferina, 2020). The stages of the recommended inquiry learning model can accommodate activities that lead to improving students' critical thinking skills (Novita, 2021). In addition, another inquiry learning model has been identified as improving HOTs, namely Inquiry Lab learning.

According to Ural (2016), laboratory inquiry learning develops positive attitudes towards learning environments. The characteristics of the laboratory inquiry learning model are (a) students are given an ill-structured problem at the beginning of the activity, (b) students do not know the answers to the problems given, (c) follow the procedures they think are best, (d) observation and data recording carried out based on the best way according to the students' thoughts, (e) interpretation, explanation, and

generalization were carried out based on the way students did themselves, (f) students discussed their work with others, (g) provided some cue procedures (Sanjaya, 2012). Furthermore, the guided inquiry laboratory experiments have led to an increase in the students' academic performance (Ural, 2016).

The inquiry learning model based on the laboratory is a set of activities aimed at immersing students in the scientific process and providing them hands-on experience with the scientific method through laboratory experiments (Ernita et al., 2021) and designed to draw students directly into the scientific process through the use of an experimental mechanism to carry out a scientific procedure (Wahyudi et al., 2018). According to Llewellyn (2013), teachers might give several degrees or types of inquiry learning methods. Each student group must be given the chance to pick the degree of the learning model they want. Although there is more than one level of the learning model, and each one can help develop various HOTs, teachers typically employ only one level of the learning model throughout the learning process, given that time is limited. It does not give precise information about the most effective degree of research. Teachers require information on the degree of inquiry, especially on the level of inquiry most suited for students. Ultimately, the appropriateness of the survey level can impact the efficacy of learning. Researchers in this project will discover and assess HOTs with two levels of inquiry learning models and explain HOTs outcomes using two levels of inquiry models. Based on the background above, the objective of this research was to describe how students' HOTs improved and examine the variations in efficacy between the two levels of the inquiry learning model, namely the Inquiry Lab and Guided Inquiry learning models.

RESEARCH METHOD

General Background

This research began with a preliminary study in a literature study and a field study. The field research aimed to determine the situation and conditions at Islamic Senior High School 2 Samarinda before conducting research. The literature study examined the material to be taught and researched relevant to the states and situations at Islamic Senior High School 2 Samarinda. This research design was a quasi-experimental: pre-test post-test non-equivalent control group design. The three demand classes were the two experimental groups, while one conventional class was the control group. In this research, the data collection used was in the form of multiple-choice tests/questions based on the level of the HOTs item level on fluid mechanics material, which consisted of 20 multiple choice questions with question levels from C4, C5, and C6 and observation sheets to collect data on HOTs.

This study emphasized the analysis of the effectiveness of the Inquiry Lab Model, Guided Inquiry, and Conventional Model by analyzing the increase in students' HOTS before and after participating in the physics learning process with three learning models. The conventional model in this research is a lecturer-centered learning model, including lectures, presentations, and discussions. Teaching instruments and research instruments are valid if $r_a > r$ table and invalid if $r_a < r$ table. The physics learning process with the Inquiry Lab Model, Guided Inquiry Model, and Conventional Model is said to be effective if: (1) there is a significant increase in students' higher order thinking skills at = 5%, (2) of N-gain.

Participants

The research was conducted in learning physics subjects for seven weeks from September to November 2017 for students of 11th Science class at one of the Islamic Senior High School Samarida, 108 students. Calculation of the number of samples is based on the Slovin formula, namely $sample = [population / (1 + e^2 \times population)]$ with an error tolerance of $e = 5\%$ (Tejada & Punzalan, 2012). There are two types of learning model levels applied in this research, namely the Inquiry Lab learning model and Guided Inquiry. We conducted a study in Samarinda on Fluid Mechanics in the 11th grade of Islamic Senior High School 2 Samarinda. The research subjects consisted of three classes, namely 11th Science 1 class with 37 students using the Guided Inquiry learning model, 11th Science 2 class with 36 students using the Inquiry: the model, and for class of 11th Science 3 class with 35 students using the conventional learning model. The samples were 108 students out of all students in the Islamic senior high school as a population.

Instrument and Procedures

Research design was a quasi-experimental: pre-test post-test non-equivalent control group design. The students' HOTs in this measured using a multiple-choice worksheet. Aspects of measuring HOTs, including skills to analyze and evaluate, indicators of analytical skills students include organizing, showing, and distinguishing parts. Evaluation indicators consist of the skills to assess, conclude, determine, criticize, interpret and decide. Indicators of creating skills include planning, designing, formulating, and proposing hypotheses (Vijayaratnam, 2012). Table 1 shows the research design in this research. While Figure 1 shows the flowchart of the study.

To ensure the HOTs test's logical validity, the researcher created a test replica before developing the item test, taking into account the indicator subject matter's accuracy and the HOTs aspect's accuracy. The HOTs examination sheet contains a rubric assessment to guarantee the marking is objective. Three experts evaluated the HOTs sheet's validity by evaluating the subject matter's accuracy and the HOTs dimensions' accuracy. The expert examination determined that the HOTs test sheet was valid. The reliability of the test was measured using the Cronbach alpha formula and showed a high category with a reliability index of 0.70. The research treatment used four strategies: Lab Inquiry, Guided Inquiry, and Conventional. It is supported by research conducted by (Prayitno et al., 2017). Furthermore, the request was adopted from the study (MargusPedaste, 2015).

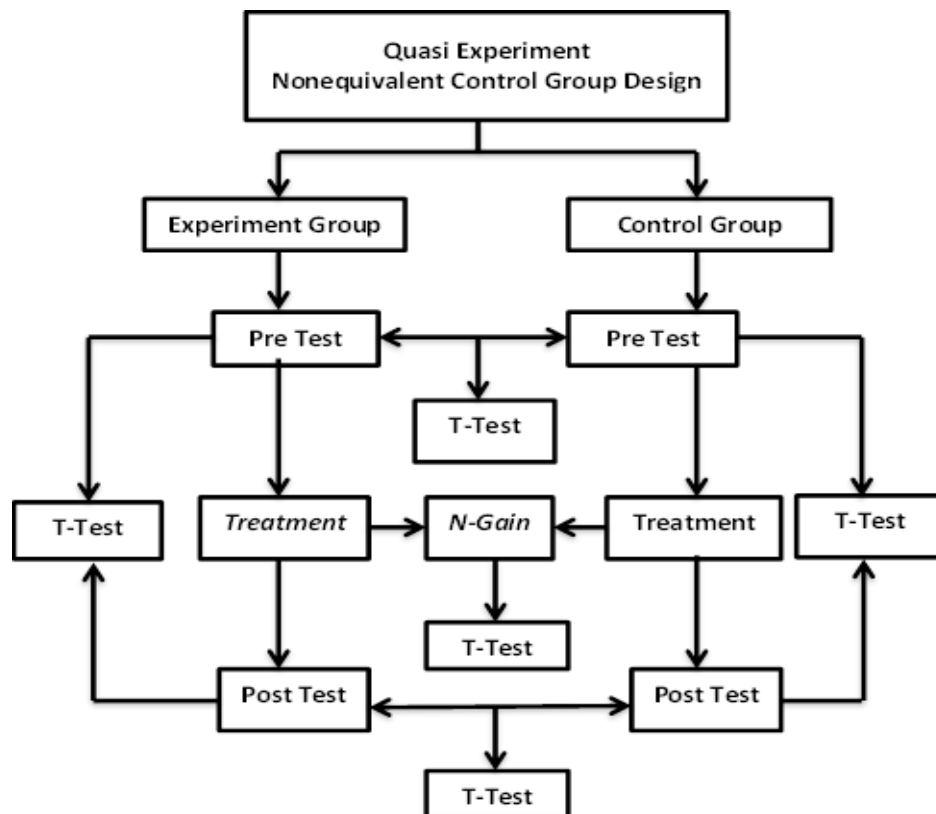


Figure 1. Flowchart of the study adapted from Muhidin and Hendri Winata (2016).

Table 1. Research design.

Group	Pre-Test	Treatment	Post-Test
Group 1	X_1	Y_1	X_1
Group 2	X_2	Y_2	X_2
Group 3	X_3	Y_3	X_3

A conventional learning system that consists of the one-way communication system by the gurus to the students, which consists of imparting education to the student in the best possible way (Upasana, 2014), was applied for this research. All Inquiry Lab, Guided Inquiry, and Conventional learning strategies applied in this research were developed by researchers and assessed for feasibility by three learning science experts. The feasibility of the chosen learning strategy is assessed from the accuracy of the learning steps and the achievement of learning objectives. Expert assessment claims the selected learning strategy has met the requirements. Before conducting the research, there were partner teachers who were trained to apply learning strategies during the experiment.

Data Analysis

The data were analyzed in two stages: content validity and internal consistency dependability. The degree of relationship between test content and the logical and curricular domains to be examined is referred to as content validity. Analogies items have been devised and built to assess the knowledge, skills, and talents thought important for graduate school achievement. Validity was analyzed using the Pearson correlation coefficient in SPSS. Furthermore, if the value of item-total correlation is greater than the r-table value can be the key that all items in the instrument are declared

significant and can be used for further testing (Faishol, 2016). Therefore, N means the sample in this research is 108 students. Because the significance used is at the 0.05 level, the r table value based on the number of samples in this research is 0.159. Then, the item must be significant when the Pearson correlation coefficient is more than 0.159.

Internal consistency reliability measured in this research was to compare the variance of each item with a total variance test analyzed with Cronbach's alpha in SPSS. Internal consistency reliability refers to the homogeneity of items intended to measure the same quantity (active/reflective preference) the extent to which the responses for the items are correlated. The Cronbach's alpha coefficient, the average of all possible separator pair correlations, is the general metric for this form of reliability.

The Cronbach alpha analysis method on SPSS 2.0 was used in this research to analyze the reliability value. It is the most popular method for testing internal consistency in behavioral science. In a unidimensional test, the alpha coefficient is useful for measuring reliability by taking into account item-specific variance. A single factor or construct that has been determined must be present in order for this to be true (Mohajan, 2017). In this research, we measured the skill dimension HOTS. Furthermore, according to Hanekom et al. (2014), the minimum standard of reliability that is generally accepted is 0.65. Thus, the reliability of the test items can be claimed to be reliable if the reliability value is more than 0.65 or > 0.65 . In this research, all the indicator items of the HOTS test instrument were reliable because > 0.65 .

The effectiveness of two-level investigations and conventional strategies were analyzed using ANCOVA analysis, Tukey's test, and Kruskal Wallis' test. The pre-tests as the covariates to investigate the main effects of post-test (Siew et al., 2017). Before the Kruskal Wallis test was carried out, the Kolmogorov-Smirnov normality test and the Levene homogeneity test were first performed. A post hoc Least Significant Difference (LSD) test using SPSS and R studio was then performed to determine whether the effectiveness of the four learning strategies differed significantly. The Kruskal Wallis test was used to compare the difference in scores of three types of learning models between structured, guided, and conventional classes. The test is suitable for comparing ordinal scale data and not normally distributed data. All data were analyzed using statistical software packages, namely Statistical Package for Social Sciences (SPSS) for Windows version 23 and R studio.

RESULTS AND DISCUSSION

Before conducting the study, teaching and research instruments must be validated and reliable. Therefore, Five scientists from Mulawarman University have been assessed the validity of the Inquiry Lab, Guided Inquiry, Conventional, and research equipment, as can be seen in Table 2.

Table 2. Results of HOTS test validity and reliability.

Item	HOTS Index Points	Validity	Reliability
Analysis (C4)			$\alpha = 0.70$
1	0.520	Valid	Reliable
2	0.239	Valid	Reliable
3	0.428	Valid	Reliable
4	0.407	Valid	Reliable
5	0.126	Invalid	Reliable
6	0.251	Valid	Reliable
7	-0.050	Invalid	Reliable

Item	HOTs Index Points	Validity	Reliability
8	0.188	Valid	Reliable
9	0.364	Valid	Reliable
10	0.308	Valid	Reliable
11	-0.064	Invalid	Reliable
12	0.381	Valid	Reliable
13	0.333	Valid	Reliable
14	0.604	Valid	Reliable
15	0.098	Invalid	Reliable
Evaluation (C5)			$\alpha = 0.283$
16	0.434	Valid	Not Reliable
17	0.403	Valid	Not Reliable
18	0.840	Invalid	Not Reliable
Creating (C6)			$\alpha = 0.174$
19	0.380	Valid	Not Reliable
20	0.330	Valid	Not Reliable

Average values before and after the HOTs test are presented in Table 3. The Guided Inquiry and Inquiry lab classes have the highest scores, while conventional ones have the lowest averages. In the results of the average value in the class that was treated with the inquiry lab and guided inquiry learning models, the difference was so small that there was almost no difference in the results of higher-order thinking skills between the two. Based on n-gain calculations, there is an increase for the class of 11th Science 1 in the very high category (0.98) or 98% using the Inquiry Lab model, the high category for a class of 11th Science 2 (0.83) or 83% using the Guided Inquiry and 11th Science 3 (0.34) or 34% using the conventional model.

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Table 3. ANCOVA test results.

Source	df	Mean Square	F	Sig. (p-value)
Pre-Test	1	0.617	7.12	0.00
Learning Strategy	3	29.63	341.78	0.00

The results of ANCOVA (Table 3) show that there are differences in the effectiveness of the three models implemented between laboratory inquiry, guided inquiry, and conventional in increasing the HOTS of different students ($p = 0.000 < 0.05$). The results of this test also showed that the results of the pre-test had an effect on the post-test gain ($p < 0.001$). Furthermore, to find out more details further on the ANOVA test. Table 4 shows the results of ANOVA.

Table 4. ANOVA test results.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	22062.275	2	11031.137	622.511	0.000
Within Groups	1860.642	105	17.720		
Total	23922.917	107			

The results of the ANOVA test (Table 4) for the three treatments of the conventional model learning model with two levels of discovery, namely the lab inquiry learning model and guided inquiry, with the results of F table 622.511 with a significant $0.000 < 0.05$. In this case, there is no difference between the three learning models, so proceed to the test by Tukey LSD. Table 5 shows the multiple comparisons of dependent variables (the learning strategies).

Table 5. Multiple comparisons of learning strategies.

(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Lab Inquiry	Guided Inquiry	9.471*	0.985	0.000	7.52	11.42
	Conventional	34.054*	0.993	0.000	32.09	36.02
Guided Inquiry	Lab Inquiry	-9.471*	0.985	0.000	-11.42	-7.52
	Conventional	24.583*	0.999	0.000	22.60	26.56
Conventional	Lab Inquiry	-34.054*	0.993	0.000	-36.02	-32.09
	Guided Inquiry	-24.583*	0.999	0.000	-26.56	-22.60

*. The mean difference is significant at the 0.05 level.

The findings of the Tukey LSD test indicated that the corrected mean of the two levels of the inquiry did not differ significantly, but significantly from the conventional level, As indicated in the Table 6 column notation, this implies that the efficacy of the two stages of HOTs improvement research is higher and it significantly differs from the conventional approach, yet the efficacy of the two inquiry levels varies significantly. On the other hand, the request for a guided class, i.e., a guided inquiry learning class, receives HOTs, indicating that this group only received HOTs and another in "Good Acceptable" or above. HOTs are produced by three different types of learning models. The mean difference in the scores of the five skills between open inquiry, guided inquiry, structured inquiry, and conventional methods was significant ($p > 0.001$) using R studio, according to the findings of the Kruskal Wallis test (Table 6).

The significant difference in the average scores of the two models of lab inquiry learning and guided inquiry with conventional models between the three classes, as shown in Table 5. It can be examined in detail from the average ratings in Table 5. The classes that implement open lab inquiry learning have The highest mean on the results of HOTs compared to other guided inquiry learning models, and the lowest results of HOTs is the conventional learning model. The laboratory inquiry class has higher averages than the conventional and guided inquiry, as shown in Table 6.

Table 6. HOTS scores are based on three learning models.

Results from Three Learning Models HOTS Scores		
Test	N	Mean Rank
Inquiry Lab	37	87.86
Guided Inquiry	36	55.69
Conventional	35	18.00

Likewise, the structured inquiry class has higher-order thinking skills from the test results of 20 multiple choice questions whose standard questions already refer to the HOTS questions. In addition, in the learning process, students are given experience through experiments to train higher-order thinking skills. The students in the inquiry lab class love studying because it provides them with several opportunities to collaborate with their peers in order to complete experimental assignments. They also reported being challenged to be more critical and creative in generating experimental questions and completing experiments that they devised themselves utilizing available resources. The students complained that they had too many tasks since, in addition to creating the experiment, which was a new experience for them, they were also required to report on it while also having additional homework from other disciplines. For example, in the Curriculum Analysis course, students analyze the curriculum and then create lesson plans for high school students.

The results revealed that the average HOTS value was higher and significantly different in the inquiry or in the inquiry and guided inquiry learning model from that in conventional classes. This indicates that two stages of research are more successful than conventional methods in enhancing HOTS. The research results of (Putri & Ayu 2018) also demonstrate that the application of the investigation approach improves HOTS more effectively than traditional ones. Why is the lecture technique pulled into a learning approach focused on teachers? A teacher teaches the students verbally, is only disturbed by occasional inquiries. In a larger measure, the effectiveness of the learning approach highlighted the ability of students to collect knowledge conveyed by their professors (Prayitno et al., 2017).

In the meanwhile, HOTS empowerment requires additional tasks outside simply memory, including analysis, assessment, and production (Murphy et al., 2013). As a result, the greater the thinking skills of students who had a lecture approach, the lower among conventional students. This is in line with (Novita 2021) findings, conclude that learning by applying guided inquiry-based worksheets (i.e., LKPD) is effective for improving students' creative thinking skills on the sub-material factors that affect the rate of reaction. Additionally, it concluded that the guided inquiry-based physics learning materials are valid, practical, and effective for use in teaching and learning and can facilitate the development of science process skills in junior high school students. (Windiastuti et al., 2018) stated that the development of The Guided Inquiry student worksheet for Biology 11th Grade Senior High School is legitimate, practical, and successful.

In contrast to discovery learning, such as inquiry learning, students have HOTS because they are student-centered. The Inquiry step comes from the scientific method (MargusPedaste, 2015). This approach, scientific truth, has been tested by making three phases of truth testing: reasoning, hypothesis, and verification. The logic of deductive testing produces hypotheses. The hypothesis is furthermore confirmed whether

empirical data supports it or not (MargusPedaste, 2015). The student HOTS can be performed as a scientific technique via inductive and deductive thinking (Wang & Jou, 2016). Students will develop proficiency in assessing, synthesizing, evaluating, and creating logical arguments while also examining empirical evidence that supports knowledge.

The scientific method is a way of learning that involves observing (to identify problems), questioning (to construct hypotheses), collecting data/information with various techniques, associating (analyzing data/information), concluding and communicating the results instead of the problem formulated (Sarwanti, 2016). The academic talents of students can be defined in the following ways. According to Piaget, children's cognitive abilities increase progressively as they get older. The sensory-motor stage occurs between the ages of 0 and 2, the pre-operational stage occurs between the ages of 2 and 7, the concrete operational stage occurs between the ages of 7 and 11, and the formal operational stage occurs between the ages of 11 and above. Students' intellect levels might be greater, lower, or equal to their age. Several 10-year-old children, for example, can finish the job of a 15-year-old youngster. On conversely, it has been proven that 15-year-old youngsters are unable to finish the task of 10-year-old kids. Academic performance is impacted by a variety of elements, including skill, tenacity, learning quality, capacity to take lessons, and study time allocation. Students are provided the same amount of quality lessons, number of lessons, and learning time if the factors of talent, tenacity, and ability to accept lessons are generally divided among their talents. It is related to students learning outcomes will be distributed well for HOTS. It requires the right learning model or strategy to achieve or develop as well as improve higher-order thinking skills. Between the two levels of inquiry, namely learning lab inquiry and self-guided inquiry, there are significant differences, and the most significant in improving HOTS is lab inquiry rather than guided and conventional inquiry.

CONCLUSION

The effectiveness of performing an open inquiry, guided inquiry, or structured inquiry in increasing students' HOTS was not significantly different. The three stages of the investigation were substantially greater than the standard approach. In terms of HOTS, the use of three levels of inquiry vs. conventional methods resulted in significantly different outcomes. The open inquiry had the highest effect on increasing HOTS, followed by guided inquiry, conventional inquiry, and structured inquiry. Although all three levels of inquiry are equally effective at increasing HOTS, an open inquiry appears to be more successful when used in a student's scientific learning process since it results in a greater improvement in HOTS development. Students who have a strong grasp of HOTS will be able to create a variety of scientific experimental designs that will aid in the development of their HOTS. The implications of this research for universities include that the curricula for university courses should focus more on mini-research activities, especially those related to the conduct of open inquiry. There is a significant difference in the government, particularly the Indonesian ministry of education, among the two levels of inquiry, namely Inquiry laboratory learning and Guided Inquiry itself, and the most important is that HOTS improves learning at the Inquiry Lab rather than the guided and conventional research. This research has several limitations on the subject used, namely only on students of 11th Science class at one of the schools of

Islamic Senior High School Samarida, as many as 108 students. The outcome may vary depending on the region, school, and program. Moreover, there are time limits for practicums in school laboratories; due students take a long time to transition from classroom to laboratory. Based on the present findings as well as those of previous analyses dealing with the effectiveness of performing an open inquiry, guided inquiry, or structured inquiry in increasing students' HOTs, it can be suggested for future research using the larger scope and using different methods for better result. Furthermore, policymaking by the government, especially the Ministry of Education of the Republic of Indonesia, should facilitate small-scale research activities of teachers by providing assistance in laboratory facilities.

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