ANALYSIS OF HIGHER ORDER THINKING SKILLS COMPONENTS ON THE CONTENTS OF PHYSICS FOR CLASS X SEMESTER II HIGH SCHOOL IN WEST SUMATERA

Abdul Azis¹, Yenni Darvina¹*, Gusnedi¹, Silvi Yulia Sari¹

¹ Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia

Corresponding author. Email: ydarvina@fmipa.unp.ac.id

ABSTRACT

The importance of curriculum implementation in 2013 is the development of Higher Order Thinking Skills (HOTS) in learning. The results of observations show that the worksheet used in public high schools (SMAN) in West Sumatra is still diverse, starting from the worksheet made by the subject teachers and issued by the publisher. All of these worksheets have not been identified whether they already contain HOTS components in them. Therefore, a component analysis research was conducted HOTS on the material presentation Physics worksheets class X semester II at SMAN throughout West Sumatra. This research is a descriptive study with a qualitative approach. The population in this study was all worksheets for high school physics students of class X semester II, which is used by 34 public high schools in West Sumatra. The sample in this study is the highest number of SMA class X semester II physics worksheets used in schools published by three different publishers and two worksheets made by physics subject teachers. The research data were taken using the analysis instrument of worksheet offerings and data collection techniques through documentation studies. Based on the research, the entire worksheet F X/II RC-IP Has the highest percentage indicator. From this data, it summarized that the percentage of availability of HOTS indicators in the presentation of the contents of the Class X Semester II Physics Worksheets at Senior High Schools throughout West Sumatra is still low, with the category not yet facilitating.

Keywords: Worksheet analysis, HOTS

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I. INTRODUCTION

The 21st century had challenged the government. In this case, the government had to improve and refined the curriculum from the 2006 curriculum to the 2013 curriculum. Future challenges require various skills, including life skills and career, study skills and innovation, technology skills, and information media [1].

The implementation of the Curriculum 2013 is expected to solve various problems currently being faced by the world of education, especially in entering the era of globalization [2]. One of the essences that have been considered in the 2013 curriculum is the introduction of higher-order thinking skills (HOTS). HOTS is a thought process that involves mental activities to explore complex, reflective, and creative experiences and abilities that are carried out consciously to achieve a goal. The aim is to acquire knowledge that includes levels of analytical, synthesis, and evaluative thinking [3]. HOTS helps students have intelligence in analyzing the environment, reading, and even socializing. Besides, students will be able to deduce information and apply their knowledge to other things.

Higher Order Thinking Skills (HOTS) also applied following the low ranking of the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) compared to other countries [4]. The results of the assessment are issued by PISA once in three years. On December 3, 2019, PISA released the results of the students' assessment. In terms of reading ability, Indonesia is in the 6th lowest rank (74) of the 79 PISA participating countries. In Mathematical skills, Indonesia in 73rd place.
HOTS-oriented learning wants active learning. Students are not expected to participate in the learning process by sitting still and participating in the learning without participating during the learning process. Of course, if it is done by students, it will make them not get the meaning of the learning process. Based on the interviews, the curriculum was not fully implemented in learning. Many students during learning are not active and seem to accept what is taught to them. This is of course contrary to the learning desired by the curriculum. Various studies have shown that active learning is better than traditional learning. Active learning provides opportunities for students to absorb, remember and understand the subject matter longer, and the most important thing is that students can think at a higher level [5].

Active learning requires teachers to provide various tools to support the learning process. One of them is teaching materials in the form of Student Worksheets (LKS). LKS functions to facilitate the implementation of learning for students and as teaching materials that can activate students in the learning process. The use of worksheets is expected to be able to change the learning conditions from the teacher's role in determining “what is a lesson learn?” to “how to provide and enrich the learning experience of students [6].

Then, the worksheets used are expected to develop students’ understanding during the learning process. Students continuously are trained in the learning process that they follow. That way, it is hoped that the curriculum in producing graduates who can answer the challenges of life in the 21st century will be realized [7].

The worksheets used must contain HOTS-oriented learning, with HOTS components presented in the worksheets used. HOTS components that need to be considered are decision-making skills, problem-solving skills, creative thinking skills, and critical thinking skills [8]. Then the HOTS component is in the form of a cognitive domain at the Bloom taxonomy level classification. There are 6 levels of cognitive processing dimensions, namely remembering (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5), and create (C6). HOTS when viewed from the Revised Blooms' Taxonomy is taken from the levels of analyzing (C4), evaluating (C5), and creating (C6)[9].

The results of the survey of 88 public high schools in West Sumatra show that 38.6% of schools used worksheets of varying forms, both publications by publishers and teachers. The following is the use of worksheets in some of these schools.

<table>
<thead>
<tr>
<th>No</th>
<th>LKS</th>
<th>Multiple Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Publisher (Intan Pariwara)</td>
<td>20 school</td>
</tr>
<tr>
<td>2</td>
<td>Publisher (CV Grahadi)</td>
<td>3 school</td>
</tr>
<tr>
<td>3</td>
<td>Publisher (Sastro Wijaya)</td>
<td>1 school</td>
</tr>
<tr>
<td>4</td>
<td>Publisher (Viva Pakarindo)</td>
<td>6 school</td>
</tr>
<tr>
<td>6</td>
<td>Made By The School Teacher Concerned</td>
<td>4 school</td>
</tr>
<tr>
<td>7</td>
<td>Not Using Worksheets</td>
<td>54 school</td>
</tr>
<tr>
<td></td>
<td><strong>Amount</strong></td>
<td><strong>88</strong></td>
</tr>
</tbody>
</table>

(Survey: 2020)

Even though it is used in the learning process, the worksheets used are not yet known whether they contain HOTS components in terms of material presentation and evaluation questions. From the description above, it can be seen that there is a gap between the conditions that occur in the field and the expected ideal conditions. LKS found in schools, it is not known whether there is a Higher Order Thinking Skill component in the content presentation in SMA class X semester II high school physics worksheets in SMANs throughout West Sumatra. For this reason, it is necessary to research to find out whether the physics worksheets of SMA class X semester II used in schools throughout West Sumatra have a Higher Order Thinking skill (HOTS) component.

II. METHOD

This type of research is a descriptive researcher with a qualitative approach. Descriptive research is shown to describe or describe existing phenomena, both natural and human engineering[10]. Research with a qualitative approach produces descriptive data in the form of written or spoken words from people and observed behavior [11].
The population is a generalization area consisting of objects or subjects that have certain qualities and characteristics that are applied by researchers to study and then draw conclusions [12]. The study population was all high school physics worksheets class X semester II used by 34 public schools in West Sumatra. To take a sample that will be used as a source of research data in the population, it is done by using a sampling technique or sampling technique [13]. The sampling technique for student worksheets (LKS) in this study was purposive sampling. Purposive sampling is a sampling technique with certain considerations so that the data obtained will be representative [10]. The analyzed worksheets were five of the eight worksheets obtained. Three LKS issued by the publisher and two more worksheets made by the physics teacher concerned. The five worksheets analyzed were the LKS written by Reza Davianta with the publisher CV Grahadi which was coded (LKS FX / II RZ-GR), the LKS by Risdiyani Chasanah et al with the publisher Intan Pariwara which was coded (LKS FX / II RC-IP), LKS has written Bayu Kurniawan et al with the Viva Pakarindo publisher coded (LKS FX / II BK-VP), the three LKS were selected with the consideration of the use of more than one school and two more LKS analyzed were student worksheets made by subject teachers at SMA 3 Pariaman with code (LKS FX / II GI) and LKS made by subject teachers at SMA 1 Padang with code (LKS FX / IIG II). The two worksheets were selected with the consideration that they already represent the worksheets made on behalf of the subject teacher.

In practice, the research is carried out in three stages. The first is the preparation stage, the second is the implementation stage, and the third is the completion stage. In the preparation stage, in addition to preparing the research design and determining the subject and object of research in the form of worksheets to be used. Preparation in the form of drafting the instrument is designed in such a way as to the purpose of the instrument itself, namely as a tool needed in research. Before writing the instrument items, the lattice of the instrument should be written first. The instrument that has been made is then validated by the validator. Evaluation of the validity of the instrument was carried out by 3 validators using the instrument validation sheet. The assessment of the validity of the analysis instrument for the availability of HOTS components on this LKS is in the form of a checklist or check-list with a scale of 1 to 5. There are several revisions after the validation of the instrument by the validator, namely revisions to the addition of the suggestion column and improvements to the instrument and the objectives to be achieved are more clarified.

The results of the overall validity were searched using the Kappa Cohen formula. At the end of the assessment, the kappa moment value (k) is obtained [13].

\[
\text{Moment Kappa (k)} = \frac{P_o - P_e}{1 - P_e}
\]  

The abbreviation (k) is the kappa moment which indicates the validity of the product. Abbreviation (P_o) is a realized proportion, calculated by dividing the number of values given by the validator by the maximum number. While the abbreviation (P_e) is the unrealized proportion, calculated by means of the maximum value minus the total value given by the validator divided by the maximum number. The categories of kappa moment decisions obtained are in the following table [14].

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 – 1.0</td>
<td>Very Valid</td>
</tr>
<tr>
<td>0.6 – 0.79</td>
<td>Valid</td>
</tr>
<tr>
<td>0.4 – 0.59</td>
<td>Enough Valid</td>
</tr>
<tr>
<td>0.2 - 0.39</td>
<td>Kurang Valid</td>
</tr>
<tr>
<td>0.0 – 0.19</td>
<td>Not Valid</td>
</tr>
</tbody>
</table>

The validity results obtained from three expert lecturers are in the very valid category. These results are shown in Table 3.

<table>
<thead>
<tr>
<th>Validator</th>
<th>Skor</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.91</td>
<td>Very Valid</td>
</tr>
<tr>
<td>2</td>
<td>0.98</td>
<td>Very Valid</td>
</tr>
<tr>
<td>3</td>
<td>0.78</td>
<td>Very Valid</td>
</tr>
</tbody>
</table>

After the preparation for the research is complete, the research enters the implementation stage, namely data collection. Data collection techniques are methods used to obtain research data or information. The data collection technique in this research is through documentation study, information is obtained from various kinds of written sources or documents. The document in question can be in the form of writings, pictures, or monumental works of a person [15]. This documentation study is carried out by collecting documents or data needed in the research problem and then examining it in depth. The documents used in this study were written...
documents, namely three high school physics worksheets for class X semester II were used the most and two more worksheets were made by the physics teacher concerned in several schools in West Sumatra. The data obtained from the documentation study were analyzed using revised instruments.

The worksheets were then analyzed using validated instruments to obtain the necessary research data. The first data obtained were the availability of HOTS questions based on Anderson's Revised Bloom Taksinami and the second data was the availability of HOTS indicators in the LKS content presentation. The data analysis technique used in this research is the content analysis technique, which is to analyze the contents of a book or document by making concrete conclusions so that the message can be fully understood [16]. Data processing techniques used in this study are divided into two ways according to the research objectives to be achieved.

a. Analyze the availability of HOTS questions on the available worksheets Data processing techniques used for the purpose of this study are:
   1. Adding the appearance of questions with the LOTS, MOTS and HOTS categories on each LKS analyzed.
   2. Calculating the percentage of availability of LOTS, MOTS and HOTS questions in class X semester high school physics worksheets with the formula:
      \[
      \text{Percentage of availability} = \left( \frac{\sum \text{The appearance of LOTS questions}}{\sum \text{The whole question}} \right) \times 100\%
      \]
      (2)
      \[
      \text{Percentage of availability} = \left( \frac{\sum \text{The appearance of the MOTS question}}{\sum \text{The whole question}} \right) \times 100\%
      \]
      (3)
      \[
      \text{Percentage of availability} = \left( \frac{\sum \text{The appearance of the HOTS question}}{\sum \text{The whole question}} \right) \times 100\%
      \]
      (4)

3. Determine the average percentage proportion of each category from all analyzed worksheets.
4. Draw conclusions, namely drawing conclusions from the data that has been obtained.

b. Analyze the availability of HOTS indicators on the available worksheets Data processing techniques used for the purpose of this study are:
   1. Adding the appearance of HOTS instrument items on each LKS analyzed.
   2. Calculating the percentage of the content of the physics worksheets for class X semester II that can facilitate the HOTS indicator on each student worksheet analyzed with the formula:
      \[
      \text{Percentage of availability} = \left( \frac{\sum \text{HOTS indicator instrument items that appear}}{\sum \text{HOTS indicator instrument items}} \right) \times 100\%
      \]
      (5)

3. Determine the average percentage proportion of each HOTS category from all analyzed worksheets.
4. Determining the criteria for offering high school physics worksheets for class X semester II that can facilitate the HOTS indicator can be seen in Table 12.

<table>
<thead>
<tr>
<th>Percentage Criteria</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 – 100</td>
<td>Very facilitating</td>
</tr>
<tr>
<td>61 - 80</td>
<td>Can facilitate</td>
</tr>
<tr>
<td>41 – 60</td>
<td>Enough to facilitate</td>
</tr>
<tr>
<td>21 – 40</td>
<td>Less facilitating</td>
</tr>
<tr>
<td>0 – 20</td>
<td>Don't facilitate</td>
</tr>
</tbody>
</table>

5. Draw conclusions, namely drawing conclusions from the data that has been obtained.

III. RESULTS AND DISCUSSION

Implemented by analyzing 5 samples of worksheets. The sample consisted of 3 LKS from the publisher with the code LKS F X / II RC-IP, LKS X / II RZ-GR, LKS F X / II BK-VP, and 2 LKS made by subject teachers in two different schools in West Sumatra. The two LKS with codes is LKS F X / II G I, LKS F X / II G II. The analysis was conducted to determine the availability of four HOTS indicators such as problem-solving, decision making, critical thinking, and creative thinking in the content presentation of each LKS. Worksheets that contain components can form good cooperation between students, the interaction of students with students and students with higher teachers, increase the courage to face difficult questions, better learning activities, and good student character in terms of discipline, persistence, conscientiousness, and responsibility[17].

After analyzing the availability of HOTS components on the content of the worksheets. The results of the assessment were obtained on five worksheets, where not all worksheets contain HOTS components properly. The analyzed worksheets have advantages and disadvantages in facilitating the existence of HOTS components
for students. The discussion of the results of the HOTS component analysis on the Physics Worksheet is described as follows.

1. **LKS F X/II RZ-GR**

The results of material analysis on Newton's law material, Newton's gravity, work and energy, momentum and impulse along with harmonic motion, get the conclusions that can be seen in Figure 1:

![Figure 1. Average Percentage of Availability of HOTS Indicators at LKS F X / II RZ-GR](image)

Based on Figure 1, on Newton's law material, the average percentage of HOTS component availability is 13.3% in the non-facilitating category. In the newton law material, the indicator of critical thinking is the ability that has the highest availability indicator that can be found. However, for the indicators of decision-making, the availability of indicators was not found on the LKS. Decision-making indicators are also not found in all material on the LKS. This certainly indicates that decision-making skills are not trained to students and determines that it is detrimental to students because decision-making skills are skills that need to be taught and trained to students from an early age because in everyday life many things require good decision-making skills [18].

Furthermore, in Newtonian gravity material, the average percentage of HOTS component availability was 19.7% with the category of not facilitating. Of the four indicators, the indicator of critical thinking has the highest percentage of availability. In terms of business and energy, the average percentage of HOTS components availability is 23% with the less facilitating category. In this material, the categorized critical thinking ability is sufficient to facilitate. Furthermore, momentum and impulse material becomes the material with the highest percentage of availability compared to other materials. The average size of availability of HOTS found in the LKS was 25.3% with the category of less facilitating. Unlike other materials. In momentum and impulse material, indicators of critical thinking are the highest indicators that can be found. The next material, namely harmonic motion, has an available HOTS indicator of 20.4% in the category of less facilitating. The highest indicators that can be found in the material are indicators of critical thinking and this is the same as the availability of the highest indicators on business and energy materials.

Overall, LKS F X / II RZ-GR is categorized as less facilitating. However, LKS in presenting the material always gives apperception to students who read. With the existence of apperception, LKS F X / II RZ-GR is able to attract students' attention so that they focus on the learning material to be studied. However, the low availability of HOTS indicators in the presentation of the material, LKS F X / II RZ-GR in its use must be circumvented in the learning process in order to train students' HOTS abilities.
2. **LKS F X / II RC-IP**

The results of the HOTS indicator analysis for each material can be seen in the figure:

![Figure 2](image-url)

**Fig 2.** The Average Score Percentage of HOTS Indicators at LKS F X / II RC-IP

The results of the analysis of LKS F X / II RC-IP on the availability of HOTS indicators get the highest score compared to other LKS, LKS F X / II RC-IP has the availability of HOTS components with the largest percentage of all LKS. In the five materials, not all of them were categorized as less facilitating. For Newton's law and impulse-momentum. Both of these materials have availability percentages of 47% and 54% in the sufficiently facilitating category. Even one of the indicators in this material has a percentage of the availability of the HOTS indicator which can facilitate the HOTS indicator when making it a learning resource.

Critical thinking indicators on Newton's law material have a percentage of availability with the category of being able to facilitate. However, in the indicator of decision making, the percentage of availability is low, that is, categorized as less facilitating. Then on the same indicator in the material momentum and impulse have the greatest availability, namely indicators of critical thinking with the category of being able to facilitate. In this momentum and impulse material also, the problem-solving indicator has a large percentage of availability with the category of being able to facilitate as well. In this material, the lowest indicator can be found in the indicator of decision making with the less facilitating category. For business materials.

For energy effort matter and harmonious motion. The average percentage of the availability of HOTS indicators in this material is 30.95% and 26.9% in the less facilitating category. In the energy sector, indicators of critical thinking are the highest indicators of availability in facilitating HOTS in students. Furthermore, in Newton's gravitational matter. The amount of HOTS indicator availability is 37.2% with the category of less facilitating. In this material, the indicators of creative thinking are the highest indicators with the category that is enough to facilitate students. Indicators of decision-making in this material have the lowest availability of indicators. The low indicators of decision-making make this indicator the lowest in the three items. And if the overall calculation indicator of decision making is the indicator with the lowest percentage.

In the LKS as a whole, the indicators of decision-making are more striking than the other indicators in their average percentage. This is certainly a note because decision-making is very important for students to face real-life [18]. Someone in his life will certainly face a situation where he has to make decisions in dealing with these circumstances. Of course, this deficiency can be overcome with the teacher's strategy later in the learning process. LKS F X / II RC-IP as a whole also has a solid and easy-to-understand content presentation. This is certainly capable of creating HOTS-based learning by noting improving the learning process and covering up existing shortcomings.

3. **LKS F X / II BK-VP**

The results of the analysis on the availability of the HOTS indicator as a whole get an LKS score of 14.25% in the non-facilitating category. Not all materials on the availability of HOTS indicators are in the non-facilitating category. The newton law material on this LKS has an availability percentage of 25.4% with the category of less facilitating. The value contained in Newton's law material is far proportional to other materials so that the LKS gets an average percentage in the insufficient category. The percentage of each material can be seen in Figure 3 below.
In Newton's law material, the percentage of availability of critical thinking indicators is very high compared to indicators in other materials. The average percentage is in the quite facilitating category. In this material, indicators of creative thinking are also found in worksheets. This makes the percentage of indicators for creative thinking the lowest of all indicators. The low percentage of availability of creative thinking indicators in the student worksheets indicates that the student worksheets do not facilitate students to master creative thinking skills. Meanwhile, creative thinking is very important for students in solving a problem because by creative thinking students can solve a problem in various ways which are certainly considered correct. By thinking creatively, students are sensitive and flexible in seeing various relationships to state something.

Then in other materials, namely Newton's gravity, energy effort, impulse-momentum, and harmonic motion, the large percentage of available indicators is categorized as not facilitating. In Newtonian gravity, the average percentage for the availability of HOTS components is 12.5%. Then the energy business material amounted to 16.1% in the category of not facilitating. In these two materials, indicators of critical thinking are the highest indicators.

Furthermore, in the impulse-momentum material, HOTS components were found to be 15.5%. Of the three indicators found, the problem-solving indicator was the highest, followed by the critical thinking indicator. In contrast to the harmonious motion material. In this material, only one indicator is found, namely critical thinking. So that overall, the average percentage of this material to the HOTS indicator availability is very low, namely 2.78%. This is an important note and another learning strategy is needed to cover this low percentage.

3. LKS F X / II G I

The average percentage of HOTS scores on the LKS is 16.44% so that the LKS can be categorized as not facilitating the availability of HOTS indicators. In each material, there are only two materials in which the HOTS indicator availability is in the category of less facilitating and the rest is not facilitating. The results of the analysis of the LKS F X / II G I can be seen in Figure 4.

Based on the figure, energy and impulse-momentum business materials have availability percentages of 22.2% and 23.8%. In the matter of business and energy, the indicator of critical thinking is the highest with the category of sufficiently facilitating. For Newton's law material, Newton's gravity and harmonic motion have a percentage of 10.6%; 15.28%, and 10.4% in the non-facilitating category. In the newton law material, the indicator of solving is the highest indicator that can be found in facilitating HOTS. And in this material also indicators of decision-making can be found in low categories as well. Then in Newton's gravity material and
harmonic motion, the indicator of critical thinking is the highest in facilitating HOTS components. The size is sufficient to facilitate Newton's gravity material and less facilitate the harmonic motion of the material.

LKS presentation combines student understanding with making students active in proving a concept in an experiment and discovering the concept of a structured task that has been compiled with instructions and directions. This certainly encourages and encourages students to learn.

4. **LKS F X/II G II**

The results of material analysis on Newton's law material, Newton's gravity, work and energy, momentum and impulse along with harmonic motion can be seen in Figure 5.

![Fig 5. The percentage of HOTS Indicator Average Score at LKS F X / II G II](image)

For LKS F X / II G II the percentage of availability of HOTS indicators as a whole got an LKS score of 22.55% in the category of less facilitating. From the whole, only in the harmonious motion material, the percentage of HOTS availability does not facilitate. In the harmonic motion material, the percentage of availability was only found at 16.1%. Where in this material the highest HOTS indicator found was an indicator of critical thinking with the category of less facilitating. Other indicators are in the category of not facilitating and even decision-making indicators are not found in the material.

For the other four materials, namely first, Newton's law material. The percentage of availability of HOTS indicator was obtained by 20.23% with the category of less facilitating. In this material, there are no indicators of creative thinking and the indicators with the highest availability are indicators of problem-solving and critical thinking in the category of less facilitating. In Newton's gravity material, the availability of 24.6% was obtained, and the impulse-momentum material was 27.4% in the less facilitating category. In this material, the problem-solving indicator is the highest indicator with the category of less facilitating. And for momentum and impulse, indicators of critical thinking are also included in the highest indicators encountered.

In LKS F X / II G II, it is the same as LKS F X / II G I which in the presentation of the material presents the process of proving a concept in an experiment and finding the concept of a structural task that has been compiled with instructions and directions. This is very good for increasing student understanding. In this case, the teacher's creativity in the learning process is required to create a HOTS-based learning process using this LKS X / II G II.

**IV. CONCLUSION**

Based on the results of the HOTS indicator analysis studied, it was found that five LKS were not HOTS oriented. The HOTS component of the LKS from publishers and teachers used by schools in West Sumatra is still low in the category of less facilitating and not facilitating. LKS that have the highest HOTS indicator is LKS with code LKS F X / II RC-IP with the category of less facilitating. However, in the LKS F X / II RC-IP, the two materials were in the sufficiently facilitating category with an average score of 47% and 54%. Meanwhile, the physics worksheets that got the lowest percentage of HOTS component availability were worksheets with the code of LKS F X / II BK-VP in the non-facilitating category. The most common indicator is the critical thinking indicator, which is the highest availability of the four worksheets analyzed. And the indicator that is rarely found is the indicator of decision making. Even in one LKS, these indicators were not found.
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