

CHAPTER I

PRELIMINARY

1.1 Problem Background

Education is a very important thing to enhance the development of a country. The better education in a country, the better the development of the country will be. At present we are in the 21st century known as the 4.0 revolution era marked by the rapid development of science and technology, so that the improvement of science and technology education is one of the important foundations in the development of a country. Science and technology education is expected to be able to deliver students to meet the needs of the 4.0 revolution era.

Physics is a science that studies the nature and natural phenomena and all interactions that occur in them. Physics is the science that is the basis of science and is the basis for all discipline of science. Genetic engineering and technology also makes physics the basis of its development (Young and Freedman, 2007). To meet the needs of the revolution era 4.0, based on the syllabus by curriculum 2013 of physics subjects for the senior high school issued by the minister of education and culture states that learning physics in senior high school aims to train students to master knowledge, master concepts and principles of physics, have scientific skills, have science process skills, and have critical and creative thinking skills. So to achieve this, students of senior high school cannot only have Lower Order Thinking Skills (LOTS), but must also be able to achieve Higher Order Thinking Skills (HOTS) (Kusuma et al, 2017).

The survey results of Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) show that the ability of Indonesian students to think scientifically is low. That is because students are not well trained in solving HOTS. Based on the PISA reported by the Organization for Economic Co-Operation and Development (OECD), Indonesia is ranked 64 out of 65 countries (OECD 2012). While for PISA in 2015, Indonesia

received an average score of 403 for science (third from bottom), 397 for reading (last place), and 386 for mathematics (second from bottom) from 72 participating countries. Even though the increase in Indonesia's achievements is quite significant compared to the results in 2012, the overall achievements are still below the OECD country average. In 2018 Indonesia's PISA scores for mathematics ranged from 379 and science was 396. As a comparison, China and Singapore ranked high for math scores with scores of 591 and 569.

In the PISA assessment there are 3 categories of levels: low, medium or medium and high. In the low category, students only carry out one-step procedures, for example remembering facts, terms, principles or searching for a single point of information from a graph or table. In the medium category, students are required to be able to use and apply conceptual knowledge to describe or explain phenomena, choose according to procedures that involve two or more steps, organize or display data, interpret or use graphic or simple data sets. In the high category, students are required to be able to analyze complex information or data, process or evaluate evidence, justify, give reasons from various sources, develop plans or sequence of steps to approach a problem (OECD, 2015). The characteristic of the questions given by PISA is the estimation of HOTS.

The problem faced by teachers is the difficulty of developing the HOTS system, which includes the application of HOTS-based learning and HOTS assessment. This is because in general the questions used so far and textbooks are routine and do not measure higher-order thinking skills. The lack of references regarding how to create HOTS questions and examples of HOTS problems make it difficult to overcome (Sani, 2019).

The results of interview at SMA St. Lusia Sei Rotan, it was found that Mr. Sumitro, a physics teacher at the school, was still unable to make HOTS-based questions properly. The results of data analysis from questionnaires that have been distributed obtained 78% of students choose that the questions used by teachers can directly apply the formulas in the book. The results of the data analysis of semester exam questions about work and energy do not have a item that truly measures the ability of students' HOTS, whereas in the grid given by the teacher there should be

33.33% (5 out of 15) Multiple choice questions about work and energy given have cognitive levels C4, C5, and C6 that can measure students' high-level thinking skills (HOTS). So it can be concluded that in school students are only accustomed to taking tests based on LOTS which have cognitive levels of C1, C2, and C3.

The use of HOTS items in tests can train students to sharpen their abilities and skills in line with the demands of the 21st century. Through HOTS-based test items, critical thinking skills (creative thinking and doing, creativity, and independent learning), will be built through practice in solving various problems of real daily life (problem solving) (Warisdiono, 2017).

The result of Research by Kusuma, et al (2017) on the development of HOTS assessment instruments in physics learning using the Borg & Gall method shows that HOTS-based instruments that are made can help students practice their Higher Order Thinking Skills. The problem that was developed was declared valid. Reliability for multiple choice and essay questions is high. Distinguishing power for multiple choice questions is accepted, for essay questions most are accepted even though some are revised and rejected. Afriani, (2019) also conducted the same research and it was found that the test instrument for senior high school was appropriate to be used as a measure of students' Higher Order Thinking Skills with high validity and reliability, moderate level of difficulty and level of text readability in accordance with the measured level. And Lindawati, et al (2019) found that the Authentic Assessment Instrument to Measure Higher Order Thinking Skills for Students based on the validation results of expert lecturers, assessment experts got grades in reasonable categories, material experts got very decent category values, and language experts from three senior high school educators got a very decent category value.

Seeing the importance of HOTS test instruments in learning of this area, the lack of HOTS questions used by teachers in schools, as well as teachers who are still unable to make HOTS test instruments, it is important to conduct research under the title " **The Development of Higher Order Thinking Skills (HOTS) Test Instrument for Work and Energy in Senior High School**". The test instrument

was developed using Research and Development (R&D) method, the Borg & Gall model.

1.2 Problem Identifications

Based on the background of the problem raised, problems that can be identified include :

1. Students are only trained to complete physics tests with solutions based LOTS, so they are less able to solve physics problems based HOTS.
2. Lack availability HOTS test instruments in schools so that teachers cannot do evaluation according to the global needs of the 4.0 revolution era.
3. Teachers who have not been trained in making HOTS test instruments so that the objective tests given to students are only LOTS-based

1.3 Problem Limitations

Based on the identification of the problem above, the researcher limits the research problem :

1. The development HOTS test instrument for work and energy in senior high school
2. The developed test instrument is in the form of multiple choice (objective test) which focuses on work and energy

1.4 Problem Formulations

Based on the limitations of the problem above, the formulation of the problem in this research is :

1. How is the validity of the HOTS objective test of the physics for work and energy in senior high school that has been developed?
2. How is the reliability of the HOTS objective test of the physics for work and energy in senior high school that has been developed?
3. How is the difficulty level of the HOTS objective test of the physics for work and energy in senior high school that has been developed?
4. How is the distinguishing power of the HOTS objective test of the physics for work and energy in senior high school that has been developed?

5. How is the effectiveness of the distractor of the HOTS objective test of the physics for work and energy in senior high school that has been developed?

1.5 Research Purposes

Based on the above problem formulation, the purpose of this research is:

1. Evaluate the validity of the HOTS objective test of the physics for work and energy in senior high school that has been developed
2. Evaluate the reliability of the HOTS objective test of the physics for work and energy in senior high school that has been developed
3. Evaluate the difficulty level of the HOTS objective test of the physics for work and energy in senior high school that has been developed
4. Evaluate the distinguishing power of the HOTS objective test of the physics for work and energy in senior high school that has been developed
5. Evaluate the effectiveness of the distractor of the HOTS objective test of the physics for work and energy in senior high school that has been developed.



1.6 Research Benefits

This research is expected to be useful for:

1. Students
HOTS objective test questions that have been developed are expected to be used as exercises to develop and optimize their Higher Order Thinking Skills (HOTS), and also motivate students to improve their knowledge.
2. Teachers

As an questions bank and alternative evaluation tool to determine students' higher-order thinking skills.

3. School

HOTS objective test questions that have been developed can be a means to improving the quality of students' higher-order thinking skills tests so that can help improve school quality.

4. Researcher

To add experience about the world of education, especially in the development of a test instrument.

1.7 Defenitions of Operational

1. The test is a set of questions that must be answered, or questions that must be selected, responded to, or tasks that must be performed by a person who is tested in order to measure certain aspects (behaviors / attributes) of the person nbeing tested
2. The objective test is a test which can be carried out objectively in an examination.
3. Validation is a concept related to the extent to which the test measures what should be measured. The test has a high validity if the results match the criteria, in the sense of having a parallel between the test and the criteria
3. Reliability is the level or degree of consistency of the results of measurements with the same test at different times.
4. Distinguishing power is the ability of each item to distinguish between students who have high ability and low ability.
5. Difficulty level is a number that indicates the difficulty or ease of a problem.
A good question is a matter that is not too easy and not too difficult.
6. Effectiveness of the distractor is an option or other answer choice from the correct answer, each option presented has the same possibility to be chosen. One option is called effective if it fulfills its function or the purpose it is presented for

7. Higher Order Thinking Skill (HOTS) is the ability to think that occurs when someone takes new information and information that has been stored in his memory, then connects that information and delivers it to achieve the goals or answers needed.



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