

## ANALYSIS OF AVAILABILITY OF HOTS IN PHYSICS EXAM AT SENIOR HIGH SCHOOL IN LIMA PULUH KOTA DISTRICT

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### ABSTRACT

The 2013 curriculum requires students to have thinking skills, such as Higher Order Thinking Skills (HOTS). One strategy to train students' higher-order thinking skills is to apply HOTS questions in the learning evaluation. Through evaluation, the teacher can determine the level of students' skills in higher-order thinking. Preliminary observations show that the Physics exam questions use in Senior High School (SHS) in Lima Puluh Kota District have not identified whether it already contains HOTS in it. Therefore, the study conducts an analysis of the availability of HOTS on physics questions at SHS in Lima Puluh Kota District. This research is descriptive research with a qualitative approach. The data population in this study are all SHS in Lima Puluh Kota District. The sample in this study is six SHS in Lima Puluh Kota District. Sampling for schools carries out using the Proportionate Stratified Random Sampling technique. The research data takes using the instrument of analysis of the questions presented and collecting data through documentation. Based on the analysis, it is found that the percentage of HOTS availability on the questions for each skill is as follows. Transfer one concept to another 19.98%, process and applying information 40.50%, find connections from different kinds of information 32.23%, use the information to solve problems 36.67%, critically examine ideas and information 8.10%. Based on these data, it can be concluded that the percentage of the availability of HOTS in physics questions for senior high schools in Lima Puluh Kota District is 27,9%, with the category of less available.

**Keywords :** Analysis; Exam Question; HOTS



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## I. INTRODUCTION

Education is an essential capital in the intellectual life of the nation. Education will continue to develop according to the demands of the times. Education in Indonesia currently directs students to meet the demands of the 21st century. The competencies needed in the 21st century are critical thinking, collaboration, communication and creativity. The government's effort to improve the quality of learning and the quality of graduates is to develop a curriculum. One of the new things in the 2013 revised 2017 curriculum is implementing the Higher Order Thinking Skills (HOTS) concept [1].

Higher-Order Thinking Skill (HOTS) is a high-level (cognitive) thinking ability that consists of the ability to analyze, evaluate, and create in the taxonomy of cognitive domain objectives. HOTS on questions measures the ability to transfer one concept to another, process and apply information, find connections from different kinds of information, use the information to solve problems, examine ideas and information critically [2]. Evaluation questions that fall into the HOTS category are questions with levels C4 (analysis), C5 (evaluation) and C6 (creating) [3].

The characteristics of the HOTS questions measure higher-order thinking skills, using a variety of questions and based on contextual problems. The role of HOTS questions in the assessment is to prepare students' competencies in the 21st century, increase student learning motivation, improve the quality of assessment of learning outcomes and foster a sense of love and care for regional progress. In terms of the knowledge dimension, HOTS questions generally measure the metacognitive dimension, not just measuring the factual, conceptual or procedural dimensions [4].

The subject that is closely related to the thought process is physics. Physics learning includes phenomena from simple to complex problems. It trains students to think in a complex manner, not only requires students to be able to solve problems mathematically, but students are required to find physical concepts [5]. Problems in physics are phenomena that occur in everyday life so that physics can train students to think at a higher level.

Students' higher-order thinking skills can achieve if they continue to train. One way to train students' higher-order thinking skills is to use an evaluation in the form of HOTS questions. Applying the HOTS questions expects that students will become familiar with complex problems so that students' higher-order thinking skills will increase.

The assessment standards in the revised 2013 curriculum adapt international standard assessment models gradually. Assessment of learning outcomes expects to facilitate students to improve higher-order thinking skills (HOTS). Questions with HOTS indicators highly recommend in various forms of grade assessment and grade exams. The application of HOTS questions can prepare students' competencies for the 21st century, increase students' learning motivation, and improve the quality of assessment. Observing that one of the objectives of preparing HOTS questions is to develop students' creativity, teachers must also be creative in preparing HOTS questions. Teachers must have sufficient and varied supplies of HOTS questions for certain KDs that can make HOTS questions so that the characteristics of HOTS questions do not change and the quality is maintained. In assessing learning outcomes, the teacher uses HOTS items proportionally [6], meaning that not all evaluation questions are HOTS questions.

Higher Order Thinking Skills also applied following Indonesia's low ranking in the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) compared to other countries. The research results published by PISA every three years, which were released simultaneously on December 3, 2019, Indonesia's ranking decreased compared to PISA results in 2015. Indonesia is in the 9th lowest rank or 71st rank out of 79 PISA participating countries in scientific ability. That shows that Indonesia is still in the lower grade in solving problems with the HOTS category and illustrating the importance of teachers directing their students to think at higher levels to compete with other countries.

Based on the initial study, researchers made observations about learning models and teaching materials used in schools, and researchers found that schools had implemented student-centred learning models. Besides that, the teaching materials used are also based on HOTS even though they are in a low category. It is what researchers know based on previous research conducted by Syafrinaldi [7]. Researchers also analyzed students' abilities in solving national exam questions. They found that students' abilities in solving national exam questions were still low and below the graduation standard. In contrast, the graduation standard required students to complete national exam questions with an average of 55.

Based on the description above, it can see that there is a gap between the ideal situation and the actual conditions in the field where the learning tools and student worksheets are already HOTS oriented, but students' ability to answer national exam questions is still low. The teacher's midterm exam questions and final physics semester exam have not identified whether there are HOTS questions. Therefore, it is necessary to research whether the midterm exam questions and the Physics Semester exam of SHS in Lima Puluh Kota District already have HOTS.

## II. METHOD

Based on the background, the purpose of the research is to find out the availability of HOTS on the questions of the midterm exam and Physics semester exam of SHS in Lima Puluh Kota District. Descriptive research was conducted with a qualitative approach. Descriptive research is one of the most basic forms of research. Descriptive research intends to describe or describe existing phenomena, both natural and human engineering [8]. Descriptive research carried out to explain something or illustrate something as it is [9]. A qualitative approach is a research that produces descriptive data in written or spoken words from people and observed behaviour [10].

The population of this research is all SHS in Lima Puluh Kota District. The sampling technique in this research is proportional stratified random sampling. The Proportional Stratified Random Sampling technique sampling is because the population in this study are public high schools scattered in Lima Puluh Kota District. So that all schools can represent, the sample is taken with the same proportion [11]. The sample selection was made by grouping schools based on strata, as seen from the average national exam scores in 2019. The sample was then taken based on the high, medium, and low score categories. The sample schools in this study were SHS 1 Suliki, SHS 1 Harau, SHS 1 Payakumbuh, SHS 1 Akabiluru, SHS 1 Pangkalan Koto Baru, SHS 1

Mungka. The questions studied are the midterm and semester exam for Physics grades X, XI, and XII in 2019/2020.

Based on the research objectives, the research instrument used in this study was an analysis sheet in a statement regarding HOTS on SHS Physics questions in the Lima Puluh Kota district. The overall validity results sought using the Kappa Cohen formula [12]:

$$\text{Moment Kappa } (k) = \frac{P_o - P_e}{1 - P_e} \quad (1)$$

The validation results obtained from two expert validators are in the very valid category. These results can be seen in Table 1.

**Table 1.** Instrument Validation Results

No	Validator	Score	Criteria
1	Expert 1	0,81	Very Valid
2	Expert 2	0,84	Very Valid

The validation results obtained from two expert validators are in the very valid category. After being revised, this research instrument was re-validated.

Then the data collection stage. This research's data collection techniques are through documentation studies and information obtained from various written sources or documents. This documentation study collects documents or data needed in research problems and then examines them in-depth. The data obtained through the documentation method is data on midterm exam and Physics semester exam questions from sample schools in the Lima Puluh Kota district. Midterm exam and Physics semester exam questions collected are then analyzed to determine the availability of HOTS.

The data analysis technique used is content analysis, which is a method by making contextual inferences (conclusions) so that communication messages can understand in their entirety [13]. Content review is a procedure used to draw valid conclusions from a book or document [14]. It can conclude that the data analysis technique with a content study is a step used to complete both books and documents to understand in their entirety. The data processing technique carried out in this study used the formula:

$$\frac{\sum \text{The emerging HOTS}}{\sum \text{HOTS}} \times 100\% \quad (2)$$

The criteria for high school physics questions available for HOTS skills can be seen in Table 2.

**Table 2.** The Criteria for Physics Questions Available HOTS

Interval	Criteria
81-100	Very Aavailable
61-80	Aavailable
41-60	Sufficient Aavailable
21-40	Less Aavailable
0-20	Not Aavailable

(Source: Ref [15])

### III. RESULTS AND DISCUSSION

Based on the research objectives, data were obtained about the availability of HOTS skills on the midterm and semester exam of Physics in Lima Puluh Kota District. The research analyzed 60 samples of physics test texts from 6 SHS in Lima Puluh Kota District. After the analysis, the percentage of skills availability is obtained, which is described as follows.

The results of the analysis of the availability of HOTS on the questions of the midterm and semester exam for grade X Semester 1 SHS in Lima Puluh Kota District can be seen in Figure 1.

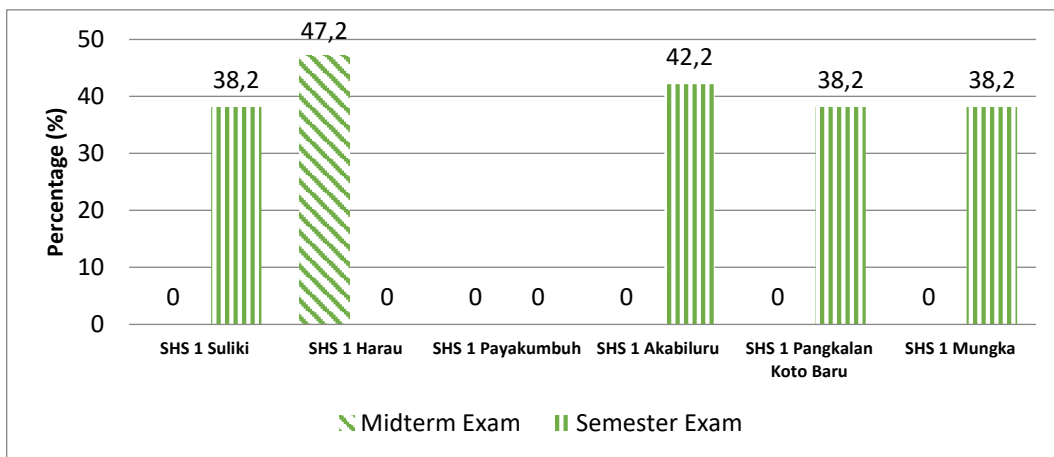


Fig. 1. Availability of HOTS on midterm exam and physics semester exam for grade X semester 1

Based on Figure 1 in the mid-semester Physics exam questions for grade X semester 1, the average availability of HOTS is 8% in the not available category. In contrast, in the semester exam questions, it is 26% in the less available category. At the midterm questions, only middle exam questions at SHS 1 Harau has HOTS questions with a percentage score of 47,2% with sufficient available category, namely on vector material, this is because the Basic Competence studied for midterm material in grade X semester one is only up to the C3 cognitive level, namely apply. The highest percentage of HOTS on the midterm questions is the ability to process and apply information with the not available category. There are three materials in the semester exam with a cognitive level of C4 in the semester exam, namely straight motion, circular motion, and parabolic motion. Most HOTS questions are found in the illustrative motion material, namely three questions. The highest percentage of HOTS is in SHS 1 Akabiluru with a score of 42,2% with sufficient available category, and there are still questions that do not contain HOTS questions. On average, the HOTS questions found in each manuscript are one question, the most HOTS questions found in semester exam questions in SHS 1 Suliki with two questions. The skill with the highest percentage is processing and applying information, which is 43% with a sufficient available category. The use of test questions with higher-order thinking skills can improve student achievement [16], Increase students' learning motivation, and improve learning outcomes [17].

Furthermore, the average percentage of HOTS availability on the midterm and semester exam questions for grade X Semester 2 for each school can be seen in Figure 2.

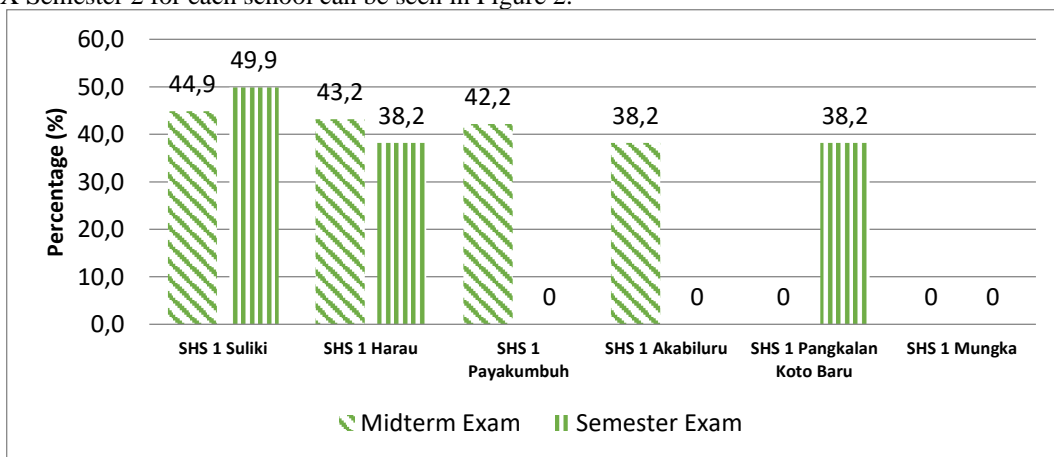


Fig. 2. Availability of HOTS on midterm exam and physics semester exam for grade X semester 2

In the midterm questions for grade X semester 2, SHS 1 Suliki got the highest average percentage score of 45% with a sufficient available category, and there were still questions that did not contain HOTS questions. The highest percentage of HOTS skills on the ability to process and apply information with a sufficient available category means that general questions have trained students to process and apply information. The lowest percentage of HOTS skills is in the ability to examine ideas and information critically, this is because HOTS questions are found only at the C4 cognitive level. In HOTS, students are stimulated carry out contextual analysis that occurs around them [18]. In the semester exam, SHS 1 Suliki got the highest average percentage score of 50% in the sufficient available category, and there are still question texts that do not contain HOTS questions. Most HOTS questions are found in Newton's Law material, namely three questions. Overall, the

availability of HOTS skills on the midterm questions for grade X semester 2 is 28% with the less available category and 21% on the semester exam questions with the less available category.

The availability of HOTS on the midterm and semester exam questions for grade XI semester 1 for the six schools can be seen in Figure 3.

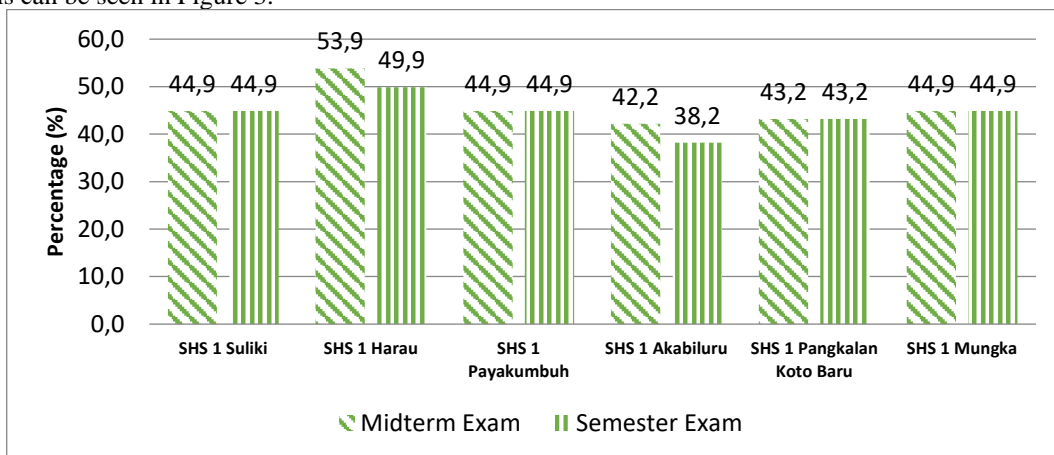


Fig. 3. Availability of HOTS on midterm exam and physics semester exam for grade XI semester 1

Figure 3 contains the availability of HOTS on the midterm and semester exam questions for physics grade XI semester 1. It is known that the midterm and semester exam questions in each school contain HOTS questions. In the midterm questions, the highest availability of HOTS is in SHS 1 Harau, namely 54%, with a fairly available category. The HOTS questions in each text for the midterm test are only one question on average, the most questions found in SHS 1 Harau are three questions. Most HOTS questions are found in rigid body equilibrium materials. The HOTS questions were found only at the C4 cognitive level. The HOTS skill with the highest percentage is processing and applying information with available categories. Overall the average percentage score of the midterm questions is 28%, with the less available category.

In the semester exam questions, there are HOTS questions from the six schools. SHS 1 Harau got the highest average percentage score of 50%, with sufficient available category. On average, there is only 1 HOTS question in each question text, this is certainly not enough to train students in answering HOTS questions. There are at most HOTS questions in one text, only two questions in SHS 1 Harau. The HOTS skill with the highest percentage is processing and applying information. Availability of HOTS skills in the physics grade XI semester 1 semester exam questions 44% with sufficient available categories.

Furthermore, the results of the analysis of the availability of HOTS on the questions of the midterm and semester final exam for grade XI semester 2 for the six schools can be seen in Figure 4.

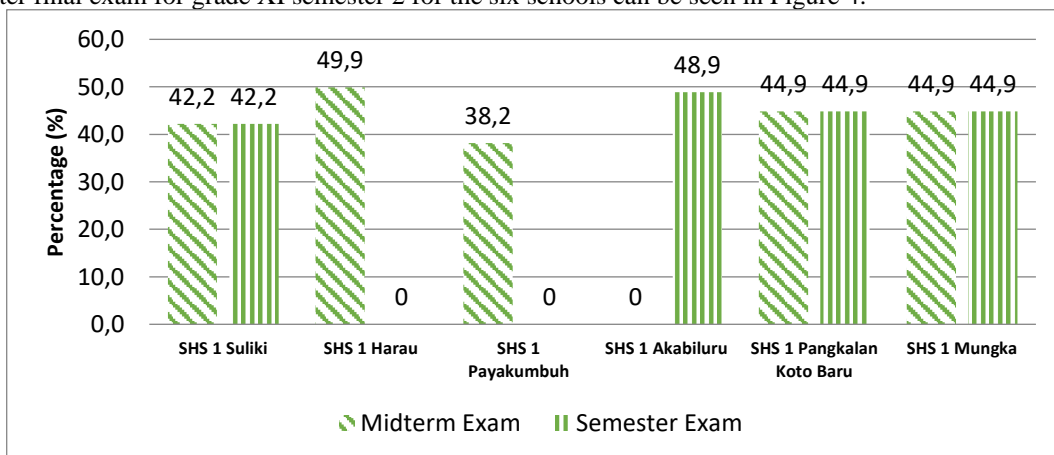


Fig. 4. Availability of HOTS on midterm exam and physics semester exam for grade XI semester 2

Availability of HOTS skills in semester 2 Grade XI on physics midterm questions is 37% with the less available category. SHS 1 Harau got an average percentage score of 50%, SHS 1 Pangkalan Koto Baru and SHS 1 Mungka got the highest average percentage score of 45% with a sufficient available category, and there are still text questions that do not contain HOTS questions. The HOTS questions found in each question paper, on average are only one question. HOTS skills with the highest percentage are processing and applying information. Overall, the availability of HOTS skills on the midterm questions is 37% in the less available category. For



semester exam questions, the highest percentage was in SHS 1 Akabiluru with a score of 49% with a sufficient available category, and there are still question papers that do not contain HOTS questions. Most HOTS questions are found in wave material. Overall, the availability of HOTS skills on semester exam questions is 30%, with the less available category.

Analysis of the availability of HOTS's availability on the midterm and semester exam Physics grade X SHS in Lima Puluh Kota District can be seen in Figure 5.

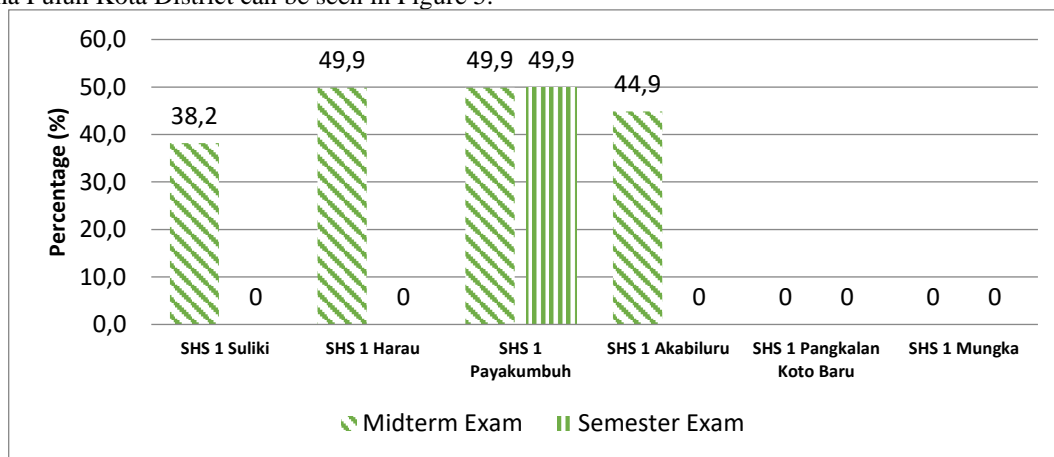


Fig. 5. Availability of HOTS on midterm exam and physics semester exam questions for grade XII semester 1

The availability of skills analysis results in Figure 5 shows that in the midterm questions, the highest percentages are SHS 1 Harau and SHS 1 Payakumbuh with a score of 50% with a sufficient available category, and there are still text questions that do not contain HOTS questions. The HOTS questions in the semester exam are only found in the SHS 1 Payakumbuh question text with an average percentage score of 50% with sufficient available categories. The HOTS problem is found in the capacitor material. Overall the availability of HOTS skills on the midterm questions is 30% in the less available category, the percentage for 8% semester exam questions with the not available category. The grade XII analyzed questions were the only semester one questions because, in semester two, there were no midterm and Semester exams but focused on the semester exam.

Overall, the lowest percentage of HOTS skills is on the ability to examine ideas and information critically. This is because the questions used for the midterm and semester exam are multiple-choice questions. Multiple choice questions are hard-pressed to effectively measure creativity, collaboration, and communication, and their use to measure critical thinking skills is always controversial [19]. The ability to examine ideas and information critically is not available. The use of stimuli that do not require students to think critically and find new ideas in solving problems on the questions. This can be detrimental to students because the HOTS assessment can improve students' critical thinking skills effectively [20].

The availability of HOTS questions in each Physics exam question manuscript in the less available category is because the HOTS questions found in each question text are at most three questions, namely in the semester exam Grade X semester 2 SHS 1 Suliki, and the midterm grade XI semester 1 at SHS 1 Harau. In general, the HOTS questions in each question text are only 1 question, and there are still question readers who do not have HOTS questions. There are 22 physics materials with analytical indicators, but not all materials are met in the availability of HOTS questions from the analysis results. The availability of HOTS skills in SHS 1 District of Suliki is 34.5%, with less available. in SHS 1 Harau is 33.2% in the less available category, and SHS 1 Payakumbuh district is 27% in the less available category, SHS 1 Akabiluru district is 25.4% in the less available category, SHS 1 Pangkalan Koto Baru district is 25, 2% with less available category and SHS 1 Mungka 21.8% with less available category. The following are the sample criteria that the researcher uses. The results of the analysis showed that 22 question texts did not contain HOTS questions. Overall, the availability of HOTS is described, transfer from one concept to another 21.1% with the category of less available. Process and apply information 40.7% with the category of less available. Find links from various information 32.2% with less available category. Use the information to solve problems 36.3% with less available category. Critically examine ideas and information 9.1% with not available category. The overall abilities have the highest percentage of skills process and apply information. Overall, the availability of HOTS skills on SHS Physics questions in Lima Puluh Kota District is 27.9%, with the less available category.

#### IV. CONCLUSION

The study results state that the HOTS skills in each test question text were on average in the unavailable, less available, and moderately available categories. The question paper with the highest fulfillment of the HOTS component is the midterm test for grade XI SHS 1 Harau 53.9% with a sufficient available category. The school with the highest availability of HOTS skills is SHS 1 Suliki 34.5% in the less available category. The most dominant skill found was the skill to process and apply information, while a minor skill found was examining ideas and information critically. Meanwhile, there are twenty-two question texts in which there are no HOTS questions. It can conclude that the percentage of HOTS availability in SHS Physics questions in Lima Puluh Kota District is 27.9%, with the category of less available.

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