23 (4), 2022, 1802-1826

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Developing HOTS Instruments: Is It Difficult for Physics Teachers?

Duden Saepuzaman[1,2,*], Heri Retnawati[2], Edi Istiyono[2], & Haryanto[2]

[1]Departemen of Physics Education, Universitas Pendidikan Indonesia, Indonesia

[2]Department of Educational Research and Evaluation, Universitas Negeri Yogyakarta,Indonesia

Abstract: This study aims to identify the difficulties of physics teachers in making High Order Thinking Skills (HOTS).This research is phenomenological qualitative research. Data was collected through interviews, tests followed by FGD. The participants of this study were 33 physics teachers. The data were analysed using Bogdan and Biklen with reduction stages, looking for relationships between themes and conclusions. The results showed that the teacher was very familiar with HOTS. Overall, the teacher has understood the importance of HOTS and the learning process for teaching HOTS to students. But the thing that became the teacher's obstacle was assessing HOTS through an instrument that measures HOTS. If traced to the teacher's difficulties very sequential, start planning, constructing problem questions, making stimulus, combining concepts/formulas in physics, to the validation stage.

Keywords: developing instruments, physics teachers' difficulty, HOTS.

Abstrak: *Penelitian ini bertujuan untuk mengidentifikasi kesulitan guru fisika dalam membuat Keterampilan berpikir tingkat tinggi (HOTS). Penelitian ini merupakan penelitian kualitatif fenomenologis. Pengumpulan data dilakukan melalui wawancara, tes yang dilanjutkan dengan FGD. Partisipan penelitian ini adalah 33 orang guru fisika. Data dianalisis menggunakan Bogdan dan Biklen dengan tahapan reduksi, mencari hubungan antara tema dan kesimpulan. Hasil penelitian menunjukkan bahwa guru sangat familiar dengan HOTS. Secara keseluruhan, guru telah memahami pentingnya HOTS dan proses pembelajaran untuk mengajarkan HOTS kepada siswa. Namun hal yang menjadi kendala guru adalah menilai HOTS melalui instrumen yang mengukur HOTS. Jika ditelusuri kesulitan guru sangat berurutan, mulai perencanaan, penyusunan soal soal, pembuatan stimulus, penggabungan konsep/rumus dalam fisika, hingga tahap validasi.*

Kata kunci: *pengembangan instrumen, kesulitan guru fisika, HOTS.*

▪ INTRODUCTION

Today it is known as a century full of competency challenges in both science and technology. The challenges in the 21st century are the competencies required not only on conceptual knowledge but also skills to apply knowledge and thinking skills (Ratna and Retnawati 2019). Some 21st-century skills include critical thinking, working together (collaboration), communication, and creativity (Pacific Policy Research Center 2010). Critical and creative thinking skills are often known as the scope of High Order Thinking Skills (HOTS) (Heong et al. 2011). It increasingly shows that HOTS needs to be owned by everyone. People need critical and creative thinking to solve real-life problems.

The importance of HOTS is shared by everyone, including students as the next generation. In dealing with complex real-life problems, students as the next generation must have conceptual knowledge and various life skills, including HOTS (Afifah and Retnawati 2019). As an implication, the implementation of education or learning in the

Duden Saepuzaman
*Email: dsaepuzaman@upi.edu

DOI: http://dx.doi.org/10.23960/jpmipa/v23i4.pp1802-1826
Received: 14 April 2022
Accepted: 20 June 2022
Published: 29 June 2022

classroom must facilitate the training of HOTS students. For students' HOTS to develop optimally, students need to be familiarised with activities that train HOTS itself (Arifin and Retnawati 2017). Training students' HOTS is very important because it is one of the curriculum goals in High School's Basic Framework and Curriculum Structure.

Achieving this goal requires cooperation, support, and effort from all parties involved, especially teachers. The teachers must be able to create and train HOTS for students both in learning and assessment. In addition to using the right learning model, teachers also need to provide questions or exercises to improve students' HOTS. Walsh, Murphy, & Dunbar (2007) also expressed a similar sentiment, who suggested the importance of practical guidance on improving thinking skills and assessing students' thinking abilities. Therefore, teachers need to prepare instruments in the form of questions used to measure students' HOTS. The questions are given in a test/exam (daily tests, midterm exams, or semester exams) (Arifin and Retnawati 2017). Problems with the HOTS model are usually characterised by a problem that relies on the memory of particular knowledge to solve it and requires the ability to process and connect knowledge to solve the problem. If the problem can be solved only by using prior knowledge without connecting knowledge, this ability is usually only classified as Low Order Thinking Skills (LOTS) (Saido et al. 2017).

Regarding Indonesian students' HOTS conditions can be viewed from several aspects, for example, the results of the National Examination. Based on the results of the National Examination 2018 as a whole, it is known that as many as 40% of students have difficulty answering questions that require high logical reasoning or questions loaded with HOTS. Indonesian students' challenges in completing HOTS questions are also apparent from Indonesian students' achievements in international studies, such as Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). The skills contained in TIMSS and PISA are referred to as HOTS (Conklin 2012). The TIMMS results show that from 1999 to 2015, Indonesian students were ranked lower, and there tended to be no difference in scores obtained; for example, TIMSS 2015 Indonesia was ranked 44 out of 49 countries (Nizam 2016). Not much different from the TIMMS results, the latest PISA 2018 data, for example, in science, shows that Indonesia ranks 70th out of 78 OECD countries or participating countries. The score of Indonesian students' scientific ability is 396. This value is far from the average value of science ability from OECD countries, which is 489. It means that Indonesian students' scientific ability is still below the average.

The difficulties or low achievement of Indonesian students' HOTS indicate several things. First, learning that takes place in class does not fully facilitate the development of students' HOTS. Secondly, students are not accustomed to solving HOTS questions, so they have difficulty solving HOTS questions. These things indicate that learning and assessment in the classroom have not led optimally to increase students' HOTS. For example, the insertion of HOTS model questions in the national testing (UN) needs to be balanced by increasing teachers' and students' teaching and learning abilities. This policy reinforces that learning and assessment or measurement of learning outcomes held in class must facilitate students' HOTS development.

The success of learning in facilitating students' HOTS's achievement must involve all parties, not the teacher, who plays a vital role. The finding of students' difficulties could be due to the teachers' difficulties developing HOTS-based learning and assessment. Teachers' difficulties are in line with Retnawati et al. (2018), which shows that the teachers' ability about HOTS, the ability to improve students' HOTS, the teachers' ability to solve HOTS-based problems, and measure students' HOTS is still low. Fauzan (2019) and Laila (2019) reported the same thing that showed that the teachers' ability to create and develop HOTS questions was still lacking. It indicates that teachers have difficulty in making or developing HOTS questions.

This research is focused on finding information in the form of teachers' difficulties in making HOTS questions in learning Physics. This information helps in planning programs that can improve the teachers' ability to make HOTS questions in physics, both theoretical and practical. Researchers do not have any relationship and do not treat respondents who would affect the information obtained.

▪ METHOD

This research uses a qualitative research approach with a type of phenomenology. This research is a descriptive-explorative study because it aims to describe and find the difficulties of high school physics teachers in compiling instruments that measure HOTS. The participants of this study were 33 physics teachers. In general, these respondents represented three regions of Indonesia, namely western Indonesia (West Java, DKI Jakarta, Banten, and Lampung), the central part (Kalimantan), and the eastern part (Sulawesi and Papua). These respondents came from 14 public high schools and 19 private high schools/foundations. In general, respondent data is presented in Table 1. Overall, teachers have more than eight years of teaching physics experience.

Table 1. Participants' demographics

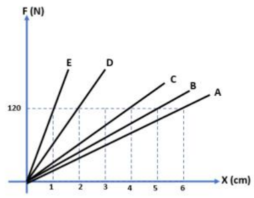
	Public school	**Private school**
West Java	4	10
Jakarta	1	1
Lampung	1	1
Banten	3	2
West Kalimantan	1	3
South Sulawesi	2	2
West Papua	2	0

The interview material and FGD are matters related to HOTS. HOTS question compilation are divided into several themes ranging from (i) teacher perception about HOTS definition (ii) characteristics of HOTS questions in physics, (iii) some examples of HOTS questions made by teachers, (iv) the teacher's ability to solve on HOTS question, (v) teacher perceptions related to HOTS learning requirements in physics, (vi) the teachers' difficulties in teaching HOTS, (vii) teacher ways to rain students' HOTS in classroom learning, (viii) assessing HOTS, (ix) the teachers' difficulties to prepare HOTS instruments, and (x) difficulties in carrying out HOTS assessments.

Based on this objective, several questions were developed, which would be extracted from respondents through interviews, questionnaires, and FGDs. These questions are developed based on research objectives. In this study, the researcher himself is the main instrument. They are testing the validity and reliability of this study using triangulation. Patton (2002) advocates the use of triangulation by stating that triangulation strengthens research by combining methods. In this study, triangulation was carried out using sources by comparing and cross-checking the degree of trustworthiness of information obtained through different time and qualitative research tools (Patton, 2002). In this study, the data compared are direct formal interviews, distributed questionnaires, and direct FGDs. Data is considered valid and reliable when the information obtained is coherent. Describe the HOTS ability teacher, and it was carried out using a test instrument consisting of two questions. The questions used are presented in Figure 1. This instrument has been validated by experts and has been empirically tested for its validity and reliability

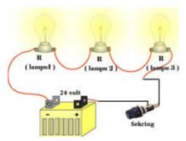
Data related to the Physics teacher's difficulty compiling HOTS questions was collected through interviews, tests and continued through FGD to complement the data. The interview aims to capture all information related to teachers' perceptions and difficulties in making HOTS questions. The test using HOTS questions is intended to determine the teacher's ability to answer HOTS questions. At the same time, the FGD aims to verify and complete the interview and test data. The data collection was conducted in the range of April 21 to May 9, 2020

1. The five springs have the characteristics shown in the graph of Force (F) against the increase in length (x), as shown in the following figure.



A car having a mass of 1370 kg is used to carry two passengers with a total mass of 130 kg. In this car, four identical springs are installed as shock absorbers. If when passing through a car hole oscillates with a frequency $\left(\frac{2}{\pi}\right)$ Hz, which spring is most appropriate to use out of the five springs in the graph above? Explain!

2. Suppose Consider the following picture of a series of three identical lamps.



The fuse has a limit of 0.4 A. If the R2 lamp blows, while no other lamp is available, there are only a few obstacles of the following size.

Resistor	Resistance	Quantity
A	47 Ω	5
B	51 Ω	5
C	100 Ω	4

For the remaining two lamps to light normally as before, how can a proper resistor circuit be made to replace a broken lamp?

Figure 1. Item to measure the teacher's ability to solve HOTS questions

Data analysis was performed using Bogdan and Biklen (1982), starting with the data reduction stages of FGD record results and interviews. These reduction results are then presented in a table, and an interrelated relationship is sought to obtain a comprehensive and credible picture and understanding. The last stage, the relationship between themes, is used to conclude high school physics teachers' difficulties in preparing HOTS questions. In this study, respondents were told that the data provided were only used for research purposes and would not affect the respondent's position or rank. Also, the respondents' names were mentioned in the code, so they would not affect the respondents' fate the only relationship between researchers and participants in collecting and exploring data by interviews and tests. Focus Group Discussions (FGD) are generated from teachers' knowledge about HOTS, especially the teachers' difficulty making HOTS physics questions.

▪ RESULT AND DISSCUSSION

Teachers' perceptions related to the definition of HOTS

Information obtained about the teachers' perception of HOTS in physics shows that physics teachers still have different perceptions about HOTS. Teachers' perceptions of the HOTS physics problem are mostly related to their length and refer to Bloom's taxonomy. Some teacher-related explanations associated with the purpose of HOTS questions in physics are presented in Table 2.

Table 2. Teachers' perceptions regarding hots in physics

Physics Teachers' Perceptions About HOTS	Result
High Order Thinking Skills or High-Level Thinking Skills	Most teachers understand HOTS by definition by referring to Bloom's taxonomy (analyse, C4; evaluate, C5; and create, C6) or other skills (such as critical, creative, reflective). Even though some still define HOTS, it is always associated with learning and questions.
The ability to solve high-level problems	
HOTS is a students' ability to think higher-level by using his reasoning in learning or answering problems	
Problems that require higher-order thinking skills, C4-C6 Cognitive Domains	
The high-level ability (critical thinking, logical, linking one problem with another problem to create)	
He is training in critical power and creativity through physics content.	
The level of difficulty in problems	
The learning that combines concepts and factual facts in everyday life as well as connecting with other subjects that are in harmony	
The ability to think is not merely recalling, restating, or referring without processing (recite). Still, it requires other higher abilities, such as thinking creatively, critically, collaboratively, and communicatively.	
The flow of thinking to hone the ability to think critically, logically, creatively, reflective, metacognitive, innovative, etc.	
HOTS is a concept that demands or trains students to think at a high level if, for example, it is adjusted to Bloom's taxonomy from C3 onwards.	
HOTS (*Higher Order Thinking Skill)* is a matter of high analytical ability or high taxonomic level	
HOTS is a higher level of thinking than memorising, where the intended ability to think higher level here is the ability to think creatively and critically. HOTS itself is based on an educational concept called	

Physics Teachers' Perceptions About HOTS	Result
Bloom's Taxonomy consisting of three domains, namely cognitive, psychomotor, and afective.	
Learning systematically according to circumstances	

Based on the research findings presented in the study results, in general, the teacher did not understand the meaning of HOTS as a whole. The tendency of teachers to only understand HOTS refers to the revised Bloom's taxonomy in terms of cognitive aspects, which include analysing (C4), evaluating (C5), and creating (C6). There are no teachers who explicitly put forward the dimensions of conceptual, procedural, and metacognitive knowledge. According to Bloom's revised taxonomy (Anderson and Krathwohl 2001), HOTS is a slice between the three main components of the cognitive process dimension (analysis, evaluation, and creation) with the top three components of the knowledge dimension (conceptual, procedural, and metacognitive). This result is in line with Retnawati, Djidu, Kartianom, Apino, and Anazifa (2018) which shows that teachers still lack understanding of HOTS. Other finding, related to HOTS training, this training was often held at the beginning of the emergence of the 2013 curriculum. Because one of the 2013 curriculum review components is high-level thinking skills (HOTS), indirectly, this indicates that the 2013 curriculum socialisation and training are still not optimal. It is in line with Retnawati (2015), which states that teacher training and socialisation of the 2013 curriculum are still lacking based on qualitative studies. Furthermore, Retnawati (2015) stated that there were found some problems in teacher training and socialisation, such as several interpretations of training and socialisation themes and time constraints that led to incomplete material delivery.

Characteristics of questions included in the HOTS problems in Physics

Table 3 contains the analysis and data reduction findings to reveal the teachers' knowledge about the HOTS question's characteristics. The teachers' response to the second sub-theme proves that most of the teachers said that the HOTS question was a question that demanded the ability not merely to memorise or mere formula but to require higher abilities. Also, some teachers still hold that every HOTS question must be marked with a stimulus.

Table 3. Teachers' perceptions regarding the characteristics of hots questions in physics

Teachers' perception about HOTS Problem Characteristic in Physics	Result
HOTS questions in physics are questions that make students use their reasoning abilities, namely by using the ability of analysis, synthesis, and evaluation	The teachers understand HOTS questions' characteristics with different views ranging from questions that measure Bloom's taxonomic domain (analysis, synthesis, and evaluation), problem-solving, there is stimulus, relating to the real world, linking several concepts or formulas. There is also a review of HOTS questions which are done in some steps.
Demanding to predict and draw conclusions from the data provided to solve problems in a given	
Questions that are linked to real-life and connect the concepts of one with the other	
Questions that require formula analysis in answering questions such as a combination of formulas in working on physics problems	

Teachers' perception about HOTS Problem Characteristic in Physics	Result
Analysis problem. Requires more than one concept to understand/be able to answer it.	
Usually, HOTS questions contain information as a stimulus to solve problems, link several concepts and contextual problems.	
Questions-based problems in daily life	
Problems that include physical concepts in everyday life (for example, in technology products) require thinking patterns (e.g., cause-effect) and reasoning. Questions not only require students' mathematical abilities.	
The HOTS question does not mean that the problem is complicated or difficult. Teachers can make HOTS questions from simple topics that can only explore students' abilities more deeply.	
Problems that can be answered by memorising formulas but need to understand the concepts of the material as well stimulate students to think critically and creatively.	
Scientific steps then solve questions that are in the form of real natural phenomena.	
Problems that require more thinking cannot be answered directly in one step.	
Questions that require students to hone critical, logical, creative, reflective, metacognitive, innovative, etc.	
Problems with cognitive levels C4, C5, and C6	
Comparative analysis	
Questions problems that are difficult are usually about HOTS	

Further findings were found by teachers defining HOTS about learning and problems. It shows that the teacher still understands HOTS in part. One factor that is allegedly lacking in understanding is the lack of socialisation and training related to HOTS teachers take. It is reinforced by the data that some teachers have never attended HOTS training or socialisation. So that socialisation and training are still needed to introduce HOTS to Physics teachers. In addition to participating in the causes, further effectiveness of the activities carried out also needs to be considered. Sometimes teachers who have attended training or outreach still have difficulty understanding and applying HOTS both in planning, learning processes, and assessment. This study's data shows that most of the training that teachers have participated in is seen as less effective.

The Examples of HOTS Questions in Physics

Regarding examples of HOTS questions in physics, some answers or examples of questions given by the teacher When asked to provide examples of HOTS questions in physics are presented in table 4. Not all teachers write examples of HOTS questions and their indicators. Some teachers claimed that they could not produce HOTS questions, but they were not sure about measuring HOTS or not, so they did not dare to raise their questions.

Table 4. Examples of hots questions made by the teachers

Examples of HOTS Questions According to The Teachers	Result
Not sure yet about measuring HOTS Indicator of the problem: Students can predict the movement of the box with a particular style of the image presented. Example problems: presented a picture of a man pushing a box with a specific style. Also shown is the length of the inclined plane and the height of the board from the ground. Students are directed to use the incline plane equation and find the weight of the box. So students can predict whether the package can move with style given by the man. Draw a picture (draft) example of a series of closed electric current in which there is a series of joint resistance between a series of series resistance and a series of parallel resistance (C6 - Create) DisajPresented graph v of x of straight motion, students can describe the motion of objects. Presented performance data of two washing machines based on the engine's rotation and its fingers, students can deduce which washing machine performance is better based on the data presented. Indicator: Applying the concept of momentum in everyday life. Problem: (presented a video about car collisions with road dividers). How is the change in momentum related to the level of damage to the car? What should be done to reduce the level of damage in similar incidents? An object is given a force. Objects remain stationary. Where is the style? Force added, the object remains stationary. Who stole our style? The force continues to be added, and new objects move, even then slowly. We don't even need the force as big as the last one to keep that thing moving. What exactly happened? Can you graph the relationship between force and speed to time? Indicator: Analysing the density of objects based on the ability to expand an object. Problem: A cube-shaped vessel with a side length of 200 cm is found at a temperature of 34 degrees Celsius. The	Most teachers have not made HOTS questions because some of the examples given do not seem to measure HOTS.

Examples of HOTS Questions According to The Teachers	**Result**
vessel is then heated so that the temperature becomes 72 degrees Celsius. What is the vessel's density before and after it is heated if the coefficient of expansion of the length of the vessel is 0.000012/°C?	
An export company that needs a freight ship conducts a shipbuilding auction. Bidders 1. make a prototype of a transport ship with a size of 10 cm x 20 cm x 6 cm. Materials, please select the price for the type of material 2. make a shipbuilding budget 3. predict how much the value of goods can be transported. For example, using 100 rupiah coins The auction winner is the one who can transport the most goods and the smallest value of manufacture	
Problem Indicator: Analyse the use of convex mirrors and flat mirrors on cars Problem: why are convex mirrors used as rearview mirrors on cars? Explain! However, even though it is equipped with a rearview mirror, why do you still use flat mirrors located at the top near the steering wheel? Explain the reason!	
Two small wooden blocks A and B, floated on the surface of the pond. Both are 150cm apart. When the waves spread on the water's surface, Observed pad when t = 0-second block A is on the top and beam B is in the valley. Both are separated by one wave peak. When t = 1, the second block of A is at a balanced point and is moving downwards. What is the wavelength of water?	
Students can give examples of heat transfer by convection	
The human body can only withstand acceleration 10 times the acceleration of earth's gravity (g = 10 m / s2), without endangering itself. A plane swooped at a speed of 756 km / h and by the pilot was deflected back up at the same rate forming a circular path with a radius of 365 m. In your opinion, will this condition endanger the airplane pilot? Explain using existing data.	
Indicators: Designing a submarine design which is easy to set the depth utilising Archimedes law and torque Problem: Make a draft of air space in the submarine that allows the submarine to easily change the depth	

Examples of HOTS Questions According to The Teachers	Result
Presented information (picture/description) with much known physical quantities about traffic collisions between cars and trucks. And there are speed limit signs. Asked: After the crime scene, which car broke the rules?	
Indicator: Analysing the static electric coloumb force	
Problem: Two similar electric charges with a distance r experience a coulomb force of F. If the distance of the two charges is reduced by 1/2 times the original distance what is the coulomb force that occurs ...?	
An electric heater whose resistance R uses a voltage source of 10 V. The heater is used to heat 1 liter of water from 10 degrees C to 70 degrees C. If 70% of the heat produced by the heater is taken out of the water, then the time required is t second. If the heat produced by 80% of the heater is taken, then the time required is. . . .	

Teachers' understanding of the characteristics of HOTS questions varies, related to Bloom's taxonomy (analysis, synthesis, and evaluation), problem-solving, stimuli related to the real world, connecting some concepts or formulas, problems carried out with several steps, and some even think that HOTS problem is difficult. These findings show that new teachers understand the characteristics of HOTS questions conceptually without operations. Further findings through the FGD, some teachers could not explain more specifically the characteristics of the HOTS questions. The teacher recognised this condition when trying to make HOTS questions, and there is a sense of self-confidence whether the questions made measure HOTS or not. This condition was reinforced by discovering teachers' difficulties when asked to make HOTS indicators and items. Most of the questions made by teachers do not yet reflect the characteristics of HOTS questions. These two findings seem to be closely related. The low understanding of teachers regarding HOTS and HOTS characteristics impacts the low ability of teachers to make HOTS questions. These results are in line with research Novi Arti (2015), which shows that the low understanding of science teachers in understanding HOTS and the characteristics of HOTS questions impacts the low ability of teachers to make HOTS questions.

The Teachers' Ability to Solve on HOTS Questions

The teachers' ability to HOTS questions is obtained based on the teachers' answers to HOTS questions. The researcher asks the teachers to provide solutions to two HOTS physics questions. For example, problem no. 1 is related to material elasticity properties. Some teachers' answers to HOTS physics questions were then clarified through interviews and obtained responses as follows.

Teacher-2 "system mass is the mass of the car plus the mass of the person so that the mass of the system (1370 kg + 130 kg = 1500 kg), with known spring frequency and arrangement data, the constant spring value can be determined using the frequency equation for spring: $f=1/2\pi\ \sqrt{(k/m)}$. So the constant spring value of the system is

240,000. Because k what is obtained belongs to the system, using the principle that the parallel system spring constant is the number of constants of each constituent spring, the spring constant for one spring is 6000 N/ m. The constant spring value is adjusted to the force graph (F) for the change in the length (x) of the spring with the relationship k being the gradient of the curve F with x or F divided by x, using Hooke's law, must be equal to 6000 N / m, then for F 120 N, an increase is obtained 2 cm long. So what is appropriate is the spring D."

Teacher-8 "The mass of the system is the mass of the car plus the mass of the person so that the mass of the system (1370 kg + 130 kg = 1500 kg), by using $f=1/2\pi\sqrt{(k/m)}$, so that the constant spring value is 240,000 N / m. The spring value of the curve F with x, the corresponding value for F 120 N is obtained x = 5 cm, so that according to the spring B "

Teacher-11 "The total mass is 1500 kg, using and describing $\omega=2\pi f$, so the constant spring value is 24,000 N / m. The spring value of the curve F with x, the corresponding value for F 120 N is obtained x = 0.005 m or 5 cm, so that what is appropriate is the spring B "

Teacher-13 "The total mass (1370 + 130 = 1500 kg), with known frequency and spring arrangement data, the spring constant value can be determined by using the frequency equation for spring $f=1/2\pi\sqrt{(k/m)}$: so that the constant spring value of the system is 240,000. Because k what is obtained belongs to the system, using the principle that parallel has a relationship$1/k_p= 1/k_1+ 1/k_2+ 1/k_3+ 1/k_4$: so we get a spring constant for one spring of 960,000 N / m. by adjusting this data to the graph, $k=F/x$ the closest spring is a spring which if given a force of 120 N will result in an additional spring length of 1cm so that the most appropriate spring is E." Based on the four answers, the correct answer is the answer from Teacher 2. The answers' description puts forward more systematically identify important information or physical quantities and known conditions by analysing, investigating, solving problems (creating), evaluating, and drawing conclusions. The answers written by Teacher 1 are presented in Figure 2. The crossing that appears from Teacher 1's answers is clarified by Teacher 1 as a mistake in counting.

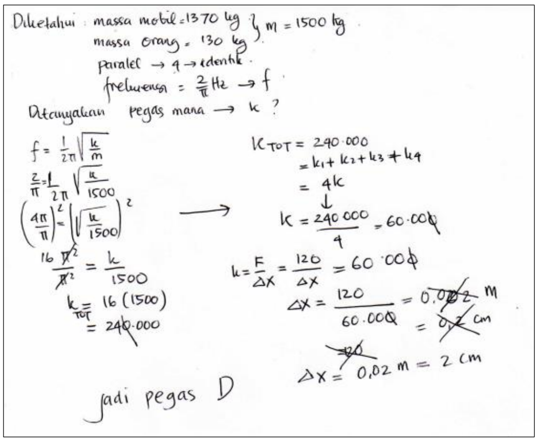
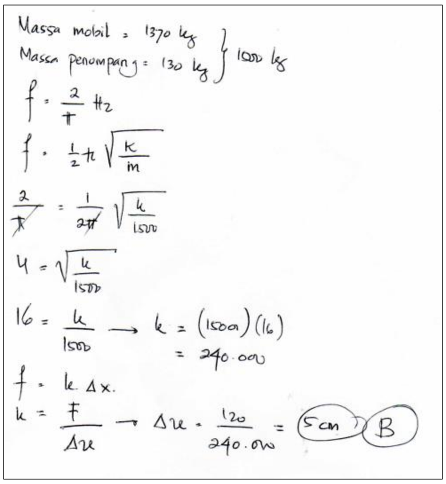
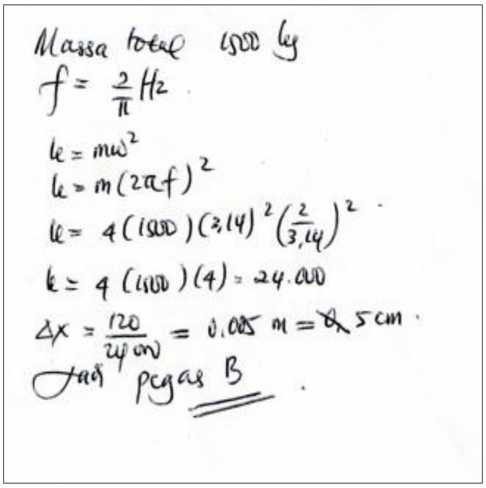


Figure 2. Teacher 2's Answer

Based on Teacher 2's answer in Figure 2, Teacher 1 appears to write known physical quantities, namely the mass of the person, the mass of the car, the frequency, and the parallel spring system's condition. After that, teacher 2 formulates a spring that must be selected with the appropriate spring constant's physical characteristics. Using the oscillation principle in the spring system and determining the value of the combined spring constant finally obtained the constant value of 24,000 N/m. Another principle used by Teacher 1 to solve this problem is the principle of a parallel spring system. The spring system spring constants arranged in parallel are added so that a single spring constant value of 6000 N/m is obtained. Using Hooke's law, obtained for a spring constant of 6000 N/m, if given a force of 120 N, will result in an additional spring length of 0.02 m or 2 cm. So the chosen Teacher 1 is spring D. For the answers from Teacher 8, 11, and 13, at the beginning or in general, principles that are used correctly, only some parts are not quite right. For example, Teacher 8's answer and Teacher 11's answer. The written solutions of Teacher 8 and Teacher 11 are presented in Figure 3.



(a)



(b)

Figure 3. (a) Teacher 8's Answer (b) Teacher 11's Answer

Based on Figure 3, it appears that, in general, the solutions proposed by Teacher 8 and Teacher 11 are almost the same. Inaccurate reasoning in this solution assumes the system spring constant is used as a reference, not a single spring constant. It indicates that the reasoning for identifying teacher problems is still low. As for Teacher 13, the fallacy of thinking reasoning lies in determining a single spring constant arranged in parallel. The principle applied by Teacher 13 is the principle of a series spring system rather than parallel. Teacher 13's written answers are presented in Figure 4.

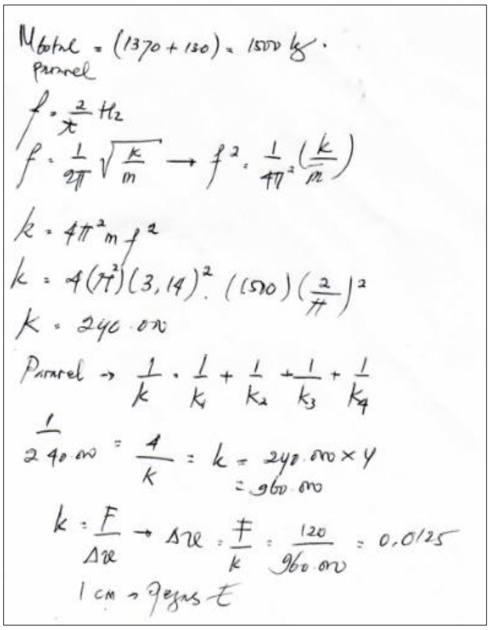


Figure 4. Teacher 13's answer

The Importance to Teach HOTS in Physics Learning

The teacher's response to the compulsory HOTS learning in Physics learning shows that most teachers say that HOTS is very important and must be taught for various reasons or considerations. In general, teacher's responses to the importance of training HOTS implemented in physics learning are presented in Table 5.

Table 5. Teachers' Perceptions about The Need to Train HOTS

The Teachers' Perception About The HOTS Training	Result
It must because physics is very close to the thinking ability at a higher level.	Almost all teachers feel it is essential to teach HOTS to students because students can improve their thinking skills and solve various problems.
Must learn about HOTS in learning so that our students are accustomed to using higher-order thinking skills.	
Must get students to think critically, logically in solving problems, because problems faced by students are not just problems in lessons but far in the future students will solve problems later on.	
HOTS learning is essential because most students understand that physics is only a matter of the count. The calculation is only used to strengthen student reasoning; many physics concepts are beneficial and must be stated in classroom learning.	
Must, so that understanding is more in-depth. In addition to students, HOTS questions also help improve teaching skills	
Must but not for all subjects or Basic Competencies in physics	

The Teachers' Perception About The HOTS Result Training
Must, because people who can understand the principles of physics are people who already think with HOTS
HOTS learning is very necessary for learning physics so that students' thinking can develop well, both in terms of critical and creative thinking.
In the learning process, it does not become a necessity depending on the needs and goals. But the ability demands must be had to adjust the demands of the times and current conditions; for example, 21st-century skills are needed. Physics as a science is a science discipline that supports technological progress, and the development of the age must determine these needs.
Must, but at school, it's not mandatory. But the teacher must keep up with the times, so it is better to use HOTS in learning
Must exist. It is so students can get used to thinking analysis of a phenomenon or problem that is around
There is a necessity because the HOTS ability will be useful for one's life regardless of whether it will use physics or not later.
It must but be adjusted to the conditions of each student in school and the teachers' ability.
Must, Because an educator certainly wants his students to think critically, be able to work in teams, be able to communicate, be creative and innovative, and be confident.

Related to the importance of HOTS in learning physics, the study results showed that almost all teachers felt it was important to teach HOTS to students with several reasons that relied on the goal so that students could improve their thinking skills be able to solve various problems. Conklin (2012) mentions HOTS is one of the important things, which is the key orientation of education policy implementation. Conklin further stated that there are two main reasons: students must succeed at school, and secondly, they must make a positive contribution to society. Teacher awareness shows that they are ready to make changes or improvements during the learning process. The teacher believes that both the teacher and the students are important to have HOTS. It is reflected by teachers' expectations and readiness to take part in training related to increasing their competencies to be applied in the classroom to optimize student learning outcomes. Regardless of the teachers' interests enhancing his competence and students' interests, HOTS is related to importance, which supports each other. In line with this study conducted by Avargil, Herscovitz, and Dori (2012) found that students also supported teachers' professional development, and so did the teachers. This finding is also supported by the research results showing that teachers have tried to apply various innovative learning models to train HOTS students in learning. Various kinds of innovative learning applied by teachers are considered quite appropriate to train HOTS students such as learning that contains problem-solving (Apino and Retnawati 2017; Djidu and Jailani 2016), contextual learning, project-based learning (Anazifa and Djukri 2017), Experiment-based learning, scientific approach and practice questions based on HOTS. This condition reinforces that the teacher realises the importance of HOTS for personal but very important and is owned and trained on students. It is in line with what was revealed by Retnawati (2018) that to realise the importance of HOTS, and the teacher teaches students skills by developing or designing learning activities that develop HOTS students

Teacher Difficulties in Teaching HOTS in The Class

In the next sub-theme, teachers are asked to explain the difficulties encountered when teaching HOTS. In this sub-theme, it is hoped that the teacher can describe in detail and open up the difficulties faced when teaching HOTS to students. Some findings of teachers' difficulties for this sub-theme are presented in Table 6.

Table 6. Teachers' difficulties in teaching/training hots in class

Teachers' Difficulty to Teach HOTS	Result
Students are not accustomed to HOTS learning, and HOTS questions	Teachers have difficulty learning HOTS
Difficult to get rid of impressions in physics students is a collection of formulas so that when learning or given HOTS questions, the first thing students ask is to use which formulas	
Students' abilities heterogeneous	
The successful application of HOTS learning depends very much on the students' characteristics. If applied to classes with the above abilities, it is effortless because students like HOTS learning. But when applied to the lower middle class, they have a little difficulty learning HOTS. So much-needed patience, persistence, and variety of teaching from teachers and high student motivation.	
Some sourcebooks do not provide HOTS questions. So you have to make it yourself. Children often have difficulty working on HOTS questions.	
There is not enough time to teach HOTS in class	
The material in every semester and each based competence there are too many	
The measurement tools for mid-term exams, final semester exams, school exams, national exams not reflecting HOTS yet	
The limited capability in media and technology	
Making lesson plans that are in line with the HOTS assessment.	
The limited of references or knowledge about HOTS	

Teachers' Difficulty to Teach HOTS	Result
learning	
In learning HOTS-based practice questions, it is still difficult to distinguish which HOTS questions are difficult, and there is a tendency for HOTS questions to be difficult or vice versa	
Difficulties in designing learning activities, designing HOTS evaluation questions, and changing students' mindset	
The lack of interest and attention of students towards learning so that it affects all classroom activities. Where students sit, listen, note, and memorise	

Teachers' Ways to Train Students' HOTS in Physics Learning

In training student's HOTS, teachers do it in various ways, such as applying innovative learning models to the exercises working on HOTS questions. In general, some of the ways teachers do HOTS in Physics learning are presented in Table 7.

Table 7. How teachers train HOTS

The Teachers' Ways to Train Students' HOTS	Result
Learning to train HOTS is by involving students to continue to ask questions and solve problems is also one of the efforts. The teacher must also inspire students to have a strong desire to learn physics, and the teachers' knowledge to apply HOTS must also be comprehensive.	Teachers train students' HOTS by using a variety of different learning models. The teacher can name several learning models for teaching HOTS
By applying a variety of learning method	
Through project-based learning	
Begin by getting used to giving HOTS questions in the example problems	
Giving animations about physical symptoms, let students observe, so students start asking questions so that students get used to thinking first	
By linking the concepts being taught with students' personal experiences. For example, when teaching the concept of momentum conservation, I ask students, "does this concept apply in everyday life?" "If not, what assumptions/conditions must be met for the law of conservation of momentum to be true?"	
Students have explained the material slowly, with the number of students that are not too many (divided into small groups).	
Practicing hots questions on students must be gradual, starting from the introduction in the daily teaching and learning activities.	
Students are taught concepts through tangible things and then linked to physical concepts. which will be taught	

The Teachers' Ways to Train Students' HOTS	Result
To get used to formulate problems, compile experimental procedures, conclude data based on observations, make table/graph/picture representations, show videos about physics lessons related to the application of concepts in daily life, allow students to submit questions/answer questions, students work collaboratively, train students' communication skills	
For learning not yet understood as what is done only training students with HOTS questions	
It can be through practical learning in the lab or outside the classroom or learning that there are demonstration methods or group work to students.	
With practicum based learning or STEM learning	
Depending on the situation, student characteristics, and the material.	
Presenting the phenomenon in advance regarding HOTS learning taught using existing learning media so that students are expected to have a rationale when invited to think into more complex ones.	

Table 7 shows that most teachers have tried to train students' HOTS through the various model of innovative learning. Associated with efforts to improve students' HOTS through learning can be done with several activities, such as involving students in problem-solving activities, providing opportunities to build their knowledge, and improving the ability to analyse, evaluate, and create (Apino and Retnawati 2017). In line with this, Retnawati (2018) states that building HOTS-oriented learning can minimise teacher domination and maximise students' role in the learning process.

How to assess HOTS

The analysis results and data reduction related to how teachers rate students' HOTS are summarised in Table 8. Most teachers tend to view HOTS as being assessed only through the HOTS test instrument. There does not appear to be any other evaluation for assessing HOTS other than through testing.

Table 8. How teachers assess HOTS

How Teachers Assess Students' HOTS	Result
With certain rubrics, because not all students can solve problems perfectly.	Most teachers believe that the right instrument for HOTS grades is through test instruments in the form of questions in the form of descriptions that have been completed with scoring rubrics.
Through the questions that students must do work on	
Do the assessments, as usual, the activeness and scores test	
Created questions or written tests in the form of a description	
Assessing the logic and process of how students answer in answering questions	

How Teachers Assess Students' HOTS	Result
Although students do not answer correctly, students can already get half the point from the overall point (HOTS questions)	
Asking students to give HOTS questions taken from the internet related to the material I teach	
Must have scoring guidelines and adapted to the level of the problem.	
HOTS assessment uses multiple-choice, provided students are required to write down their solutions or reasons for determining answers.	
Not yet understood how to assess HOTS	

The data in Table 8 confirm that most teachers already know about test instruments for measuring students' HOTS, such as descriptions with contextual problems. Although teachers do not understand how to assess students' HOTS, they only do assessments like other learning outcome assessments. In carrying out HOTS-based learning or assessment, it was found that the teacher encountered difficulties. If viewed from the difficulties that can be captured information, in general, teachers' difficulties come from the side of the private teacher and students. The teacher still feels that he has not fully mastered the competencies needed starting from the understanding of HOTS-based learning (starting to plan, carry out until assessment), the lack of references and understanding related to HOTS, mastery of technology, and classroom management in facilitating heterogeneous student abilities and characteristics. Also, teachers also find it difficult to teach HOTS when asking students' and students' abilities because the teacher believes that achieving students' HOTS high requires adequate student interest, motivation, and initial ability. The teachers' difficulties in learning are not new. Several previous studies (Retnawati 2015; Retnawati et al. 2017) show some difficulties for teachers in applying learning models or assessments according to curriculum demands. Although this condition is found, teachers' enthusiasm and motivation to improve their competence and train students is very high. According to Ahmad (2014), this belief will foster teacher enthusiasm in making innovations and changes that align with the teachers' positive perceptions of each change and foster teachers' desire to innovate to support curriculum implementation.

Regarding HOTS assessment, most teachers have a good understanding of students' HOTS grades. It can be seen from the teachers' response that measuring HOTS can be done by compiling problem descriptions or essays using contextual problems that must be solved or resolved. Assessment does not only focus on the students' final answers but also the completion process. This result is relevant to Retnawati's research (2018) which concluded that the teacher had a good understanding of assessing students' thinking abilities analysed based on teacher mathematics response data. These results are different when compared with research conducted on 25 mathematics teacher candidates in Turkey by Didis, Erbas, Cetinkaya, Cakiroglu, & Alacaci (2016) which results in the finding that teachers still make mistakes in assessing students' thinking abilities in making mathematical models of problems that are was given. They also pointed out that many teachers only judge students' thinking skills based on the final results (only give an assessment: true or false, good or bad, appropriate or incorrect).

Difficulties in Developing HOTS Instruments

Concerning the teachers' difficulties in preparing HOTS instruments or questions, the data collected from the interview results are presented in Table 9. The difficulties faced by teachers are quite diverse. Starting from the difficulties encountered include constructing questions, making stimulus, assessment rubrics, and validation.

Table 9. Teachers' difficulties compiling hots questions

Teachers' Difficulty Developing HOTS Instruments	Result
Difficulty raises high-level thinking aspects of easy problems such as selecting diction and composing sentences or stories/stimulus that help students make reasoning to solve HOTS questions.	Some teachers have a description and understanding in the preparation of HOTS questions, but technically, there are some difficulties in its making. Difficulties encountered include the construction of questions, stimulus, assessment rubrics, time management, and validation.
Fewer references	
Sometimes stuck with LOTS of type problems	
Difficulty combining HOTS questions with counts complex	
Creating an assessment rubric	
Determine the material in the curriculum that can be made HOTS	
Understanding in making HOTS questions between teachers, supervisors, and other different parties	
Preparation and planning, and the making of HOTS questions requires a long time even though the material is	
Difficult to formulate stimulants that are relevant, interesting, and contextual	
When constructing HOTS instruments, it is sometimes doubtful whether the instruments made are included in the HOTS question type or not.	
At the time of making the questions, often doubts arise whether students can do or not	
HOTS Problem is too complex	

Based on this data, it appears that if traced to the teacher's difficulties is sequential. Start planning (making indicators), constructing problem questions (sentences, diction), making stimulus, combining concepts/formulas in physics to the validation stage, which states that the questions measure HOTS or not.

The research results regarding the ability and difficulty of teachers in compiling HOTS instruments were of the view that the right instrument for HOTS scores was through test instruments in the form of questions in the form of descriptions that were completed with scoring rubrics. It is true but not entirely compatible. Test instruments for measuring HOTS do not always have to be elaborated. For example, TIMMS and PISA questions that measure HOTS but in the form of multiple choices. None of the teachers referred to the TIMMS and PISA questions when developing HOTS questions. HOTS students can be measured through assignments and tests built based on HOTS aspects and indicators. Tasks can be applied by creating rubrics, but testing can be used with various types of testing, such as multiple-choice questions or essays. Both assignments and tests have specifications to measure students' thinking abilities. Multiple choice is more appropriate for measuring the skills of analysing and evaluating, while essays are more appropriate for measuring creating skills (Retnawati, 2018). This finding indicates the lack of understanding of the teacher regarding the form of questions to measure HOTS.

Other difficulties seem to be explored by the teacher in compiling HOTS questions, among others, difficulties in raising the high-level thinking aspect of easy questions, preparation, and planning in making HOTS questions require a long time even though the material is large, formulating relevant and contextual stimulants, constructing constructs questions (sentences, diction), combining concepts/formulas in physics, HOTS questions are seen to be too complex, making assessment rubrics because HOTS must always describe, weighting each question whether the same or different, to the validation stage which states that the problem is have measured HOTS or not. Another review that becomes an obstacle in preparing HOTS questions is there is always a concern from the teacher that the questions created will not be able to be done by students. Students have not answered HOTS questions; activeness and enthusiasm/student motivation are low in working on HOTS problems.

The teachers' difficulties in compiling HOTS questions are in line with Laila's research (2019), which shows that most Mojokerto Middle School teachers have not compiled HOTS questions. Teachers do not understand what HOTS questions are about their characteristics and how to arrange them. The following matters indicate this. First, the teacher has not prepared HOTS questions in carrying out his assessment. Second, the teacher has not been able to make a HOTS grid, especially about the stimulus specifications. Third, the teacher cannot compile the HOTS question formulation. Fourth, the interview results found that the teacher does not correctly understand the HOTS problem. The finding supports these difficulties that teachers are generally prepared by considering the measure skills (recall). When viewed from the context, most use context within the classroom, are very theoretical, and rarely use context outside the classroom (contextual). So it does not show the relationship between the knowledge gained in learning with real situations in everyday life.

Difficulties in HOTS Assessment

Based on interview data obtained, in general, teachers do not experience difficulties in conducting assessments, and the most difficult for teachers is making HOTS questions. In general, the data obtained related to difficulties in HOTS assessment are presented in Table 10.

Table 10. Teachers' difficulties doing hots assessments

Teachers' Difficulties in Conducting HOTS Assessments	Result
Do not experience difficulties because assessments are carried out the same as regular assessments	Most of the teachers claimed that they had no difficulty assessing HOTS; the most difficult was making HOTS questions. Besides, the teacher was concerned that the student could not answer the HOTS
Lack of references, examples from the centerless clear	
Students have not been able to answer HOTS questions	
Making assessment instruments	
HOTS is difficult to make in the multiple-choice but	

Teachers' Difficulties in Conducting HOTS Assessments	Result
easier in the essay	questions he made.
Difficulty in weighting each question whether the same or different	
Ensure whether the indicators in the rubric that are made are correct; there are no supervisors who properly explain how the HOTS assessment rubric.	
The HOTS assessment is not difficult; what is difficult is to make the problem	
Difficulty because of the lack of active students working on HOTS-based questions	

Based on this data, it can be concluded that the teacher does the same thing as assessing other learning outcomes for the HOTS assessment, which almost felt as the teacher's difficulty is making HOTS questions. Other findings during the FGD, when the teacher made HOTS questions before they were given to students, were often several things that the teacher considered. For the first one, did the questions reflect HOTS? Second, whether the students can do HOTS questions. Third, whether will students be motivated to work on HOTS questions? Because the students tend to be more comfortable with physics questions that count directly.

Teachers' difficulties are strongly suspected due to teachers' low understanding and competence in training HOTS and developing HOTS instruments. Many factors are thought to be the cause of this difficulty. First, learning that takes place in class has not been fully effective in training HOTS. Second, the teacher has not been able and accustomed to compiling HOTS questions. Third, teachers and students are not accustomed to using or working on HOTS questions. This condition is reinforced by HOTS questions made by teachers who tend not to reflect HOTS and physics questions given by teachers in class during practice and exams that are still thick with LOTS questions and tend only to play formulas in the dominant physics is thick mathematical elements. This condition will contribute to the low HOTS of students. In line with this, Altun and Akkaya's research (2014) shows that most teachers think that students' low ability to answer questions like PISA is not familiar with PISA questions. Also, several studies in several countries (for example, Altun & Akkaya, 2014; Didis et al., 2016; ; Stahnke, Schueler, and Roesken-Winter 2016) revealed that one of the determinants of student success in improving competency and thinking ability is teacher competency and teacher mastery of learning content.

The teachers' unfamiliarity in making or completing HOTS questions is also apparent from the teachers' responses in solving HOTS questions. Based on the teachers' answers, the Physics teacher has not fully performed well in answering HOTS problems or problems. Most teachers can write important information in the problems needed to solve the problem. It's just that their ability to solve HOTS-based questions is still not fully good, even though some teachers are already good. Most teachers do not see a reason for the consequences of identifying the problem being solved. For example, problem 1 is related to the elasticity of the material. In the matter said the car uses four springs. HOTS reasoning ideally comes to the ability to think that "the car uses four springs in each wheel, so that the spring circuit used must be parallel". So this information is very much needed in solving this contextual HOTS problem. This result is in line with Zulkpli, Mohamed, and Abdullah (2017), who show a low level of thinking ability among elementary and secondary school teachers in one province in Malaysia.

This condition will certainly affect student learning achievement that is not optimal (Altun & Akkaya, 2014; Didis et al., 2016; Stahnke et al., 2016). Besides, these results also show inconsistencies in teacher responses in measuring HOTS and answering HOTS-based problems. Even though the teachers have revealed that assessing HOTS must not neglect the process or solving the problem solving steps, when solving HOTS problems, most of them immediately write down the formula even some of them only write the final results and do not write the completion process.

Lack of references, sharing of knowledge and experience, and training are among the causes of many difficulties for teachers in making HOTS instruments. From the study results, it appears that not all teachers have participated in training related to HOTS. Even those who have attended training view that the training that has been followed has not been effective because it is too theoretical to be impractical. After participating in the training, the knowledge gained is not necessarily immediately practicable. In the end, the teacher returns with learning and assessment as usual. It also appears from the teacher's expectation to be given training, which is more practical, making it easy to implement. This expectation shows that the teacher is enthusiastic about improving his competence and has great expectations to be practiced directly to facilitate more optimal student learning outcomes.

▪ CONCLUSION

Based on the study results, it can be concluded that not all teachers understand HOTS and the characteristics of HOTS questions in physics very well. Teachers tend only to define HOTS from the cognitive aspect without knowledge aspects. Some teachers still cannot distinguish HOTS from learning methods, thinking skills, or instruments. The teachers are aware of the importance of HOTS for students. Teachers already know that students can be trained on HOTS using several innovative learning models (e.g., problem-based learning, project-based learning, inquiry learning, and scientific approaches). One of the causes of the low level of teacher knowledge about HOTS, the characteristics of HOTS problems, is caused by their low ability to solve HOTS problems. This study confirms that the low pedagogical ability associated with HOTS is in line with the low ability of teachers' HOTS. The research results regarding the ability and difficulty of teachers in compiling HOTS instruments were of the view that the right instrument for HOTS scores was through test instruments in the form of questions in the form of descriptions that were completed with scoring rubrics. But in practice, it turned out that the teacher encountered many difficulties. Difficulties faced by the teacher in developing HOTS questions include formulating relevant and contextual stimulants, constructing problem constructs (sentences, diction), combining concepts/formulas in physics; HOTS questions are seen to be too complex, making assessment rubrics because HOTS must always be elaborated, until at the validation stage which states that the question has really measured HOTS or not. Another review that becomes an obstacle in preparing HOTS questions is there is always a concern from the teacher that the questions created will not be able to be done by students, and students have not been able to answer HOTS questions, activeness and enthusiasm/student motivation is low in working on HOTS problems. Several factors are strongly suspected of this difficulty due to teachers' low understanding and competence in training HOTS and developing HOTS instruments. So as an improvement effort, one thing that can be done is to hold training for teachers with more effective training materials to be easy for teachers to implement in the field. Based on these findings, teachers' knowledge and skills need to be explained more broadly and in-depth that it is easy to identify any party to improve. Strategies to improve teacher quality, in this case, teachers' ability to develop HOTS questions, are centred on professional and pedagogical competencies. It is necessary to facilitate teacher skills, which can be effective training or providing media or other facilities that strongly support the improvement of teacher skills in making HOTS questions.

▪ REFERENCES

Afifah, I. R. N., & Retnawati, H. (2019, October). Is it difficult to teach higher order thinking skills?. In *Journal of Physics: Conference Series* (Vol. 1320, No. 1, p. 012098). IOP Publishing.

Ahmad, D. (2014). Understanding the 2013 curriculum of English teaching through the teachers' and policymakers' perspectives. *International Journal of Enhanced Research in Educational Development (IJERED)*, *2*(4), 6-15..

Altun, M., & Akkaya, R. (2014). Mathematics teachers' comments on PISA math questions and our country's students' low achievement levels. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *29*(29-1), 19-34.

Anazifa, R. D., & Djukri, D. (2017). Project-based learning and problem-based learning: Are they effective to improve student's thinking skills?. *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346-355.

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Longman,.

Apino, E., & Retnawati. H. 2017. "Developing instructional design to improve mathematical higher order thinking skills of students." *Journal of Physics: Conference Series* 812(1):12100. doi: 10.1088/1742-6596/812/1/012100.

Arifin, Z., & Retnawati, H. (2017). *Pengembangan instrumen pengukur higher order thinking skills matematika siswa SMA kelas X*. *Pythagoras: Jurnal Pendidikan Matematika*, *12*(1).

Arti, N. 2015. *Kemampuan guru mata pelajaran biologi dalam pembuatan soal hot (higher order thinking) di sma negeri 1 wonosari klaten (Doctoral Dissertation, Universitas Muhammadiyah Surakarta).*

Avargil, S., Herscovitz, O., & Dori, Y. J. (2012). Teaching thinking skills in context-based learning: Teachers' challenges and assessment knowledge. *Journal of science education and technology*, *21*(2), 207-225..

Bogdan, R., & Biklen, S. K. (1997). Qualitative research for education. Boston, MA, USA:: Allyn & Bacon.

Conklin, W. (2011). Higher-order thinking skills to develop 21st century learners. Teacher Created Materials.

Didis, M. G., Erbas, A. K., Cetinkaya, B., Cakiroglu, E., & Alacaci, C. (2016). Exploring prospective secondary mathematics teachers' interpretation of student thinking through analysing students' work in modelling. *Mathematics Education Research Journal*, *28*(3), 349-378.

Djidu, H., & Jailani, J. (2017, February). *Aktivitas pembelajaran matematika yang dapat melatih kemampuan berpikir tingkat tinggi siswa*. In *PRISMA, Prosiding Seminar Nasional Matematika* (pp. 312-321).

Fauzan, A. N. (2019). *Strategi guru dalam mengembangkan instrumen penilaian pengetahuan pendidikan pancasila dan kewarganegaraan berorientasi higher order thinking skills (studi di SMA Negeri 1 Surakarta).*

Heong, Y. M., & Othman, W. B. (2011). Jailani Bin Md Yunos, Tee Tze Kiong, Razali Bin Hassan, and Mimi Mohaffyza Binti Mohamad."The level of marzano higher order thinking skillsamong technical education students.". *International Journal of Social Science and Humanity*, *1*, 121-25.

Laila, N. (2019). *Meningkatkan kemampuan guru IPS dan PPKN dalam menyusun soal HOTS melalui workshop di kota Mojokerto*. *Jurnal Inovasi Pembelajaran*, *5*(2), 19-24.

Nizam. 2016. *Ringkasan hasil-hasil asesmen belajar dari hasil UN, PISA, TIMSS, INAP*.

Pacific Policy Research Center. 2010. "21st century skills for students and teachers." *Research and Evaluation*, 1–25.

Patton, M. Q. (2002). Qualitative research & evaluation methods. sage.

Ratna, A. M., & Retnawati, H. (2019, October). Content analysis of higher order thinking skills (hots) in mathematics national exam. In *Journal of Physics: Conference Series* (Vol. 1320, No. 1, p. 012067). IOP Publishing.

Retnawati, H. (2015). *Hambatan guru matematika sekolah menengah pertama dalam menerapkan kurikulum baru*. *Jurnal Cakrawala Pendidikan*, *34*(3).

Retnawati, H., Djidu, H., Kartianom, A., & Anazifa, R. D. (2018). Teachers' knowledge about higher-order thinking skills and its learning strategy. *Problems of Education in the 21st Century*, *76*(2), 215.

Retnawati, H., Hadi, S., Nugraha, A. C., Arlinwibowo, J., Sulistyaningsih, E., Djidu, H., & Apino, E. (2017). Implementing the computer-based national examination in Indonesian schools: The challenges and strategies. *Problems of Education in the 21st Century*, *75*(6), 612.

Saido, G. A., Siraj, S., Nordin, A. B., & Al-Amedy, O. S. (2017). Teaching strategies for promoting higher order thinking skills: A case of secondary science teachers. *MOJEM: Malaysian Online Journal of Educational Management*, *3*(4), 16-30.

Stahnke, R., Schueler, S., & Roesken-Winter, B. (2016). Teachers' perception, interpretation, and decision-making: a systematic review of empirical mathematics education research. *Zdm*, *48*(1), 1-27.

Walsh, G, P.. Murphy., & Dunbar. C. 2007. "Thinking skills in the early years: a guide for practitioners." *Written in Collaboration with the Early Years Enriched Curriculum Evaluation Project Team.) Available as a PDF at: Http://Www. Nicurriculum.Org.Uk/Docs/Skills_and_capabilities/Foundation/ThinkingSkillsintheEarlyYears_Report*.

Zulkpli, Z., Mohamed, M., & Abdullah, A. H. (2017). Assessing mathematics teachersâ€™ knowledge in teaching thinking skills. *Sains Humanika*, *9*(1-4).