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HOTS-BASED QUESTIONS PREPARATION STRATEGY ON SENIOR HIGH SCHOOL'S LINEAR PROGRAMME

Agnes Yulitya, Mia Rizki Idaroyanni Siregar, Nurul Hidayah Sembiring*
State University of Medan, Indonesia
**nurulhidayahsembiring@gmail.com*

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ABSTRACT

Background: One of the changes in the education assessment system in Indonesia today is the implementation of HOTs (Higher Order Thinking Skills) based assessments. The application of HOTs-based assessment aims to make the learning processe specially mathematics able to encourage students to develop creative thinking skills.
Aim: In this article, it examines conceptually with the aim of providing educators with knowledge about the concepts, characteristics, and strategies for preparing HOTs questions.
Method: This research includes qualitative descriptive research.
Findings: The strategies for compiling HOTs questions are (1) Analyzing the basic competencies that will be made about HOTs; (2) Arranging a grid of questions; (3) Using interesting problems in everyday life; (4) Writing questions; and (5) Make assessment guide lines and answer keys.

KEYWORDS

Preparation of questions, HOTs, learning mathematics

INTRODUCTION

The development of science and technology today requires humans to have various abilities to face the future including 21st century skills consisting of critical thinking, creative, innovation, communication and collaboration. The 2013 curriculum is structured to improve 21st century skills requiring teachers to play an important role in training students to develop higher-order thinking skills. Students are expected not only to know and understand a knowledge but also to be able to analyze, evaluate and even create something from the use of the knowledge they have.

To have this ability, the teacher can train students by providing assessments in the form of different test questions and demanding students to be more creative in applying the knowledge they have (Asrul & Rosnita, 2015). In accordance with Law Number 14 of 2005, teachers have the obligation to plan lessons, implement the learning process and assess and evaluate learning outcomes. Educational evaluation is the process of determining the quality of education in order to know the quality or results. The type of test evaluation instrument is the technique most often used to evaluate student learning outcomes. There are several types of tests including (1) Achievement test, (2) Proficiency test, (3) Aptitude test, (4) Diagnostic test, and (5) Placement test.

Mathematics is a science based on abstract concepts so that the provision of this subject matter can be done by linking the material to everyday life (Dinni, 2018). This is done so that students are able to find concepts from experience in the surrounding environment. Mathematics is not only oriented to the mastery of concepts or facts but rather to the ability to think creatively and apply the basic knowledge it has to solve a problem. The problem in question is certainly not in the form of questions that are usually presented but also includes questions or problems that are different from questions in general. The ability of

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students to examine a problem and relate it to the concepts they already have is what is called higher order thinking skills (Effendi, 2015).

HOTs-based questions have been tested in the national exam since 2017 and their composition is always added to the national exam the following year. However, currently the teacher has not developed an assessment in the form of a test that makes students practice higher-order thinking. Therefore, this study is expected to provide a description of concepts and strategies for compiling HOTs-based questions in mathematics learning in elementary schools in particular so that they can be used as teacher reference materials in teaching mathematics (Wahyuni, 2017).

Definition of HOTs (Higher Order Thinking Skills)

Higher order thinking skills are interpreted in various different perspectives according to experts. Higher Order Thinking Skills (HOTs) were first formulated by the author from Dusquance University, namely Susan M Brookhart in her book entitled "How to Assess Higher-order Thinking Skills in Your Classroom" where she defined that this model as a method for critical thinking, knowledge transfer and problem solving.

According to Lewis & Smith (in Hidayati, 2017) that: “Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/ or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations". This opinion explains that higher order thinking occurs when new information is received and is interrelated with previous information or expands existing information in order to formulate answers in certain confusing situations.

Meanwhile, according to Brookhart (in Hidayati, 2017) states that higher order thinking skills are classified into 3 categories, namely the form of transfer of learning outcomes, critical thinking and problem solving. Gunawan (in Fanani, 2018) explains HOTs or higher-order thinking skills as a thinking process that requires students to process existing information and can produce new meanings and implications in a certain way.

From some of these opinions, it can be concluded that HOTs or high-level thinking skills are deep thinking processes about processing information in dealing with and solving complex problems and involve analyzing, evaluating and creating skills. To measure higher-order thinking skills which are abilities that are not just remembering or referring without doing analysis, an instrument question in the form of HOTs-based questions can be used (Ariyana & Bestary, 2018). From this explanation, it can be seen that students' thinking skills can be developed through the provision of challenging HOTs concepts.

HOTs Characteristics

The characteristics of HOTs-based questions are (1) being able to measure higher-order thinking skills, (2) using interesting problems or problems in everyday life, and (3) using various types of questions. This is described in the following description.

1) Measuring the level of HOTs: These abilities include problem solving, critical thinking, creative thinking, decision making, and reasoning abilities.
2) Using problems in everyday life (Contextual): HOTs-based assessment is an assessment that involves situations in everyday life and students are expected to apply

the knowledge or basic concepts that have been obtained to solve the problem. The real problems presented include health, economic, environmental, universal funds and the role of technology in life. The definition concerns students' skills in correlating, applying and integrating science concepts to solve problems related to everyday life problems.

3) The use of questions in various forms: The use of questions with various forms has the aim of providing information about students' abilities as test takers in detail, detail and comprehensively

Cognitive Level Dimension

Dimensions of cognitive processes according to Bloom consist of six aspects, namely remembering, understanding, applying, analyzing, evaluating and creating or creating. The first and second aspects of remembering and understanding are called low-level thinking skills. While the other aspect is called higher order thinking ability. Furthermore, Bloom distinguishes and groups the levels of knowledge level dimensions starting from low or memorizing levels, medium levels and high levels, namely creating or creating. The knowledge level dimension is divided into 6 phases which include (1) remembering, (2) understanding, (3) applying, (4) analyzing, (5) evaluating, and (6) creating. The levels of cognitive processes are often used to determine learning objectives, known as cognitive levels C1, C2, C3, C4, C5, and C6 (Wachyudi et al., 2015).

The dimensions of the cognitive level are classified into 3 as explained by Puspendik (in Fanani, 2018) that the classification consists of (1) level 1 which is the level of understanding of a knowledge, (2) level 2 which is the application of the acquired knowledge, and (3) level 3 which is the level of reasoning. Each level is described as follows.

1) Level 1 knowledge dimension: Dimensions of knowledge at this level include knowledge at the level of thinking C1 (remembering) and C2 (understanding). Instrument questions at this level aim to determine students' understanding of facts or concepts. Operational verbs that are usually used in preparing questions are writing, mentioning, counting, registering, etc. This type of question on the level 1 dimension is not a HOTs question.
2) Knowledge dimension level 2: The dimension of knowledge at this level is the process of applying the facts or concepts that have been obtained. This level includes the level of knowledge on aspects of C3 (application). Operational verbs that are widely used at this level are use, apply, prove and so on. However, this type of question at this level is also not a form of HOTs.
3) Knowledge dimension level 3: The dimensions of knowledge at this level include thinking processes at the levels of C4 (analysis), C5 (evaluation) and C6 (creating). At this level students must be able to apply the knowledge, facts or concepts they already have to answer the questions presented. Students must also have high enough reasoning and logical power to be able to solve problems related to everyday life. Therefore, the types of questions at this level of knowledge dimension are HOTs or high - level thinking questions.

Strategy for Formulating HOTs

The strategy for compiling HOTs-based questions includes several steps, namely (1) analyzing basic competencies, (2) making question grids, (3) using problems related to everyday life, (4) compiling items and (5) making scoring guidelines.

METHOD

This research includes qualitative descriptive research. Qualitative research is research that is descriptive and tends to use analysis. Process and meaning are highlighted in qualitative research. The theoretical basis is used as a guide so that the research focus is in accordance with the facts on the ground. This study was conducted to analyze and describe the strategy for preparing HOTs questions on linear programming material for class XI students. The questions given have been validated by 2 lecturers and 1 mathematics teacher.

RESULTS AND DISCUSSION

The steps for compiling HOTs-based questions have the same steps as compiling the usual questions (Wahidmurni, 2018). The difference is in the use of stimuli in the form of presenting problems in everyday life. HOTs-based questions require students to think about how to apply the facts or concepts that have been mastered. Meanwhile, questions that are not based on HOTs tend to be simple questions that only measure students' ability to remember or understand a concept and do not present contextual problems related to everyday life. To write HOTS items, the question writer is required to be able to determine the behavior to be measured and formulate the material that will be used as the basis for the question (Stimulus) in a certain context in accordance with the expected behavior. In addition, the description of the material to be asked (Which requires high reasoning) is not always available in the textbook. Therefore, in writing HOTS questions, mastery of teaching materials is needed, skills in writing questions (Construction questions), and teacher creativity in choosing question stimuli according to the situation and conditions of the area around the education unit.

The strategy for compiling HOTs-based questions includes several steps, namely (1) analyzing basic competencies, (2) making question grids, (3) using problems related to everyday life, (4) compiling items and (5) making questions. scoring guidelines (Fanani, 2018:71). All of these steps are described as follows.

Conduct An Analysis of Basic Competencies (KD) that Can be Made about HOTs

Questions in any form are made to measure the achievement of the competency formulation formulated in the curriculum text of a subject. Because KD is the last competency formulation in the curriculum text, educators must analyze KD that will be made about HOTs, and ensure that the Competency Achievement Indicators (GPA) developed have shown evidence of achieving the KD. Teachers can study and examine KD which can be compiled into HOTs questions, because not all KD can be made into HOTs questions (Widana, 2017). This can be carried out independently or through teacher deliberation forums.

Compiling a grid of questions

The grid is a matrix that contains the criteria needed in compiling the items. The preparation of this grid aims to make it easier for educators to write HOTs-based

questions. Furthermore, it is explained that a good grid must have criteria including (1) reflecting the content of the curriculum, (2) having clear and easy-to-understand content components, and (3) being able to write down questions from each of the available indicators. The format of the question grid is divided into 2 parts, namely the identity section and the matrix section (Wulan & Rusdiana, 2014). The matrix part is written in the form of a column while the identity part is written at the top of the matrix while the identity part includes level/school, subject, academic year, time allocation and types of questions while the matrix part is in the form of a column consisting of at least KD, indicators, materials, types of questions, and the number of questions (Wulan & Rusdiana, 2014). An example of a question writing grid is presented in the following table. An example of a question writing grid is presented in the following table.

Table 1. Examples of Question Grid Formats

Math Daily Quiz

Education units	: Senior High School	**Class** : XI	
Subjects	: Mathematics	**Time** : 30 Minutes	
School year	: 2020/2021	**Question Type**: Description	

KD	Indicators of Competencies	Subject Matter	Indicator	Type	Cog. Level	No.
3.2 Explaining the program linear 2 variables and method solution using conceptual problems	3.2.1 Identifying equations and the linear inequality of 2 variables. 3.2.2 Identify objective function of the constraints on a linear programming problem. 3.2.3 Drawing up mathematical models of linear Programming Problem. 3.2.4 Solving the mathematical model of the problem which related with	Linear Program	Presented a story question related to daily life, where students are asked to seek maximum profit	Description	C5	1

	a linear inequality of two variables. 3.2.5 Critical in dealing with problems day-to- day which related to system of equations and linear inequalities of 2 variables. 3.2.6Analyze and conclude the concept of a system of equations and line ar inequalities of 2 variables. 3.2.7 Applying a system of linear equations and inequalities 2 variables in solving real problem.					

Using problems that are interesting or related to everyday life

The problems presented in the form of problems in everyday life are interesting and can motivate students to read in more detail the questions. Teachers can use the school environment or the local environment as a contextual stimulus to be able to attract students' interest in solving problems.

Writing questions

The question paper can be written in the form of multiple choice or description according to the needs of the teacher where the writing must be adjusted to the rules of writing HOTs questions. The number of items and the form of the questions are adjusted to the grid that has been prepared. The rules for compiling HOTS questions are in general the same as compiling questions in general, the difference is the material aspect and the use of operational verbs that must be adapted to verbs at cognitive levels C4, C5, and C6. The items that have been arranged are written on a question card. An example of a question card format is presented in the following table.

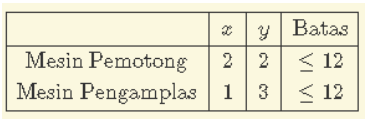
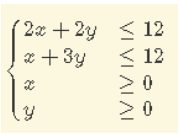
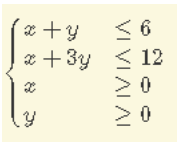
Table 2. Sample of Question Card

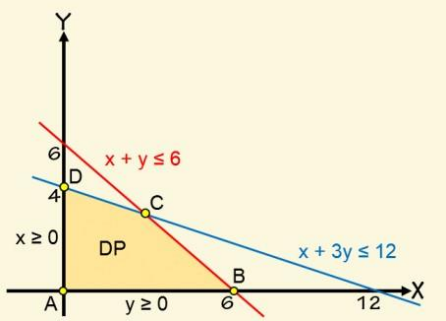
Subject:	Mathematics
Class:	XI
Semester:	2
Question Card No. 1	
Basic competencies	3.2 Describe a two-variable linear program and its solution method using conceptual problems.
Material	Linear Program
Question Indicator	Presented a story problem related to everyday life, where students are asked to seek maximum profit.
Cognitive Level	C5
About	1. Mr. Chandra owns a *home industry* of art tools that produces 2 types of products, namely art tools A and B. The two types of art tools are produced by cutting machines and sanding machines. To produce art tool A, it takes 2 hours of work on a cutting machine and 1 hour on a sanding machine. To produce art tool B, it takes 2 hours of work on a cutting machine and 3 hours on a sanding machine. Each type of machine works no more than 12 hours a day. Mr. Chandra estimates that the profit from the sale of each unit of art tool A is Rp. 175,000.00 and art tools B in the amount of Rp. 215,000.00. If Mr. Chandra has 3 units of cutting machines and 3 units of sanding machines, then the maximum profit is ....

Making assessment guidelines and answer keys

The questions that have been written by the teacher should be equipped with answer keys and assessment guidelines (Widana, 2017). The making of assessment guidelines is used to measure the results of the work from the form of description questions, while to assess the results of the work from questions in the form of multiple choice, complex multiple choice or short descriptions, it is necessary to make an answer key. An example of an answer key table format and an assessment guideline is presented in the following table.

Table 3. Examples of Assessment Guidelines and Answer Keys

No.	Answer Description	Score
1.	Information: Producing art tool A requires 2 hours of work on a cutting machine and 1 hour on a sanding machine. To produce art tool B, it takes 2 hours of work on a cutting machine and 3 hours on a sanding machine. Each type of machine works no more than 12 hours a day. Mr. Chandra estimates that the profit from the sale of each unit of art tool A is Rp. 175,000.00 and art tools B in the amount of Rp. 215,000.00. Question: If Mr. Chandra has 3 machines cutter and 3 units of sanding machine, then the maximum profit is...	2
	Answer: Let x and y be the number of art tools A and B produced, respectively. The objective function is f(x,y) = 175,000x + 215,000y. The following table can be used to create a system of linear inequalities.  The system of linear inequalities that represents the above case is  or simplified to  Next, determine the solution area and the corner points.	8



From the picture, there are 4 corner points, namely points A, B, C, and D. Corner point C is the second intersection point line and coordinates could search by using method of settlement SPLDV.

x+3y=12
x+y=6
2y=6
y=3

Substitute and get x=3. Now, we have obtained 4 corner points and their coordinates. Test the value on the objective function.

Titik Pojok	$f(x,y) = 175.000x + 215.000y$
$A(0,0)$	$0+0=0$
$B(6,0)$	$175.000(6)+0=1.050.000$
$C(3,3)$	$175.000(3)+215.000(3)=1.170.000$
$D(0,4)$	$0+215.000(4)=860.000$

The maximum profit that can be achieved per day from the use of one unit of cutting machine and sanding machine is Rp. 1,170,000.00. Because each machine has three units, the maximum profit will be 3 times, namely Rp. 3,510,000.00.

Total Score	10

CONCLUSION

From the results obtained in the discussion, it can be concluded that HOTs are a deep thinking process about processing information in completing and solving complex problems. The dimensions of knowledge on HOTs include thinking processes at the levels of C4 (analysis), C5 (evaluation), and C6 (creating). The characteristics of HOTs-based questions are (1) measuring higher-order thinking skills, (2) using problems in everyday life, and (3) using various types of questions. The strategy for compiling HOTs questions consists of several steps, namely (1) conducting an analysis of the basic competencies that will be made about HOTs, (2) compiling a grid of questions, (3) using interesting problems in everyday life, (4) writing questions, and (5) making assessment guidelines and answer keys.

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