Analysis of High School Physics National Examination questions based on Bloom Taxonomy and National Examination Question Standard in 2017/2018

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Abstract. The National Examination is for measuring the success rate of student learning at school and mapping the quality of Education in Indonesia. To fulfill the objectives of the National Examination, an instrument is needed to represent the standards set by the Indonesian government. This research is a qualitative study that aims to analyze National Examination Questions in 2017/2018 based on Bloom's taxonomy and National Examination Questions Standard. Data collected by analyzing the samples National Examination questions in 2017/2018 using operational verbs in Bloom's taxonomy and grouping topics based the standard. Based on the research, it was found that most question is in the applying cognitive domain (C3), that is, 35 %, when the least question is in the creating cognitive domain (C6), that is, only 2.5%. According to the National Examination Questions Standard, the most topic in the National Examination in 2017/2018 are “Force and Motion” and “Electric, Magnet and Modern Physics” with the same amount of 22.5%. The National Examination Questions Standard is too general in writing down cognitive levels and the topics that appear on the question.

1. Introduction
National Examination is an activity to measure graduates' competency achievement in a certain subject nationally by referring to Graduates' Competency Standards [1]. The Graduate Competency Standards are made based on Competency Standards and Basic Competencies in the Old Curriculum (KTSP) or called Core Competencies and Basic Competencies in the 2013 Curriculum. Although the National Examination is no longer used as a determinant of student graduation, the results of the National Examination used as Mapping the Quality of Education in all regions Indonesia so that the government can determine the areas that should be given guidance and assistance to improve the quality of education. In addition, the National Examination considers as selection to enter the next level of education as stated in Government Act (PP) Number 19 of 2005 which was later revised with Government Act (PP) Number 19 of 2005 [2, 3].
Based on the results of the National Examination in the Academic Year 2017/2018, it shows that the number of students in East Java for the high school level who scored below the minimum criteria was high and increased from last year, especially in the science subjects. In the 2016/2017, the percentage of students who scored below 5.5 by 85% and persisted in the 2017/2018 for high school students and increased to 96% for Islamic high school students. The data shows that the average competency achievement of high school students in the field of science still needs to be improved, one of them is in the area of Physics. The analysis also impacts on the efforts in the school to enhance the quality of education.

As an effort to improve the quality of education, especially in increasing the quality of National Examination in the field of Physics, it is necessary to analyze the National Examination questions. One of the National Examination investigates carried out one of them was based on Bloom's taxonomy and National Examination Question Standard.

Benjamin S. Bloom and measurement experts in the United States have analyzed the percentage of thinking levels that can be achieved through the general science test. This analysis is done to help their work in making question instruments that have the same objectives in all regions of the United States, or as an effort to standardize national education. The thinking level is used as the foundation for the questions on cognitive aspects which are then called the Bloom taxonomy [4]. In Bloom's Taxonomy, the cognitive domains that Anderson and Krathwohl had revised consisted of Remembering (C1), Understanding (C2), Applying (C3), Analyzing (C4), Evaluating (C5) and Creating (C6) [5]. Each aspect can be identified using the operational verb contained in the questions. Operational verbs that correspond to each cognitive level can be seen in Table 1.

| Cognitive Level | High Order Thinking                                                                 | Communication Spectrum                |
|-----------------|--------------------------------------------------------------------------------------|---------------------------------------|
| Creating (C6)   | Generating, Designing, Producing, Devising, Net Meeting, Moderating, Collaborating   | Negotiating, Negotiating, Moderating,  |
|                 | Devising, Hypothesising, Experimenting                                               | Collaborating, Collaborating,          |
| Evaluating (C5) | Checking, Critiquing, Hypothesising, Experimenting                                   | Net Meeting, Commenting, Debating     |
| Analyzing (C4)  | Attributeing, Organizing, Integrating, Validating                                    | Questioning, Reviewing                |
| Applying (C3)   | Executing, Implementing, Sharing                                                     | Posting, Blogging, Replying           |
| Understanding (C2) | Classification, Comparing, Interpreting, Inferring                        | Chatting, Contributing, Networking    |
| Remembering (C1) | Recognition, Recalling, Describing, Identifying                                    | Texting, Instant Messaging, Twittering|

In the 2017/2018 National Examination Question Standard, there are cognitive levels and the scope of the material used as guidelines for the National Examination questions. Cognitive levels in the standard, including knowledge, understanding, application, and reasoning. While the scope of the topic consists of Measurement and Kinematics; Dynamics; Work, Energy, and Collisions; Heat; Wave and Light; and Electricity, Magnetism, and Modern Physics.

2. Research Methods
The research method is a non-experimental method, which is a qualitative descriptive method by analyzing documents. Descriptive method is the search for facts with the right interpretation, which aims to describe the state of the status of phenomena that are found, described as they are, unmodified or not given treatment [7]. According to Bogdan and Taylor (1975) qualitative methods as research procedures that produce descriptive data in the form of words or verbal from people and observable behavior [8].
The research instrument was in the form of documents, namely: the primary document used as the material for analysis is 2018 High School National Examination Physics Questions. The 2018 High School National Examination Questions in Physics consist of 21 different question packages. This National Examination is given through a Paper Based Test called the UNKP and a Computer Based Test called UNBK. In this study, one sample question package that was used is the 2013 UNKP based test. Taking one sample of this question packages is having the same weight following the Graduation Competency Standards (SKL) that have been made nationally. The next document is the Operational Verbs used in the classification analysis based on revised Bloom's taxonomy and the High School (SMA/MA) National Examination Question Standard especially in the field of Physics as a reference for classifying questions based on their topics.

The next step is categorizing based on the cognitive level and the scope of the physics topics. Question items are grouped, then the percentage is calculated based on the cognitive level group and the material scope. These results are analyzed again so that conclusions can be obtained.

3. Results and Discussion
After analysing 40 items in a predetermined package, the following results are obtained:

3.1. Analysis based on Revised Bloom’s Taxonomy
Taxonomy analysis is done by grouping questions based on the operational verbs used in the questions with the operational verbs that underlie the cognitive level grouping in Bloom's taxonomy. From the analysis, we get the results as in Table 2.

| Cognitive Level | Frequency | Percentage (%) |
|-----------------|-----------|----------------|
| Remembering (C1)| 3         | 7.5            |
| Understanding (C2)| 11    | 27.5           |
| Applying (C3)   | 14        | 35.0           |
| Analyzing (C4)  | 5         | 12.5           |
| Evaluating (C5) | 6         | 15.0           |
| Creating (C6)   | 1         | 2.5            |

Based on Table 2, it can be seen that the most cognitive level found in the question is Understanding (C2) and Applying (C3). This finding is in line with the results of the Asep Sutiadi study which stated that the proportion of the Physics National Examination Questions based on the TIPP (Taxonomy of Introductory Physics Problem) was dominated by level 2 (Comprehension) which included symbolizing the domain of mental procedures [7]. Similarly, the results obtained by Rian [9], which states that the National Examination Questions emphasize more on aspects of conceptual understanding or dominated in the realm of Understanding (C2).

The proportion of cognitive domain on the Questions show that students should be more emphasized in understanding the problem conceptually, not just by remembering it. Thus, if students can understand each concept in each topic, students will be able to solve various kinds of problems related to each of these materials. Even the concepts that are understood can help students to solve questions in the domain of remembering (C1) and apply (C3). Moreover, if it is associated with other material, students can also solve problems in the domain of analysis (C4) and evaluate (C5).

3.2. Analysis based on 2017/2018 National Examination Question Standard
As mentioned in the introduction section, the scope of material contained in the 2017/2018 National Examination Question Standard especially in the field of Physics covers Measurement and Kinematics; Dynamics; Work, Energy, and Collisions; Heat; Wave and Light; and Electricity, Magnetism, and Modern Physics. Physics National Examination Questions Classification results based on the scope of the material can be seen in Figure 1.
Based on the Basic Competencies found in the 2013 Curriculum, the scope of materials in grade X are Measurement and Kinematics; Dynamics; and Work, Energy, and Collisions. The topics in class XI are Heat; and Wave and Light. While the materials contained in grade XII are Electricity, Magnetism, and Modern Physics. Thus, if grouped by grade, the proportion of UN questions can be seen in Figure 2.

Based on the results, students are required to remember more and understand the material learned in grade X. This problem might affect the results of student examination that is low. The process of recalling knowledge for a more extended period will undoubtedly be more difficult than when recalling new material learned in grade XII. This process is ultimately also influenced by the learning process or when transferring knowledge (planting memory). Memory planting consists of 3 stages, namely: entering information into memory, then storing it, and then reviving stored information [10]. Some memory can be stored in short and long-term memory [11]. Information that enters short-term memory is usually information that is stored acoustically (via audio) and visually (through its appearance).

Meanwhile, long-term memory comes from how humans create and develop codes so that information received can be stored easily in long-term memory. Long-term memory is not passive in the sense that the information it takes lives in memory waiting to be called, but in long-term memory, information is continuously organized in new forms [12]. However, interference with experience retention can occur due to damage to a part of the memory storage area or a disturbance in the search mechanism and re-reading [13]. So, in the learning process learning methods are needed that can reduce the damage among the three.

The proportion of questions derived from small class XII material causes irrelevance of the results of the National Examination with the physics concepts students have learned. Given the requirements of student learning for each grade level tend to be the same as the material load. Both in the 2013 Curriculum and KTSP Curriculum, the physics study hours in schools for grade X are fewer than physics study hours for classes XI and XII. In other words, the weight of materials or concepts teaching students tends to be more difficult than the students in grade XI and XII. The imbalance in the proportion between...
the content that appears in the National Exam Questions and the one that has been studied can also be a trigger for the low scores of National Examination results.

In the 2018 National Examination Question Standard, in addition to the material scope, there are also cognitive levels that used as references in making the questions. The results of the cognitive level analysis found in each topic can be seen in Table 2.

| Topics                              | Cognitive Level |
|-------------------------------------|-----------------|
| Measurement and Kinematics          | C1  | C2 | C3 | C4 | C5 | C6  |
| Dynamics                            | 4   | 1  |    |    |    |     |
| Work, Energy, and Collisions        | 1   | 2  | 2  |    |    |     |
| Heat                                | 2   | 2  | 1  | 1  |    |     |
| Wave and Light                      | 1   | 4  |    | 1  |    |     |
| Electricity, Magnetism, and Modern Physics | 4   | 3  | 1  | 1  |    |     |

Based on Table 2 it can be seen that in one material scope, there are no questions that contain all cognitive levels ranging from C1 to C6. Some topic only includes 2 to 4 cognitive levels only. For comparison, in the National Examination Question Standard also mentioned cognitive levels consisting of knowledge and understanding, application and reasoning or only ranged from C1 to C4. The cognitive level in the standard is written for each scope of material. In other words, the standard made still too general or less specific.

Not only the cognitive level is still written in general but also in the writing of the material scope. Some of the material written in the 2018 National Examination Questions Standard is still too general. For example, there are questions for the tube of air resonance and intensity levels of sound. However, on the standard, only "sound" topic is written. Also, magnetic induction with a wide range of sub-topics, which includes magnetic fields, Lorentz forces, and their applications are only written with "magnetism".

4. Conclusion
Based on the research, it was found that most question is in the applying cognitive domain (C3), that is, 35%, when the least question is in the creating cognitive domain (C6), that is, only 2.5%. According to the National Examination Questions Standard, the most topic in the National Examination in 2017/2018 are “Force and Motion” and “Electric, Magnet and Modern Physics” with the same amount of 22.5%. The National Examination Questions Standard is too general in writing down cognitive levels and the topics that appear on the question.

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