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PROFESI PENDIDIKAN DASAR

Analysis of Fifth Graders' Higher Order Thinking Skills in Studying Human and Animal Respiratory Organs

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Abstract

Background: *Higher order thinking skills (HOTS) are crucial for students to face the 21st century development. This study aimed to determine higher order thinking skills of the fifth graders at Muhammadiyah elementary school in Demangan and Baitussalam II Islamic elementary school in solving questions on human and animal respiratory organs.*

Method: A *descriptive quantitative approach was employed. It included survey and ex-post factor designs. The research data were collected using tests.*

Result: *The participants of the study achieved medium scores on three categories of HOTS. Thirty nine percent of Ibnu Thufail fifth graders achieved a medium score on judgement and critical thinking, 48% of Ibnu Rusdy fifth graders obtained a medium score on similar category, and 42% of the Muhammadiyah fifth graders got low scores on judgement and critical thinking. Meanwhile in problem-solving, 43% students were in medium category, 39% in low category, and 32% in medium category. Forty eight percent of the students obtained medium scores and 52% achieved poor scores.*

Implications: *The research findings imply that students' HOTS in natural science need to be improved.*

Novelty: *The present study revealed students' HOTS based on judgment and critical thinking, problem solving, logic and reasoning skills.*

INTRODUCTION

Background of the Study

The 21st century is a knowledge age full of challenges. One of the challenges in developing science associated with the function of education is improving the quality of human resources (HR). Indonesia is one of the developing countries that have poor human

resources. In 2016, the UNDP international data showed that the Indonesia's Human Development Index ranked 113 out of 187 countries in the world, far behind other ASEAN countries (Ibrahim et al., 2017).

Indonesia is also at the bottom of the list in scientific literacy and reading literacy. Data released by PISA in 2018 stated that the reading literacy of Indonesian students was ranked 6th from the bottom with a literacy level of 1a out of 6 levels. Likewise, Indonesian students obtained a score of 396 in scientific literacy, which is at level 1a out of 6 recognized levels. The average score obtained by Indonesian students on scientific literacy is in the low category, which took the 69th place among 77 countries worldwide.

Based on the data, it can be said that Indonesian students lack the ability to understand, interpret and communicate using written materials. This is also illustrated by poor, linear and fragmented reasoning used by the students to answer essay questions (Akmala et al., 2019). Reading plays a crucial role in obtaining information; therefore, it is of important aspects in higher order thinking skills (HOTS). Higher order thinking is a thought process that involves activities beyond memorization, such as relaying information that has been obtained. Learning in schools must also be directed towards optimizing the skills needed in the 21st century. One of the most influential subject matters that are able to direct and optimize students' thinking skills is science because science learning programs can support the development of 4C (communication, collaboration, critical thinking, and creativity).

Science learning at *Muhammadiyah* elementary school in Demangan has been assisted with various learning tools, properties and projectors. However, the students seemed unenthusiastic when asked to inquire about the lesson. Most of the questions raised by the students were usually pertaining to the names of the human and animal respiratory organs instead of the concrete every day problems that exist around them. The observation results showed that the students had not been able to identify real-world problems in science. This further indicates that science learning has been separated from real world contexts. As a result, learning becomes meaningless and irrelevant to students (Usmaedi, 2017). Identifying problems is the initial step to reasoning, evaluating, critical thinking and solving problems in schools and communities.

Problem-solving abilities can encourage students to perform higher order thinking skills (HOTS) such as critical thinking and creative thinking to face the 21st century challenges (Handayani & Priatmoko, 2013). Besides problem-solving abilities, logical reasoning, judgement and critical thinking are also included in higher order thinking skills (Brookhart, 2010:14).

To examine students' higher order thinking skills (HOTS), it is important to include HOTS categories in learning evaluation. However, past studies revealed that evaluation questions were mostly adopted from student books. Open-ended questions that can facilitate students' HOTS, reasoning, problem-solving abilities and investigation skills were rarely found (Fajriyah & Agustini, 2017).

All of the above suggests that little is known about the measurements of higher order thinking skills (HOTS) although in fact, students need to be equipped with HOTS to become globally competent. (Latifah, 2013) has developed a multiple choice and matching test to evaluate students' HOTS. The instrument has been declared valid empirically, but has never been used to measure students' HOTS in science. Therefore, we are intrigued to adopt the instrument developed by Latifah and use it to analyze the higher order thinking skills of fifth graders from *Muhammadiyah* elementary school and *Baitussalam II* elementary school.

Problems of the Study

This study aims to analyse the thought processes of the Fifth Graders in studying Human and Animal Respiratory Organs. Specifically, it sought to answer the following questions:

1. What are the expected Higher Order Thinking skillsto be mastered by Fifth graders?
2. What are the manifested/observed HOTS among the respondents?

Previous Related Studies

Many recent studies have focused on students' higher order thinking skills (HOTS). In a study conducted by (Fajriyah & Agustini, 2017), a test referring to Mazarno's HOTS theory was developed since the existing evaluation tests were mostly adopted from textbooks and were unable to facilitate students' HOTS. On the other hand, the current study constructed a test based on HOTS indicators suggested by Brookhart, namely problem solving, logic and reasoning, judgment and critical thinking. Research conducted by (Sari & Silitonga, 2016) revealed the effect of higher order thinking skills (HOTS) on the process of learning, learning effectiveness and problem-solving abilities. Another relevant study categorized students' higher order thinking skills into low category (44.1) (Akmala et al., 2019). This study disclosed the determining factor of students' poor HOTS, namely inadequate practice of reasoning skills in responding to essay questions. Furthermore, (Permatasari et al., 2017) found that students at MAN 1 Malang had poor HOTS with a mean score of 27.9 and a standard deviation of 8.1. The highest and the lowest scores achieved by the students were 52 and 11 (out of 100), respectively. (Ramadhan et al., 2018) analyzed a two-tier multiple choice test and the profile of students' HOTS in Quantum Mechanics in Cilacap regency. They discovered that the instrument was valid and reliable. However, the students' HOTS were categorized low with a mean score of 8.45 out of 30. It suggests that HOTS play a crucial role in helping students analyze problems. Moreover, (Sarwinda, 2019) showed that HOTS-based science worksheets had a significant effect on fifth graders' cognitive achievement in science at *Muhammadiyah 4* and *Muhammadiyah 5* elementary schools, Jakarta. Other research findings suggest that test questions at schools cannot stimulate and develop students' HOTS (Acesta, 2020). Furthermore,(Hajar et al., 2018) examined discrepancies in junior high school students' HOTS. (Yuniar et al., 2015) analyzed test questions at schools and found that the tests had not fulfilled the criteria of HOTS development. Finally, research by (Wirandani et al., 2019) proved that the questions used to measure students' HOTS were at C4, C5, C6 cognitive levels.

Research Gap & Objectives

Based on the explanation above, it can be concluded that an in-depth analysis of Indonesian students' higher order thinking skills (HOTS) needs to be conducted. There is not much known about the implementation of logic and reasoning, judgment and critical thinking, and problem-solving in Indonesia since most studies usually focus on students' HOTS at the cognitive levels of C4, C5, and C6. Therefore, the current study aimed to investigate fifth graders' HOTS based on logic and reasoning, judgment and critical thinking, and problem-solving. The findings of this study will provide important insights into the development of HOTS in Indonesian students.

METHODS

Type and Design of the Study

This study used a quantitative approach to data collection, data interpretation and data display (Arikunto, 2013:27). It belonged to a descriptive study which was intended to provide a detailed description of a particular symptom, phenomenon, or object without any intervention given to the object under study (Priyono, 2016:37; Arikunto, 2013:3). A survey was conducted to describe quantitatively the tendency, attitude, or opinion of a particular population by examining a sample of the population (Creswell, 2017). This survey

particularly aimed to analyze fifth graders' higher order thinking skills (HOTS) at *Muhammadiyah* elementary school in Demangan and *Baitussalam II* Islamic elementary school. The present study also employed an ex-post-facto design where investigations or observations were made after an incident had existed and the research examined backwards to find out the factors that influenced the incident (Arikunto, 2013; Sugiyono, 2017).

Data and Source of Data

The research subject consisted of the fifth graders from *Muhammadiyah* elementary school in Demangan and *Baitussalam II* Islamic elementary school. The research variable, which was the students' Higher Order Thinking Skills (HOTS), was measured using multiple choice and matching questions. The questions were packaged in three bundles, namely package A, package B and package C. Each package contained 10 multiple choice questions and 5 matching questions. The questions were developed based on a Basic Competence, namely human and animal respiratory organs. The HOTS-based test indicators consisted of problem solving, logic and reasoning, and judgment and critical thinking.

The data of this study were gathered using a test comprising a series of questions used to measure the participants' skills, intelligence, abilities or talents (Arikunto, 2013). The test contained higher order thinking skills-based science questions. The research instrument was adopted from (Latifah, 2020), who has done the empirical testing of the test. The test was divided into three packages, namely package A, package B and package C. Each of the packages contained 10 multiple choice items and 5 matching test items.

Package A consisted of 4 multiple choice questions and 5 matching questions on judgment and critical thinking skills, 4 multiple choice questions on problem-solving, and 2 multiple choice questions on logic and reasoning. Meanwhile, package B contained 5 multiple choice questions and 5 matching questions on judgment and critical thinking skills, 4 multiple choice questions on problem-solving, and 1 multiple choice question on logic and reasoning. Package C comprised 5 multiple choice questions and 5 matching questions on judgement and critical thinking skills, 4 multiple choice questions on problem-solving, and 1 multiple choice question on logic and reasoning. The initial data collection was conducted using google form. Every multiple choice and matching question was worth 1 point.

Descriptive statistics was used to present the data through table, graph, pie chart, mode, median, mean, decile, percentile, calculation of data distribution through calculation of mean score, standard deviation and percentage. Descriptive data analysis was done through the calculation of scores, mean, percentage and standard deviation. The research population is presented in Table 1.

Table 1. Student Population

No.	Name of School	Class	Number of Students	Role
1.	SD Muhammadiyah Demangan	Class V Ibnu Thufail	34	*HOTS* data collection
		Class V Ibnu Rusdy	34	*HOTS* data collection
2.	SD IT Baitussalam II Cangkringan	Class V	28	*HOTS* data collection
3.	SD Negeri Tugu Harum	Class V	34	Instrument Validation

No.	Name of School	Class	Number of Students	Role
4.	SD IT Bina Insan Kamil Turi	Class V	28	Instrument Validation
5.	SD Negeri Tegalsari 04	Class V	28	Instrument Validation
Total			186	

Data Collection

Data collection techniques are methods and tools used by researchers to obtain data. The data of this study were collected using a test. A test is a series of questions used to measure skills, intelligence, knowledge, abilities or talents possessed by an individual or a group (Arikunto, 2013). Test was used in this study to examine elementary students' higher order thinking skills.

Data-Collecting Instrument

The instrument used to collect the data of this study was HOTS-based questions on science. The instrument was adopted from (Latifah, 2020), who has done empirical testing on the test. The test was divided into three packages, namely package A, package B and package C. Every package contained 10 multiple choice questions and 5 matching questions. These questions were distributed to students at SD Muhammadiyah Demangan and SD IT Baitussalam II. The complete test can be seen in Appendix 1. The blueprint and the scoring guide of the test are presented in Table 2 and Table 3, respectively.

Table 2. The Blueprint of Instrument

Indicator		Item		Stimulus	Package
		multiple choice questions	matching questions		
Problem Solving	Identify the problem	3	-	Text	A
		4	-	Text	A
	Identify various kinds of solutions	5	-	experimental results	A
		6	-	experimental results	A
Logic and reasoning	The ability to reason (consider and evaluate) through true and false statements by considering principles	9	-	Picture	A
Judgment and critical thinking skill	Analyze informations	1	-	Text	A
		2	-	Text	A
		-	1	Picture	A
		-	2	Picture	A
		-	3	Picture	A
		-	4	Picture	A
		-	5	Picture	A
	Develop critical insight	5	-	experimental results	A

Indicator		Item		Stimulus	Package
		multiple choice questions	matching questions		
		6	-	experimental results	A
	Synthesize multiple points of view	10	-	Picture	A
Problem Solving	Identify the problem	3	-	Text	B
		4	-	Text	B
	Identify various kinds of solutions	5	-	Text	B
		6	-	Text	B
Logic and reasoning	The ability to reason (consider and evaluate) through true and false statements by considering principles	9	-	Picture	B
Judgment and critical thinking skill	Analyze informations	1	-	Text	B
		2	-	Text	B
		-	1	Picture	B
		-	2	Picture	B
		-	3	Picture	B
		-	4	Picture	B
	Develop critical insight	7	-	Text	B
		8	-	Text	B
	Synthesize multiple points of view	10	-	Picture	B
Problem Solving	Identify the problem	3	-	Text	C
		4	-	Text	C
	Identify various kinds of solutions	5	-	Text	C
		6	-	Text	C
Logic and reasoning	The ability to reason (consider and evaluate) through true and false statements by considering principles	9	-	Picture	C
Judgment and critical thinking skill	Analyze informations	1	-	Text	C
		2	-	Text	C
		-	1	Picture	C
		-	2	Picture	C
		-	3	Picture	C
		-	4	Picture	C
		-	5	Picture	C
	Develop critical insight	7	-	Picture	C
		8	-	Picture	C
	Synthesize multiple points of view	10	-	Picture	C

Tabel 3 Scoring Guide

Type of Questions	Item	score per question	Maximum Score
multiple choice questions	1-10	1	10
matching questions	1-5	1	5
Final Score	$\frac{scoring\ of\ \text{multiple choice questions} + \text{scoring of matching questions}}{15} \times 100$		

Data Analysis

Data analysis was performed using descriptive statistics. Sugiyono (2018:147) argues that data analysis consists of grouping data based on variables and types of respondents, presenting data for each variable studied, performing calculations to answer problem formulations, and performing calculations to test hypotheses. Research that does not formulate a hypothesis will not need to take the final step. The data analysis techniques used in this study included the presentation of data through tables, graphs, pie charts, calculation of mode, median, mean, decile and percentage as well as calculation of data distribution through calculation of mean scores, standard deviation and percentages. Descriptive statistical data analysis in this study was carried out by presenting the students' test scores, mean scores, score percentage and standard deviation.

Results

Analysis of Students' Higher Order Thinking Skills (HOTS) in General

The overall description of the participants' ability in answering higher order thinking skills (HOTS)-based questions on human and animal respiratory organs can be seen in Table 4.

Table 4. The Overall Description of the Participants' HOTS

Category	Formula	Score Range	Number of Students	%
Very poor	X < M – 1.5SD	X ≤ 24.35	5	8
Poor	M – 1.5SD < X ≤ M – 0.5SD	24.35 < X ≤ 40.73	19	29
Medium	M – 0.5SD < X ≤ M + 0.5SD	40.73 < X ≤ 57.12	20	31
High	M + 0.5SD < X ≤ M + 1.5SD	57.12 < X ≤ 73.50	19	29
Very high	M + 1.5SD < X	73.50< X	2	3

Table 4 show that all of the participants (65 students from *SD Muhammadiyah Demangan* and *SD IT Baitussalam II*) obtained a mean score of 48.92, from the category of 40.73 < X ≤ 57.12. The percentage of very poor, poor, medium, high and very high-score category achieved by the students was 8% (5 students), 29% (18 students), 31% (20 students), 29% (19 students), and 3% (2 students), respectively. Based on these data, it was concluded that the fifth graders of Ibnu Thufail and Ibnu Rusdy at SD Muhammadiyah Demangan and the fifth graders at SD IT Baitussalam had medium higher order thinking skills (HOTS). It indicates that the students' HOTS have not been developed optimally. Inadequate

preparation to answer HOTS questions can influence students' ability in acquiring knowledge and refine mindset.

Analysis of Ibnu Thufail Students' Higher Order Thinking Skills (HOTS) at SD Muhammadiyah Demangan

The description of the Ibnu Thufail students' ability in answering higher order thinking skills (HOTS)-based questions on human and animal respiratory organs can be seen in Table 5.

Table 5. Analysis of Ibnu Thufail Students' HOTS

Category	Formula	Score Range	Number of Students	%
Very poor	X < M – 1.5SD	X ≤ 25.78	1	4
Poor	M – 1.5SD < X ≤ M – 0.5SD	25.78 < X ≤ 39.70	4	17
Medium	M – 0.5SD < X ≤ M + 0.5SD	39,70 < X ≤ 53.63	13	57
High	M + 0.5SD < X ≤ M + 1.5SD	53.63 < X ≤ 67.56	5	22
Very high	M + 1.5SD < X	67.56 < X	0	0

Table 5 indicate that the majority of Ibnu Thufail students (57% or 13 students) achieved medium scores on HOTS. While 4% (1) student obtained a very poor score on HOTS, 17% or 4 students achieved poor scores on HOTS. There were 22% (5) students who acquired high scores on HOTS and 0% or none of the students got a very high score on HOTS. These numbers suggest that Ibnu Thufail students from SD *Muhammadiyah* in *Demangan* can be categorized into medium category in terms of higher order thinking skills (HOTS).

1. Analysis of *Ibnu Thufail* students' judgment and critical thinking scores

The results of the analysis of students' HOTS based on judgement and critical thinking in human and animal respiratory organs are presented in Figure 3:

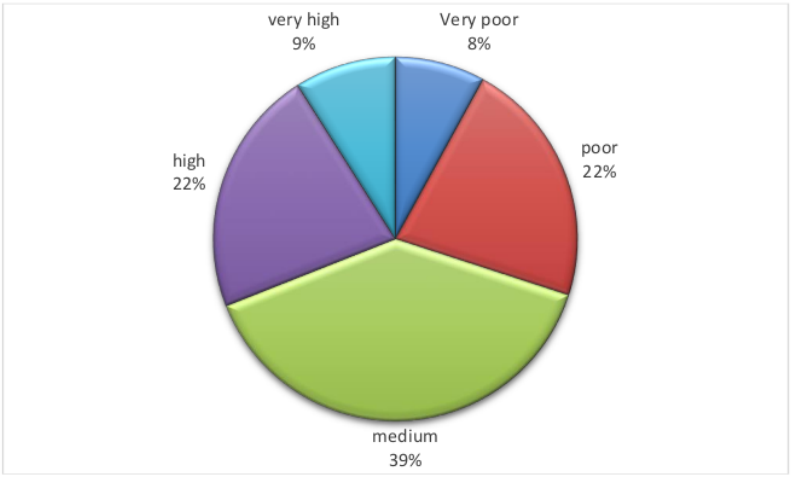


Figure 1. *Ibnu Thufail* Students' HOTS based on Judgment and Critical Thinking Indicator in Percentage

Based on Figure 3, it can be inferred that 39% of the Ibnu Thufail students achieved medium scores on judgement and critical thinking. The score range obtained by the students was $33.47 < X \leq 49.62$, where the mean score was 44.44. The highest score on judgement and critical thinking observed among Ibnu Thufail students was 66.67 (very high) and the lowest score on judgement and critical thinking found among Ibnu Thufail students was 11.11 (very poor).

2. Analysis of *Ibnu Thufail* students' problem-solving scores

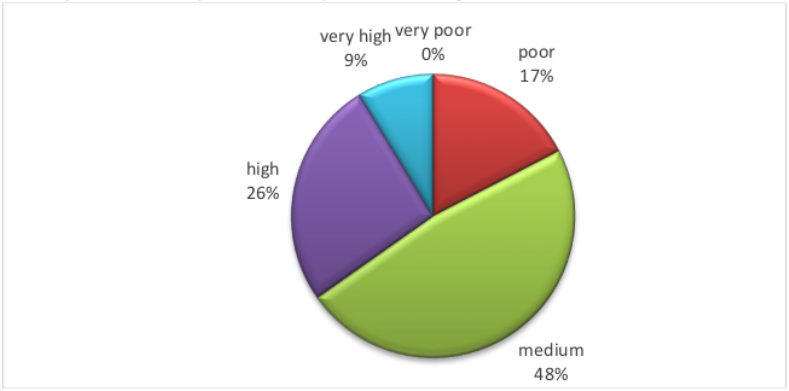


Figure 2. *Ibnu Thufail* Students' HOTS based on Problem-Solving Indicator in Percentage

Figure 2 suggests that 48% (11) *Ibnu Thufail* students achieved medium scores on problem-solving tests. The majority of the students obtained a score of 50 with a score range of $45.72 < X \leq 67.33$. The highest problem-solving score acquired by the students was 100 (very high) and the lowest score observed among the students was 25 (poor).

3. Analysis of *Ibnu Thufail* students' logic and reasoning scores

Figure 3 shows that almost half of the students (48%) or 11 students achieved medium scores on logic and reasoning with a score range of $31.54 < X \leq 68.46$. The majority of the students obtained an average score of 50. The highest score on logic and reasoning observed among the students was 100, while the lowest was 0.

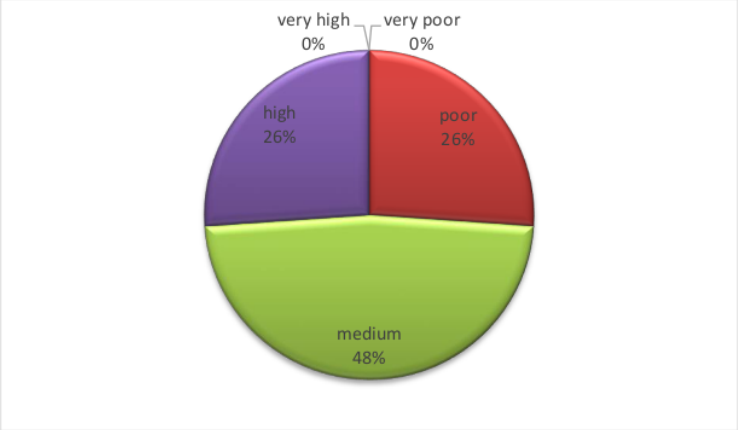


Figure 3. *Ibnu Thufail* Students' HOTS based on Logic and Reasoning Indicator in Percentage

Analysis of Ibnu Rusdy Students' Higher Order Thinking Skills (HOTS) at SD Muhammadiyah Demangan

The overview of Ibnu Rusdy students' ability in answering higher order thinking skills (HOTS)-based questions on human and animal respiratory organs is presented in Table 6.

Table 6. Analysis of Ibnu Rusdy Students' HOTS

Category	Formula	Score Range	Number of Students	%
Very poor	$X < M - 1.5SD$	$X \leq 15.65$	1	5
Poor	$M - 1.5SD < X \leq M - 0.5SD$	$15.65 < X \leq 34.97$	8	36
Medium	$M - 0.5SD < X \leq M + 0.5SD$	$34.97 < X \leq 54.30$	6	27
High	$M + 0.5SD < X \leq M + 1.5SD$	$54.30 < X \leq 73.63$	7	32
Very high	$M + 1.5SD < X$	$73.63 < X$	1	0

Based on Table 6, it was known that Ibnu Rusdy students' scores on HOTS were distributed across different categories. One (4%) student got a very poor score on HOTS, 8 (35%) students obtained poor scores on HOTS, 6 (26%) students achieved medium scores on HOTS, 7 (31%) students got high scores on HOTS and only one (4%) student acquire a very high score on HOTS. These figures suggest that the Ibnu Rusdy students' HOTS was poor.

1. Analysis of Ibnu Rusdy Students' HOTS judgement and critical thinking scores

The Ibnu Rusdy Students' HOTS in answering questions on human and animal respiratory organs contained in package B are presented as follows.

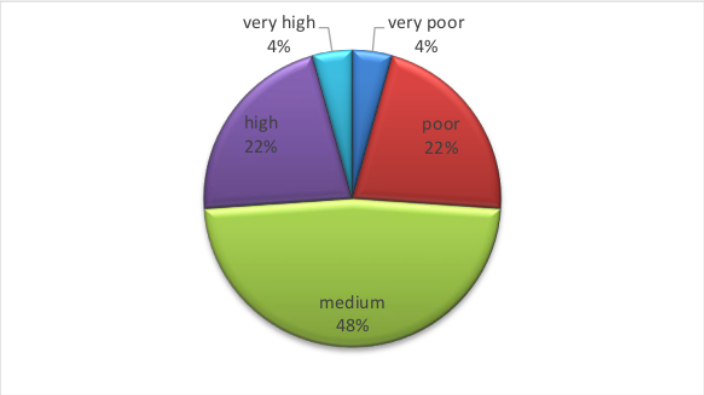


Figure 4. Ibnu Rusdy Students' HOTS based on Judgment and Critical Thinking Indicator in Percentage

In Figure 4, it can be seen that the Ibnu Rusdy fifth graders' judgement and critical thinking scores were in the medium category (48%) with a score range of $35.56 < X \leq 55.75$. The students were reported to obtain a score ranged between 40-50. The highest score on judgement and critical thinking found among the students was 80, while the lowest was 0 (very poor).

2. Analysis of Ibnu Rusdy Students' problem-solving scores

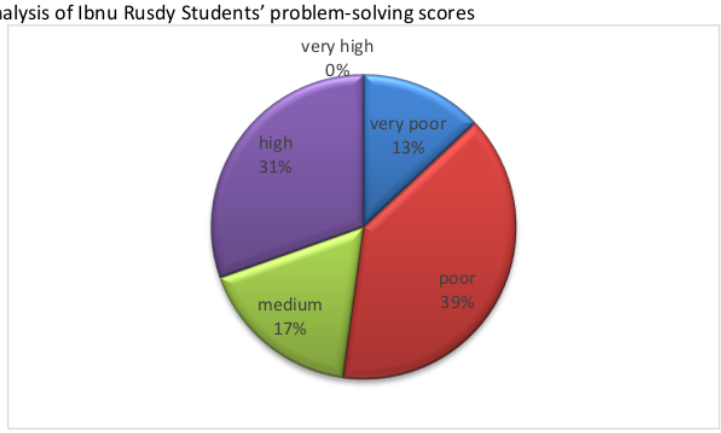


Figure 5. Ibnu Rusdy Students' HOTS based on Problem-Solving Indicator in Percentage

Figure 5 indicates that 9 (39%) Ibnu Rusdy students belonged to the low category in terms of problem-solving. The majority of the students achieved a score of 25 with a score range of $1.16 < X \leq 27.92$. The highest score observed in this indicator was 75 (very high), while the lowest was 0 (very poor).

3. Analysis of Ibnu Rusdy Students' logic and reasoning scores

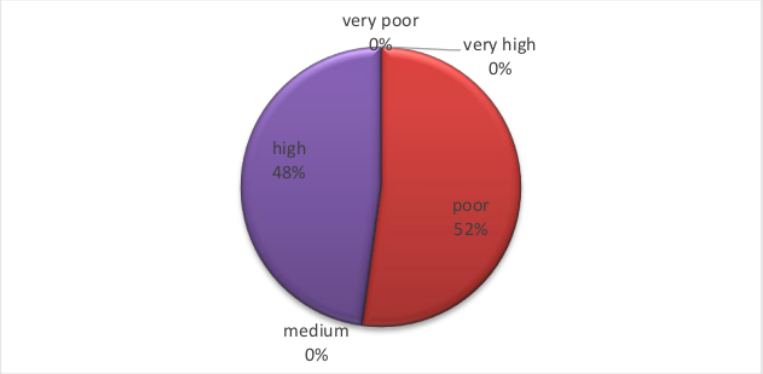


Figure 6. Ibnu Rusdy Students' HOTS based on Logic and Reasoning Indicator in Percentage

Based on Figure 6, it can be concluded that more than half of the Ibnu Rusdy students (52%) achieved low scores on logic and reasoning. The students averagely obtained a score of 0 between -28.79 < X ≤ 22.29. The highest score found in this category was 100 (high), while the lowest was 0 (poor).

Analysis of Students' Higher Order Thinking Skills (HOTS) at SD IT Baitussalam II

Students' higher order thinking skills (HOTS) at SD IT Baitussalam II in asnwering questions on human and animal respiratory organs are summarized in Table 7.

Table 7. Analysis of Baitussalam II Students' HOTS

Category	Formula	Score Range	Number of students	%
Very poor	X < M – 1,5SD	X ≤ 37,59	1	5
Poor	M – 1,5SD < X ≤ M – 0,5SD	37,59< X ≤ 50,42	3	16
Medium	M – 0,5SD < X ≤ M + 0,5SD	50,42 < X ≤ 63,26	10	53
High	M + 0,5SD < X ≤ M + 1,5SD	63,26 < X ≤ 76,10	4	21
Very high	M + 1,5SD < X	76,10 < X	1	5

Table 7 suggest that the fifth graders at SD IT Baitussalam achieved different scores on HOTS. One (5%) student achieved a very poor score on HOTS, 3 (16%) students obtained poor scores on HOTS, 10 (53%) students got medium scores on HOTS, 4 (21%) students obtained high scores on HOTS and 1 (5%) student achieved a very high score on HOTS. These numbers indicate that on the average, the students at SD IT Baitussalam possessed high higher order thinking skills (HOTS).

1. Analysis of Baitussalam II Students' judgment and critical thinking scores

The Baitussalam II Students' judgement and critical thinking skills in answering questions on human and animal respiratory organs contained in package C are presented as follows.

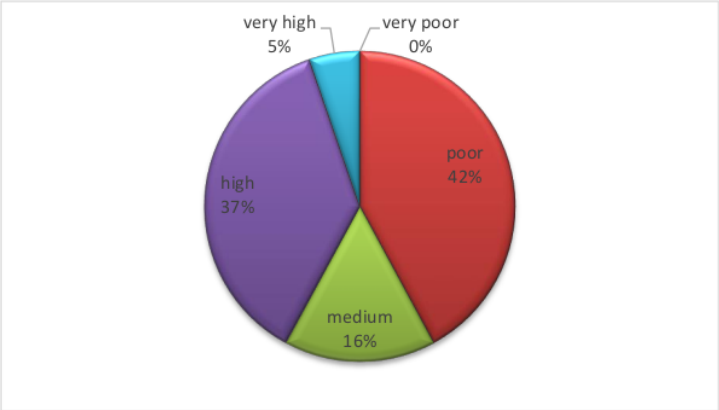


Figure 7. Baitussalam II Students' HOTS based on Judgment and Critical Thinking Indicator in Percentage

Figure 7 shows that 42% of the fifth graders at SD IT Baitussalam II obtained poor scores on judgement and critical thinking. On average, students achieved a score of 40 within the score range of $29.98 < X \leq 44.73$. The highest score found in this category was 90 (very high), while the lowest was 40 (poor).

2. Analysis of Baitussalam II Students' problem-solving scores

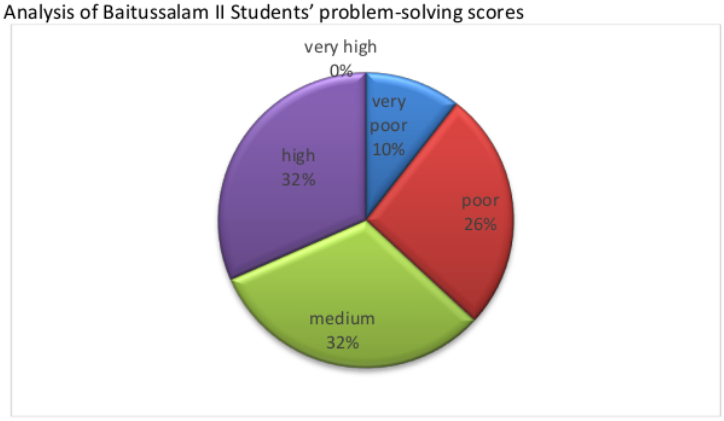


Figure 8. Baitussalam II Students' HOTS based on Problem-Solving Indicator in Percentage

In Figure 8, it can be known that the Baitussalam II students' problem-solving skills were in high and medium categories (32%). The students obtained scores between 75-100, with a score range of $58.37 < X \leq 83.73$ and a score range of $83.73 < X \leq 109.10$. The highest score found in problem-solving was 100 (high), while the lowest was 25 (very poor).

3. Analysis of Baitussalam II Students' logic and reasoning scores

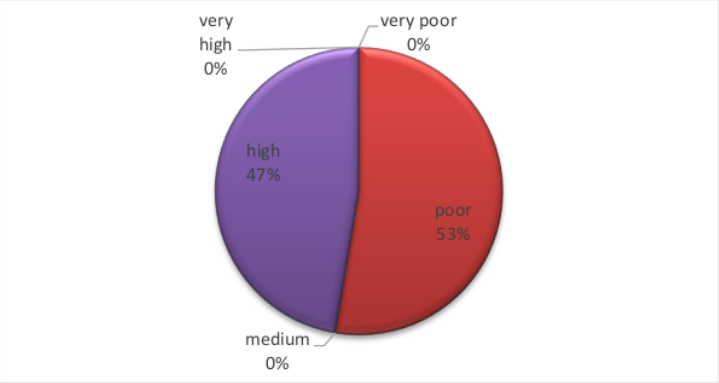


Figure 9. Baitussalam II Students' HOTS based on Logic and Reasoning Indicator in Percentage

Figure 9 indicates that Baitussalam students' logic and reasoning was categorized low. There were 10 (53%) students who obtained poor scores on this indicator, with a score range of $-29.58 < X \leq 21.72$. The highest score observed was 100, while the lowest was 0 (poor).

DISCUSSION

The mean score achieved by students at SD Muhammadiyah Demangan and SD IT Baitussalam II was 48.92 within a score range of $40.73 < X \leq 57.12$. The students' HOTS were categorized into very poor (8% or 5 students), poor (29% or 18 students), medium (31% or 20 students), high (29% or 19 students) and very high (3% or 2 students). The numbers suggest that on average the fifth graders of Ibnu Thufail and Ibnu Rusdy at SD Muhammadiyah Demangan and the fifth graders at SD IT Baitussalam possessed medium higher order thinking skills (HOTS). According to (Kurniawati et al., 2020), some factors affecting students' HOTS include inadequate practice of questions that can enrich students' knowledge and improve mindset. In the HOTS-based tests, Ibnu Thufail students from SD Muhammadiyah achieved a mean score of 46.67, with the highest score of 66.67 and the lowest score of 20. Meanwhile, Ibnu Rusdy students from SD Muhammadiyah obtained a mean score of 44.64, with the highest score of 80.00 and the lowest score of 13.33. On the other hand, the mean score acquired by the fifth graders at SD IT Baitussalam II was 56.84, with the highest score of 86.67 and the lowest score of 33.33. A more in-depth analysis was done to investigate the participants' judgment and critical thinking, problem-solving, and logic and reasoning skills.

Multiple choice tests were developed to measure the participants' judgement and critical thinking skills. The tests contained argumentative texts, scenarios, advertisements or other information resources (Brookhart, 2010) to stimulate students' cognitive ability in judging or making the right decisions. In line with Indraswati et al (2020), judgement and critical thinking skills are associated with examining assumptions, not to blindly accept information. These skills also help individuals understand a concept with a clear mind so that they can draw an appropriate conclusion. In addition, to examine the participants' problem-solving skills, questions comprising non-routine scenarios were distributed. The students were then required to complete the tasks of identifying problems as well as

exploring and finding the most efficient solutions (Brookhart, 2010). Besides, the participants' logic and reasoning skills were investigated through multiple choice questions containing true or false options (Brookhart, 2010).

Overall, 31% of the students from SD Muhammadiyah Demangan and SD IT Baitussalam II had medium achievements in higher order thinking skills (HOTS). The mean score achieved by 57% of Ibnu Thufail students on HOTS in general was medium. In detail, 39% of the students achieved medium scores on judgement and critical thinking, 48% of them obtained medium scores on problem-solving and 48% of them acquired medium scores on logic and reasoning. This finding illustrates that the students were quite skillful in judgment and critical thinking, problem-solving, and logic and reasoning. Similarly, 48% (11) of the Ibnu Rusdy students achieved medium scores on judgment and critical thinking. Less than half of the students (39%) possessed poor ability in problem-solving and 52% (12) of the students were low in logic and reasoning. An example of problem-solving question in Package B is presented in Figure 10.

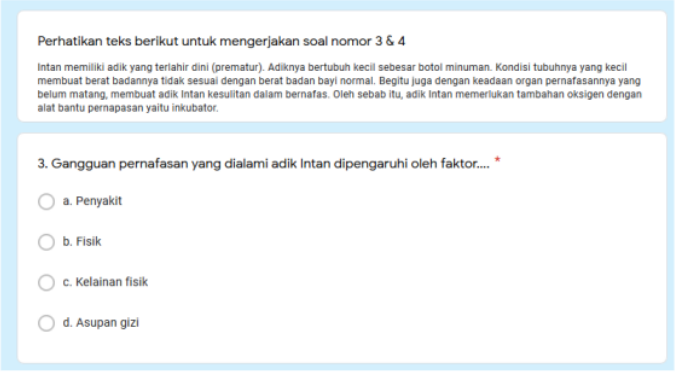


Figure 10. Problem-solving question number 3, Package B

This problem-solving question presents a stimulus in the form of a text containing a respiratory problem. The test takers were asked to answer the questions based on the stimulus text. The initial step in completing a problem-solving task is to identify or define the problem according to the question presented or the main idea implied in the text (Brookhart, 2010). Student achievement on this problem-solving task shows that the students had poor ability in identifying a problem. Next, a logic and reasoning task (number 9) provided the students with a stimulus in the form of a picture of a bird and its respiratory organs. The logical and reasoning problem contained in package B is shown in Figure 11.

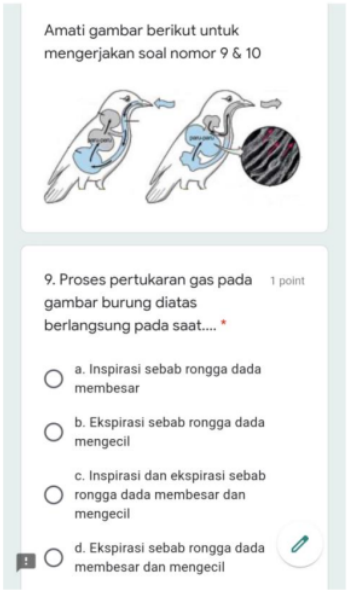
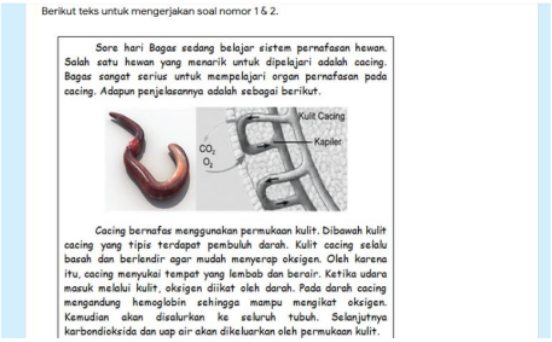


Figure 11. Logic and reasoning question number 9, Package B

The students' logic and reasoning skills were challenged by problem number 9. The problem required the students to use deductive logic to draw conclusions from the general theory of breathing and to explain breathing in birds in detail. This is in accordance with (Siswoyo & Sunaryo, 2017) who state that questions presented with pictures without containing a lot of factual information can be used to test a person's deductive logic in solving a problem because deductive logic does not require a lot of factual information. Based on this explanation, the students' lack of logic and reasoning ability shows weak theoretical mastery that prevented them from making proper associations of the problem presented.

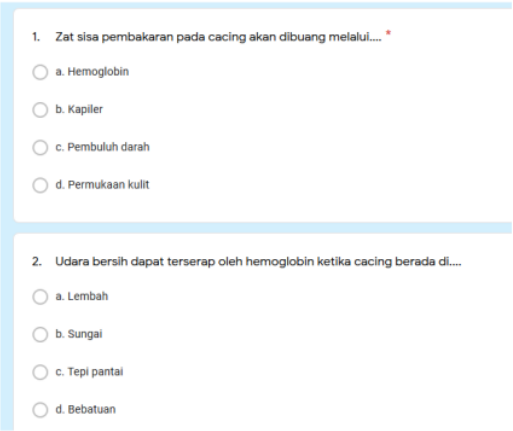
Similarly, the fifth graders at SD IT Baitussalam II obtained poor scores in logic and reasoning. There were 42% students who achieved poor scores on judgement and critical thinking. Their problem-solving skills belonged to high and medium category with a percentage of 32% and the students' logic and reasoning skills were categorized low with a percentage of 51%. The majority of the students provided incorrect answers to problem number 7 and problem number 8 related to judgement and critical thinking. The questions contained a stimulus in the form of an image. The stimulus and the problem are presented in Figure 12.


Berikut teks untuk mengerjakan soal nomor 1 & 2.

Sore hari Bagas sedang belajar sistem pernafasan hewan. Salah satu hewan yang menarik untuk dipelajari adalah cacing. Bagas sangat serius untuk mempelajari organ pernafasan pada cacing. Adapun penjelasannya adalah sebagai berikut.

Cacing bernafas menggunakan permukaan kulit. Dibawah kulit cacing yang tipis terdapat pembuluh darah. Kulit cacing selalu basah dan berlendir agar mudah menyerap oksigen. Oleh karena itu, cacing menyukai tempat yang lembab dan berair. Ketika udara masuk melalui kulit, oksigen diikat oleh darah. Pada darah cacing mengandung hemoglobin sehingga mampu mengikat oksigen. Kemudian akan disalurkan ke seluruh tubuh. Selanjutnya karbondioksida dan uap air akan dikeluarkan oleh permukaan kulit.

Figure 12. Judgement and critical thinking stimulus questions number 1 and 2, Package


1. Zat sisa pembakaran pada cacing akan dibuang melalui.... *
   - a. Hemoglobin
   - b. Kapiler
   - c. Pembuluh darah
   - d. Permukaan kulit

2. Udara bersih dapat terserap oleh hemoglobin ketika cacing berada di....
   - a. Lembah
   - b. Sungai
   - c. Tepi pantai
   - d. Bebatuan

Figure 13. Judgement and critical thinking questions number 1 and 2, Package C

In questions 1 and 2, the stimulus was given in the form of a text and the answer to each questions was stated in the text. Despite so, only a few students were successful in answering the questions correctly. Students with high scientific literacy will perform better in higher order thinking skills (HOTS) (Putranta & Supahar, 2019; Suryawati et al., 2018). In this study, the students demonstrated poor judgement and critical thinking skills due to low scientific literacy. The students' logic and reasoning skills were also in the low category. An example of logic and reasoning question is shown in Figure 14.

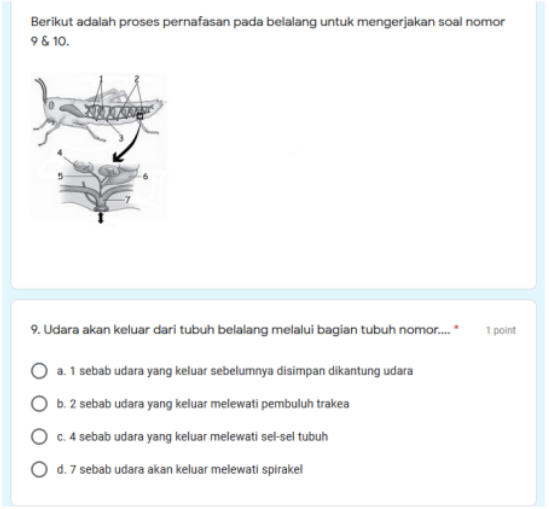


Figure 14. Logic and reasoning question number 9, package C

Unlike question number 9 in Package B, question number 9 in package C shows a different animal. The question was intended to assess the students' deductive reasoning skills. The analysis results showed that the students obtained poor scores on this category. Besides, it was also found that the students had poor problem-solving skills (package C0 and poor judgement and critical thinking skills (package A). This finding is confirmed by (Fajriyah & Agustini, 2017) who found that students have poor ability in making deductions, analyzing errors, analyzing perspectives, making decisions, enriching experiences, and solving a problem.

In addition, the results of this study suggest that the students had difficulty answering higher order thinking questions. It may happen because the students were not accustomed to solving non-routine problems. In addition, the students were unable to make associations between prior knowledge with new knowledge (Akmala et al., 2019). This was shown by the fact that the students answered incorrectly to logic and reasoning problems despite the stimulus that had been provided for assistance. Besides students' ability, learning process may also contribute to the students' HOTS development. As stated by (Fajriyah & Agustini, 2017), higher order thinking skills are essentially a form of learning outcomes that are influenced by various factors, including the learning model and media used by the teacher in the classroom. The application of appropriate learning models and media can support the development of students' higher-order thinking skills (HOTS). One learning model that can be used to improve HOTS is worksheet-assisted Problem Based Learning (PBL). This learning model has been proven to be effective in promoting students' HOTS (Sari & Silitonga, 2016).

CONCLUSIONS

Novelty and Contribution

Past studies on higher order thinking skills (HOTS) focused merely on Bloom's Taxonomy, while the current study revealed students' HOTS based on logical reasoning, judgement and critical thinking and problem-solving that are in line with the 21st century education goals.

The findings of this study will be useful for elementary school teachers and practitioners in finding effective solutions to current educational problems.

Limitation and Future Research

This study has some limitations in terms of research focus and research population. In terms of focus, the current study was only focused on one Basic Competence in science which is human and animal respiratory organs. Besides, the research subject was limited to the elementary level. Therefore, future research needs to include more indicators of higher order thinking skills (HOTS) and more extended subjects of research.

Implications/Suggestions

There are three important suggestions that can be derived from the research findings. First, schools should enrich teachers' knowledge and broaden teachers' view of higher order thinking skills (HOTS) because students' HOTS are strongly affected by the learning process. Second, elementary teachers in Indonesia need to be able to select appropriate learning strategies and methods to optimize the process of learning, develop students' thinking ability and facilitate students' HOTS, for example learning models that fully involve students in the process (inquiry, problem-based learning, project- based learning, discovery, etc). Finally, the government, supported by researchers on relevant fields should design a proper evaluation system to overcome time constraint.

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