

# An Analysis of Low-Mastery Learning in Science National Examination 2018 and Its Strategies

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**Abstract.** This study aimed to (1) Analyze the material of the National Science Exam with low mastery learning level, (2) Identify the root causes of the low mastery learning of material, and (3) Provide alternative solutions to overcome the problems. The data collection technique was done by observation and interview. Observations were made to collect national exam question data, the results of national examination mastery learning, literature review and science learning observation data in schools. Interviews were conducted for science teachers in three secondary schools in Surakarta to obtain more in-depth data based on the reality that occurred in the field. The results of the study showed: (1) Material that has low mastery learning is the subject of the classification of material and its properties; (2) The causes of low mastery learning in the form of characteristics of the subject matter and types of national exam questions used; and (3) The solution to overcome low mastery learning is to use the Inquiry-Interactive Demonstration learning model which involves the active role of students in constructing their knowledge and the required media in the form of modules to help understand and master the subjects in science

**Keywords:** National science Exam, Classification of material and its properties, Inquiry based on interactive demonstration.

## 1 Introduction

Science is formed from natural phenomena as outlined in processes, products, attitudes and applications [1]. Science as a product is often referred to as student learning outcomes from a series of learning processes carried out. Achievement of student learning outcomes is obtained after students undergo educational assessment. Assessment of education in Indonesia is carried out in three ways, namely assessment by educators, educational units and the government as stipulated and mandated in Permendikbud No. 23 of 2016. Assessment by the government is carried out with the implementation of the National Examination (UN) carried out at the end of the learning level of students. The national examination aims to measure the achievement of competency of students nationally in certain subjects [2]. In addition, the National Examination was held in carrying out the mandate of Minister of Education and Culture No. 23 of 2016 as a reference for mapping the quality of education. The natural sciences due to the National Examination is carried out at the secondary school level or equivalent by testing various basic competencies of science that have been taken in that level.

Achieving basic science competencies in the National Examination is demonstrated through the mastery learning of students in the material being tested. Absorption of students in science subjects shows the ability to absorb a concept or subject matter. When basic science competencies tested in the National Examination get low absorption, teachers and schools have great attention in preparing students for the next National Examination [3] [4].

An analysis of mastery learning National Examination by mapping the basic competencies of the Natural Sciences being tested. The results of the mastery learning can help for mapping the basic competencies of science in improving the quality of education. The results of the mastery learning capacity can help map the basic competencies of science and then become one of the references in improving the learning that has been done so far. The method and model are being considered to overcome the process.

The result of the lower mastery learning in Science Exam data is the important thing that can be used as evaluate learning process in science learning. This study aims to analyze the science material in National Examination with low mastery learning level. Furthermore, an analysis of the causes of the natural science material that has the lowest absorptive capacity and one alternative to improve it in learning.

## 2 Method

This study was done by using descriptive exploratory research method that aims to expose data and facts and explore the causes of something to find out the problem without giving action or treatment that affects it. Data collection techniques in this study through observation and interviews. Observations were made to collect national exam question data, the results of national examination mastery learning, literature review and science learning observation data in schools. National exam question data and mastery learning capacity of the science subject as a part of national exam were analyzed with the aim of classifying and calculating mastery learning level according to basic competencies (KD) in the Curriculum 2013. All indicators of questions grouped according to KD in Curriculum 2013 were calculated as the percentage of absorption average:

$$\text{Percentage} = \frac{\text{total score of mastery learning each basic competence}}{\text{items}} \times 100\%$$

Furthermore, an analysis of the items was conducted to find out the cognitive domain based on Blooms' taxonomy revision [5]. Interviews were conducted for science teachers in three secondary schools in Surakarta to obtain more in-depth data based on the reality that occurred in the field. The interview instrument used uses open questions accompanied by interview guidelines. Data obtained from the questions of the science subject as a part of national exam, the mastery learning of the natural science of national exam, literature review and interviews were analyzed by researchers to determine alternative solutions to science learning problems.

## 3 Results and Discussion

### 3.1 Analysis of Problems

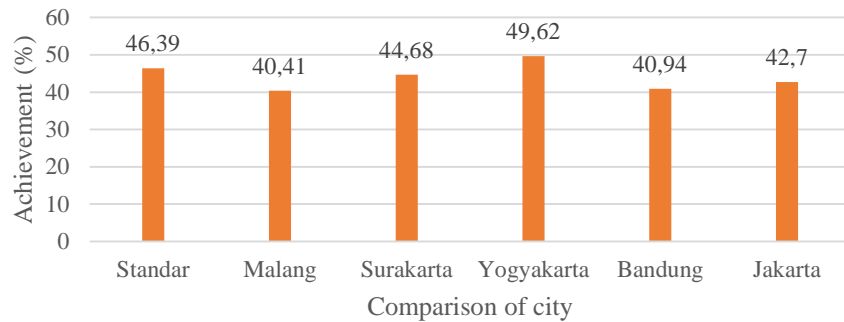
Mastery learning in the results of science subject of National Examination 2018 is one indicator that determines the achievement of competencies achieved by students. The existence of absorbency results can help educators and relevant agencies in mapping competencies that are considered easy, medium and difficult so that alternative solutions can be determined. The power analysis of the mastery learning of science subject of National Examination 2018 was carried out by classifying the question indicators retrieved from the Puspendik Kemdikbud RI [6] into basic competencies / material in accordance with the Curriculum 2013. The results are shown in Table 1.

**Table 1.** Mastery Learning of Science Subject in National Exam 2018

No	Science Materials	Items	Mastery Learning (%)
1.	Classification of materials and its properties	4	34.99
2.	Digestive system	1	35.12
3.	Solar system	1	36.62
4.	Additive and addictive substance	2	37.37
5.	Light and Optics	2	37.71
6.	Substance pressure	1	41.18
7.	Respiratory system	1	41.43
8.	Biotechnology	1	42.64
9.	Motion system in organism	1	43.40
10.	Genetics	1	43,65
11.	Harmonic motion, wave and hearing system	3	44.11
12.	Organ system of organism	1	45.51
13.	Linear motion	2	47.32
14.	Reproduction system	2	48.03
15.	Electricity and magnetism	4	48.52
16.	Classification of organism	1	49.14
17.	Energy in sustainable life	1	50.34
18.	Work and simple plane	2	51.37
19.	Bloodstream system	1	52.57
20.	Environmental pollution	2	62.46
21.	Interaction between organism and environment	4	63.51
22.	Measurement concept	2	63.58
Percentage (%)			46.39

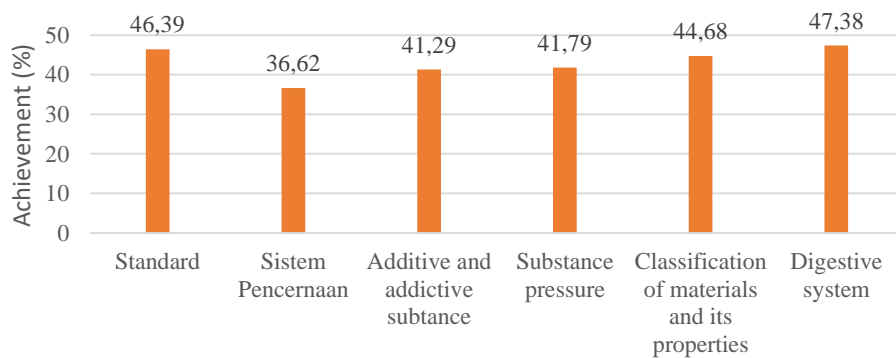
The the results of science subject of National Examination 2018 examines 22 materials divided into 40 multiple choice questions. Based on Table 1, it is known that out of the 22 materials tested, there was material with the lowest mastery learning capacity at the national level, namely the material classification material and its properties to get 34.99%. The achievement is below the average mastery learning rate of all science materials, which is 46.39% which is then used as a standard in achievement. The low mastery learning of the material at the national level is then seen in the sample of major cities in Indonesia, namely Malang, Surakarta, Yogyakarta, Bandung and Jakarta. The sample selection in the form of big cities is based on cities with the title of the city with the best education in Indonesia. The following is a

comparison of the mastery learning power of material classification of matter and its properties, as seen in Figure 1.



**Fig. 1.** Comparison of Mastery Learning on Classification of Materials and Its Properties

Based on Figure 1, it is known that the city of Yogyakarta has the mastery learning capacity above the standard set. On the other hand, the other four cities, namely Malang, Surakarta, Bandung, and Jakarta, have sub-standard in mastery learning capacity on the material. So based on the mastery learning analysis, it can be concluded that classification of materials and its properties are chosen to be studied more deeply to determine alternative solutions in science learning. The main focus in this study is the achievement of the science subject of National Examination 2018 in mastery learning capacity. Classification of materials and its properties has been gaining the lowest level of mastery learning in Surakarta. The achievement of the science subject of National Examination 2018 of mastery learning capacity in Surakarta City shows that classification of materials and its properties are included in the five lowest absorbency materials shown in Figure 2.



**Fig. 2.** Science Materials with Low Mastery Learning in Surakarta

Based on Figure 2, the science subject of National Examination 2018 in in mastery learning capacity, especially in classification of materials and its properties is one of the material with the acquisition of mastery learning that is quite low and below the national standard set. Physics and chemistry influenced the changes of materials in everyday phenomena. There is physical and chemical changes in everyday life. This basic competency is given to class VII students of semester I.

### 3.2 Analysis the Cause of the Problems

The low mastery learning capacity of science materials on classification of materials and its properties due to science subject of National Examination 2018 at the national level shows that the majority of competency attainments are still low both at the city / regency and provincial levels. The low mastery learning is caused by:

#### Characteristics of Learning Objects

The subject matter of classification of materials and its properties consists of three levels of representation, namely macroscopic, submicroscopic, and symbolic [7]. The macroscopic aspect refers to what can be observed by the human senses, both through experiments and experiences in everyday life [8]. The macroscopic concept of this material includes the separation of mixtures and changes in matter. The submicroscopic aspect refers to what occurs at the molecular level which cannot be directly observed through the human senses [9]. The submicroscopic concept includes the concepts of atoms, compounds, molecules, etc. Symbolic aspects refer to phenomena symbolized into symbols, formulas, and equations [9]. Symbolic concepts such as O, H, C, H<sub>2</sub>O, HCl, etc.

Various studies on this material indicate that there are difficulties for students in understanding sub-microscopic concepts such as the nature of matter, the structure of various compounds, and the interpretation of chemical symbols [10] and difficulties in making connections between structures, symbols, and processes chemistry [11]. Understanding sub-microscopic concepts is considered difficult and abstract so that it is considered to study things that have no meaning [12][13]. Another study explains that this consists of concepts that are not directly observable through the human senses or are abstract in nature so that they are able to train students' high-order thinking skills (HOTS) [14]. Difficulties in the macroscopic concept can also occur if students are not invited to experiment. Students' understanding of the macroscopic concept is influenced by students' daily experiences [13]. Students' difficulties in understanding the material become one of the causes of the low absorption of material both at the city, regional and national levels due to standardized test.

#### Characteristics of Science Test in National Examination 2018

The reason for the material characteristics is certainly not the only reason for low absorption. So it is necessary to have an analysis of the national exam questions on the material. Analysis of the national exam questions was carried out on one of topic that has been focused namely classification of materials and its properties in the national examination in Surakarta from the year of 2016, 2017 and 2018 as follows.

**Table 2.** Comparison of Mastery Learning in Science National Examination from the Last Three Year

Year	Indicator of Item Test	Level of Cogniti	Mastery Learning	Mean
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2016	Mention the properties of the substance based on the color change table of litmus paper	C1	74.52	74.52
2017	Determine images that illustrate acid, base or salt solutions based on changes in the color of the indicator	C3	66.22	60.32
	Determine three images which include elements, compounds, and mixtures in sequence	C3	62.38	
	Determine how to mix the mixture based on illustrations	C3	50.23	
	Determines 2 of 4 statements that show physical / chemical changes correctly	C3	62.44	
2018	Distinguish physical / chemical changes from changes in substances	C4	34.83	44.68
	Determine the separation of the mixture correctly	C3	52.31	
	Determine acid, base or salt solutions from the acid-base indicator change table	C3	48.71	
	Determine the atom, ion or molecule correctly	C3	42.87	

Based on Table 2, mastery learning capacity in this material has decreased during the implementation of national examinations in the last 3 years. The difference in the question of the National Examination on this material is the number and type of questions given. In 2016, only tested 1 item, in 2017 and 2018 tested 4 items in this material. On the other hand for the types of questions tested have increased in the cognitive domain. Based on the indicators of the questions presented, the question of the science subject of National Examination 2018 has a type of question that requires students to think higher which leads to critical and analytical thinking. Critical thinking is one of the highest-level thinking skills or Higher Order thinking Skills (HOTS). Critical thinking is a complex process that requires a high level of cognitive processing of information [15].

### 3.3 Alternative Solutions to Overcome the Problems

The low mastery learning on the subject is inseparable from the impact of learning carried out in class / school. Based on the results of observations in a junior high school in the city of Surakarta, science learning is done using the lecture method and students are rarely invited to directly discover their own knowledge. The teacher has not taught 4C (collaboration, communication, critical thinking and problem solving, and creativity) especially critical thinking skills. Furthermore, the results of interviews with junior high school science teachers showed that on this subject the teacher delivered material with the lecture method and the absence of experimental activities on this material. The teacher teaches the material in accordance with the school handbook. The use of other learning resources such

as power point is also used to explain material that is not listed in the book. The various learning method is needed to apply at school.

Learning that takes place during this time is often in the direction of the teacher providing material while students only listen. This unidirectional learning makes students not have a deep understanding of a material because they do not have experience directly in the process of finding out. This situation causes the student learning experience not to be contextual because students' knowledge is only in the form of memorization of existing theories and concepts. The learning experience made students only study science in the lowest cognitive domain [16]. This makes students' thinking skills not develop, especially their ability to think critically and creatively.

The solution to overcome the low mastery learning capacity of the subject is through learning that involves the interaction of teachers and students in constructing knowledge. Interaction in effective learning when done in two directions, namely when the teacher delivers the material, students provide feedback or the teacher together with students actively involved in achieving the learning goals. One of the learning models that make students active in constructing knowledge is the inquiry model [17][18][19][20]. Inquiry learning can provide hands-on experience for students through the process of finding out. The process of finding out can build students' concepts, so that the knowledge gained is based on their own findings at its finest.

One of the levels of inquiry learning according to Wenning is the Interactive Demonstration model. Inquiry-Interactive Learning Demonstration consists of syntax that makes students active in constructing their knowledge [21]. Table 3 below is an activity in the learning syntax of the Inquiry-Interactive Demonstration model.

**Table 3.** Syntax Learning Activity on Inquiry-Interactive Demonstration Model

Syntax Learning	Activity Based on Inquiry-Interactive Demonstration Model
Observation	Students observe, describe, and analogize a phenomenon in the form of a demonstration by a teacher. The teacher in the demonstration without giving an explanation or statement of the results of the demonstration.
Manipulation	Students think about the possibilities that will occur, the cause of that can happen, write down a problem from the demonstration carried out by the teacher and write predictions in writing. Mainali in his journal states that high-level thinking skills can develop when students discover a new problem [22]. So that at this stage allows critical thinking skills of students to develop.
Generalization	Students hold discussions in small groups. The purpose of this discussion is to be able to discuss and improve predictions if there are errors in the group as the presentation done well.
Verification	Students get governance reinforcement from the demonstration conducted by the teacher. At this stage, the teacher aligns all perceptions so that students have the same understanding. If there is an alternative conception of students, the teacher must solve it by giving reinforcement to students [21]. Giving reinforcement is done by straightening out the initial conception to improve student understanding.
Application	Students are given new problems. Giving new problems requires students to use the knowledge they have obtained to analyze and resolve these problems. Giving problems by the teacher when students have gained a clear understanding of a concept will help shape students' thinking patterns and develop their thinking skills. Students can understand a concept better when given the opportunity to apply their knowledge in a situation [23]. So that at this stage students use their critical thinking skills to solve these problems.

Based on Table 3, through the stages of learning that involve the active role of students in learning it is expected to develop students' thinking skills, especially critical thinking skills. In the verification and application phase, it is expected to be able to overcome the low absorption capacity of material classification and its changes. Through the stage of verification of the teacher and students together equate understanding of the concepts that have been learned. This is so that there are no differences in concepts between students. After students get a deep understanding, then students are given problems in the form of tests / questions that require students to use the knowledge gained at the application stage. Giving questions leads to a high level question model so students get used to critical, creative and analytical thinking in advance.

As for science learning, it takes a media that supports the teaching and learning process specifically to overcome the characteristics of the material that requires students to have the ability to transfer and connect between macroscopic, submicroscopic and symbolic phenomena. Particularly in one of the problematic aspects is the level of submicroscopic representation. In this aspect students really cannot see directly through the observation of the senses (the concept is abstract) which causes difficulties in understanding it for students to do mastery learning in science concepts.

The solution is through the use of media to visualize concepts in learning in the form of modules. Teaching materials in the form of modules can help students understand the submicroscopic aspects in the form of abstract concepts through visualizing the concept of learning [24][25]. Through teaching materials that present visualizations in the form of images can help convey information that is being studied and strengthen memory by giving an impression to the reader through image.

#### 4 Conclusion

Based on the results and discussion of the research described in the previous chapter, it can be concluded that the material of science which has low mastery learning to the results of national examination (UN) is classification of materials and its properties. Low mastery learning is caused by students having difficulty understanding abstract (sub microscopic) concepts and the use of types of questions that are more difficult than in previous years. The type of question used leads to the form of higher order thinking skills (HOTS) questions that require students to think creatively, critically and analytically. The solution to overcome through learning is to use the Inquiry-Interactive Demonstration learning model which involves the active role of students to construct their knowledge and the required media in the form of modules to help understand this subject.

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