

## IDENTIFICATION OF PHYSICS CONCEPTS PROBLEM IN ANSWERING THE NATIONAL EXAM AT SENIOR HIGH SCHOOL IN PESISIR SELATAN DISTRICT

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### ABSTRACT

*The 21st century is a century with education system that refers to 2013 curriculum which requires teachers to apply learning that is directed at finding out information so that it can help students to have deeper mastery of concepts. The low value of the National Exam (NE) proves that many students have difficulty in working on questions. Therefore, research was carried out to identify problematic physics concepts on NE questions at Senior High School (SMAN) in Pesisir Selatan District. This research is descriptive research with qualitative approach. Population of data in this study was all SMAN that held the NE in Pesisir Selatan District which consisted of 21 schools. Sampling was carried out using Proportionate Stratified Random Sampling technique. The sample of this study was 6 schools that held the NE in SMAN in Pesisir Selatan District. The data in this study were taken from 2018 and 2019 Physics NE data at SMAN in Pesisir Selatan District in education center data (2018) with data collection techniques through documentation studies. Based on this data, it can be obtained the results of identification of problematic physics concepts on NE questions in 2018 with percentage of errors in 6 main materials including Measurement and Kinematics 58.68%; Dynamics 69.33%; Work, Energy and Collision 64.79%; Heat 57.74%; Wave and Light 65.95%; and Magnetism and Core Physics 45.45%. Then, in 2019 it consisted of 4 main materials including Mechanics 58.16%; Wave and Optics 65.87%; Thermodynamics 68.23%; and Magnetism and Modern Physics 57.90%.*

**Keywords :** Identification; Physics Concepts; National Exam



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## I. INTRODUCTION

The 21st century is a century with very rapid technological developments. The free flow of information and the variety of resources in the interaction environment between countries have brought about unprecedented changes. This certainly has a positive impact on the education that is applied, so that it can adapt and meet all the demands of the 21st century.

According to Law no. 20 of 2003 Article 1 Paragraph 1 Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills they need. society, nation and state. Physics is a branch of Natural Sciences that studies natural events. Physics is also a science that deals with how to find out about nature systematically, in the form of discovery, mastery of a collection of knowledge. This knowledge includes facts, concepts or principles as well as further development processes in applying knowledge in everyday life.

Education plays an important role in obtaining quality human resources, the government's efforts to improve education in Indonesia are through curriculum development. Curriculum development has been carried out from the Education Unit Level Curriculum (KUPTK) to the 2013 Curriculum which prioritizes student-centered learning and the teacher as a facilitator. Physics learning in the 2013 Curriculum has the aim that students can

master concepts and have skills that are able to develop knowledge, move students to find their own problems that must be solved by educators using scientific approach methods [1].

Improper implementation of learning activities in learning Physics is a factor that affects students' low mastery of Physics concepts. Classroom learning activities have not been able to optimally train aspects of concept mastery [2]. Mastery of concepts is needed by students because of the relationship between one material and another so that it can lead to the next learning material. Mastery of concepts is also very important for students because this is an indicator that students have fully understood what has been taught, which is not just memorizing. So that mastery of this concept can help students in solving a problem not only in the learning process but also in everyday life [3]. Good and bad student attitudes influence learning achievement which has an impact on student learning outcomes. This is important to be able to foster a positive attitude of students so that the quality of learning increases, learning achievement, and desire for a career in the physical field. The positive attitude of students is in the form of interest in learning physics, physical training, learning physics, applying attitudes, and other sciences. Students who can apply this positive attitude will more easily understand physics learning and feel that physics is fun learning [4].

In the process of learning physics, students' thinking increases in analyzing the phenomena that occur around them. This phenomenon is explained through concepts, laws, and mathematical equations in finding the real answer [5]. The selection of appropriate models, methods and teaching materials can improve student's [6]. understanding of the physics concepts being studied so that abstract physics concepts can become more concrete.

The concept mastery aspect refers to Bloom's Taxonomy which is revised to have six cognitive levels, namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5) and making (C6) [7]. Based on the results of the 2011 Trends in Mathematics and Science Studies International (TIMSS) study in the field of science, it shows that Indonesia ranks 40th out of 42 countries that follow or rank 3rd from the bottom, higher than Morocco and Ghana [8]. Likewise, the Program for International Student Assessment (PISA) in 2012 showed that Indonesia's average PISA score was very low at 382 of the international average of 501 and ranked 64th out of 65 participating countries. This shows that students in Indonesia on average have not been able to relate and communicate various science topics, especially abstract and complex science concepts.

The National Exam is an assessment of learning outcomes by the government. The National Exam is included in the category of summative tests. The summative test is the end of the semester test or the final stage of learning evaluation (EBTA) or now better known as the National Exam (NE) [9]. In addition to the semester exams and daily tests that must be passed by students, there is a final exam that students must take at the end of their education, namely the National Exam. The high school level National Exam is a determinant of a student to be able to continue their education to college. For 2012, the government set a passing standard of 5.5 [10].

Education center data (2018) shows that the average value of the National Exam in physics at the state high school level in Pesisir Selatan District is still relatively low. The low score of the National Exam of students proves that there are still many students who have difficulty in working on the questions. The difficulties experienced by students in working on the questions result in low learning outcomes and understanding of students concepts, so it is necessary to analyze the problematic concepts in the National Exam material.

Pesisir Selatan District is a district in West Sumatra which has a Physics National Exam score that is still below the average value of the West Sumatra Province Physics National Exam, which is 39.25 while the average value of the West Sumatra Province Physics National Exam is 44.02 so that researchers determine the Pesisir Selatan District as a research place. From this we can know that the ability of students to work on questions is still relatively low or not yet optimal so that students understanding of physics concepts must be improved in order to achieve the demands of the 2013 curriculum.

The results of the documentation study that has been carried out by researchers by collecting the 2018 Physics National Exam scores in Pesisir Selatan District, then analyzing the problematic physics concepts from the exam, it is known that through data from the Assessment and Learning Center at the level of understanding of the concepts and learning outcomes of these students still not optimal. The ability of students to answer questions is also not optimal. This can be seen from the 2018 Physics National Exam scores in 21 schools that held Physics National Exam in Pesisir Selatan District by showing that Senior High School (SMAN) 2 Ranah Pesisir with the lowest average National Exam score was 31.70 and Senior High School (SMAN) 3 Painan with the highest average National Exam score was 58.64 compared to the average score of the National Exam in the Province, which is 44.25 and the average score of the National Exam, which is 44.00. Then, through the 2018 Physics National Exam scores, researchers took a sample of 21 schools that held the National Exam in Pesisir Selatan District as research samples.

Based on the description of the problem above, it turns out that there are several factors that cause students National Exam scores in answering the National Exam questions are still low, so it is necessary to analyze the problematic physics concepts in answering the National Exam questions. Therefore, to find out the problematic physics concepts in answering the National Exam questions, the researchers conducted an analysis of the problematic physics concepts in answering the National Exam questions in Senior High School (SMAN) throughout Pesisir Selatan District.

## II. METHOD

Based on this background, the purpose of this study is to find out which physics concepts are problematic in answering the National Exam questions in Senior High School (SMAN) in Pesisir Selatan District. The type of research conducted is descriptive research with a qualitative approach which aims to find out the problematic physics concepts in answering the questions of the National Exam. Descriptive research is the most basic form of research. Intended to describe or describe existing phenomena, both natural phenomena or human engineering [11]. Descriptive research is carried out with the aim of explaining something or describing something as it is. A qualitative approach is a research that produces descriptive data in the form of written or spoken words from people and observed behavior [12]. The phenomenon in this study is the phenomenon of students' ability to solve National Exam questions, so that difficult or problematic physics concepts are depicted and easy physics concepts in answering National Exam questions.

Population is a generalization area consisting of objects or subjects that have certain qualities and characteristics that are applied by a researcher to be studied and then drawn conclusions. The population of this study were all Senior High School (SMAN) that held the National Exam in Pesisir Selatan District which consisted of 21 schools. The sample is part of the number and characteristics possessed by the population. The sampling technique in this research is Proportional Stratified Random Sampling. Proportionate Stratified Random Sampling is a technique used to determine the research sample if the population used has members or elements that are not homogeneous and stratified proportionally [13].

The reason for using this sampling technique is because the population in this study is Senior High School (SMAN) which holds the Physics NE in Pesisir Selatan District. So that all schools can be represented, the samples are taken with the same proportion [14]. The sample selection was done by grouping schools based on strata as seen from the average value of the Senior High School (SMAN) National Exam (NE) from students in Pesisir Selatan District. After grouping schools based on the 2018 Physics National Exam average score, 2 schools were taken randomly from each low, medium and high category. The average 2018 National Exam scores for this school are sourced from education center data obtained online.

Based on the research objectives, the instrument used in this study is a revised instrument. The instrument is used according to the instructions that have been included on the instrument. However, in this identification, the data used is secondary data obtained from the education center data web. This data is identification according to the needs of researchers who are adjusted to the material grid on the 2018 and 2019 National Exam questions.

Then, the researcher carried out the data collection stage. Data collection technique is a method used to obtain research data or information. The data collection technique in this research is through documentation study. Information is obtained from various written sources or from documents. Documentation studies are carried out by collecting documents or data needed in research problems, then examined in depth. The data obtained through the documentation method is data on physics concepts that are problematic in answering the National Exam questions at Senior High School (SMAN) in several schools. So that the data obtained in the form of the results of the Senior High School (SMAN) Physics National Exam in Pesisir Selatan District.

The data analysis technique used is content analysis, which is a method by making inferences (conclusions) contextually, so that communication messages can be understood in their entirety [15]. Content review is a procedure used to draw valid conclusions from a book or document [16]. So, data analysis techniques with content studies are procedures used to draw conclusions from books or documents so that they can be fully understood. The data processing technique carried out in this study used the formula [17]:

$$Value = \frac{\Sigma \text{value obtained}}{\Sigma \text{max value}} \times 100\% \quad (1)$$

The criteria for the percentage value of students who experience errors in working on questions are as shown in Table 1 below.

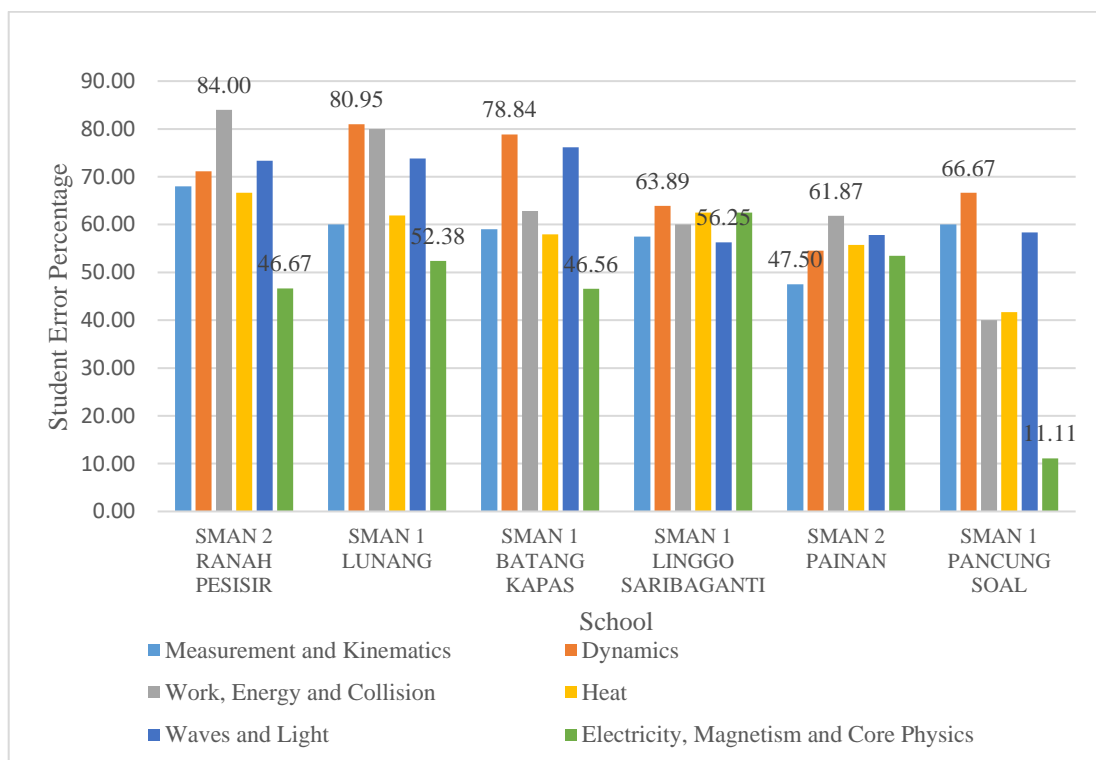
**Table 1.** Criteria for student error percentage

Percentage Value	Criteria
0% - 10%	Very Low
11% - 30%	Low
31% - 70%	Sufficient
71% - 90%	High
91% - 100%	Very High

(Source: Ref[18])

### III. RESULTS AND DISCUSSION

Based on the research that has been done by identifying 6 samples of Senior High School (SMAN) holding the National Exam (NE) in the Pesisir Selatan District, it is known that physics concepts are problematic in answering the National Exam questions at Senior High School. After identifying the problematic physics concepts in answering the National Exam questions at Senior High School, the percentages obtained are described at Figure 1.



**Fig. 1.** Percentage of Problematic Physics Concepts in Answering the 2018 National Exam Questions

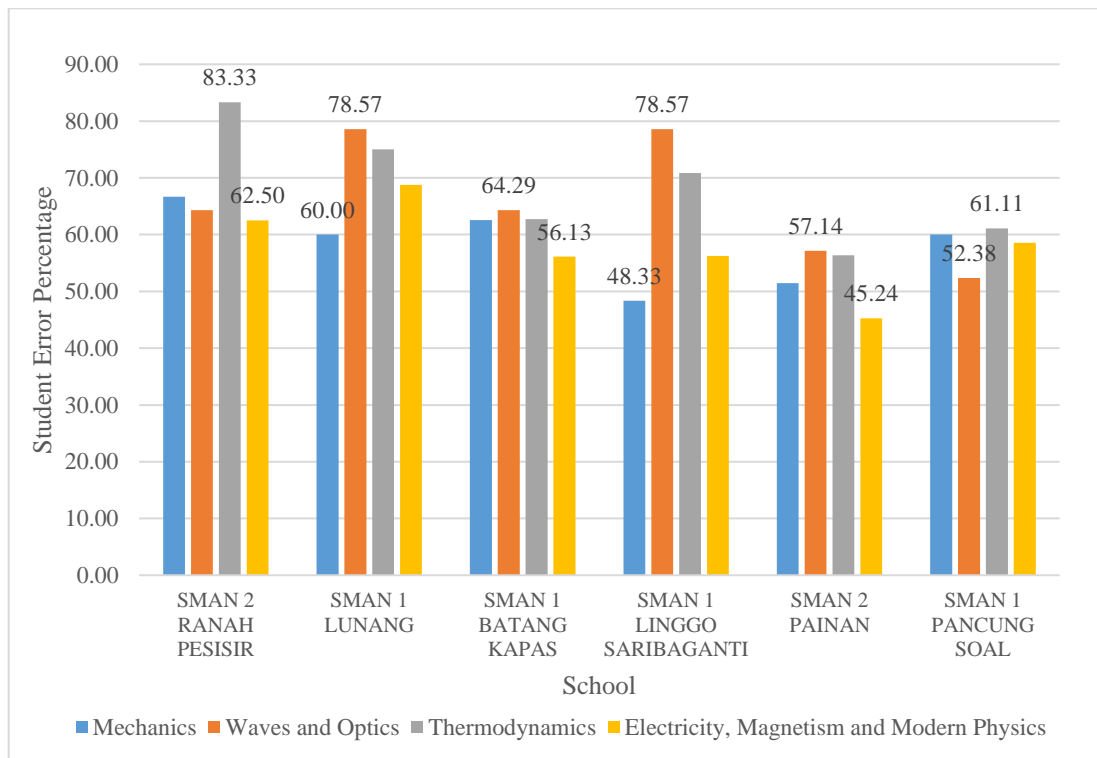
Based on Figure 1 above, it is known that the results of the identification of problematic physics concepts in answering the Physics National Exam questions on the 2018 Physics National Exam (NE) material at 6 Senior High School (SMAN) in Pesisir Selatan District. The most problematic physics concepts at Senior High School (SMAN) 2 Ranah Pesisir are on Work, Energy and Collisions with the highest percentage of 84% in the high category and the lowest percentage on Electricity, Magnetism and Core Physics, which is 46.67% in the medium category. The 2018 National Physics Exam presents 40 exam questions with 6 main materials consisting of Measurement and Kinematics; Dynamics; Work, Energy and Collision; Heat; Waves and Light; and Electricity, Magnetism and Core Physics. Each material is presented with a number of different questions, including Measurement and Kinematics material presenting 5 questions, Dynamics presenting 9 questions, Effort, Energy and Collision presenting 5 questions, Heat presenting 6 questions, Waves and Light presenting 6 questions and Electricity, Magnetism and Core Physics presents 9 questions.

In solving physics problems in the form of National Exam questions, students are required to complete using steps that require an understanding. In fact, there are still some students who have difficulty understanding the meaning of the given problem, thus making students less able to solve existing problems [19]. At Senior High School (SMAN) 1 Lunang, the most problematic physics concepts are in Dynamics with the highest percentage of

80.95% in the high category and the lowest percentage in the matter of Electricity, Magnetism and Core Physics, which is 52.38% in the medium category.

Furthermore, at Senior High School (SMAN) 1 Batang Kapas, the most problematic physics concepts were found in the Dynamics material with the highest percentage of 78.84% in the high category and the lowest percentage found in the Electrical, Magnetic and Core Physics material, which was 46.56% with the medium category. At Senior High School (SMAN) 1 Linggo Saribaganti, the most problematic physics concepts were found in Dynamics with the highest percentage of 63.89% in the medium category and the lowest percentage in the Wave and Light material, which was 56.25% in the medium category. At Senior High School (SMAN) 2 Painan, the most problematic physics concepts are found in the Work, Energy and Collision material with the highest percentage of 61.87% in the medium category and the lowest percentage is in the Measurement and Kinematics material, which is 47.50% in the medium category.

At Senior High School (SMAN) 1 Pancung Soal, the most problematic physics concepts were found in Dynamics with the highest percentage of 66.67% in the medium category and the lowest percentage in the matter of Electricity, Magnetism and Core Physics, which was 11.11% in the low category. From this description, it can be seen that the most problematic physics concepts in 2018 for 6 schools in Pesisir Selatan Regency are Dynamics materials with the highest percentage of errors for 6 schools, namely 69.33% in the medium category. After identifying the problematic physics concepts in answering the National Exam questions at Senior High School, the percentages obtained are described at Figure 2.



**Fig. 2.** Percentage of Problematic Physics Concepts in Answering the 2019 National Exam Questions

Based on Figure 2 above, it is known that the results of the identification of problematic physics concepts in answering the Physics National Exam questions on the 2019 Physics National Exam (NE) material at 6 Senior High School (SMAN) in Pesisir Selatan District. The most problematic physics concepts at Senior High School (SMAN) 2 Ranah Pesisir are in Thermodynamics material with the highest percentage, namely 83.33% in the high category and the lowest percentage in Electrical, Magnetism and Core Physics material, namely 62.50% in the medium category. The 2018 Physics National Exam presents 40 exam questions with 4 main materials consisting of Mechanics; Waves and Optics; Thermodynamics; and Electricity, Magnetism and Modern Physics. Each material is also presented with a different number of questions, including Mechanics which presents 15 questions, Waves and Optics presents 7 questions, Thermodynamics presents 6 questions, and Electricity, Magnetism and Modern Physics presents 12 questions.

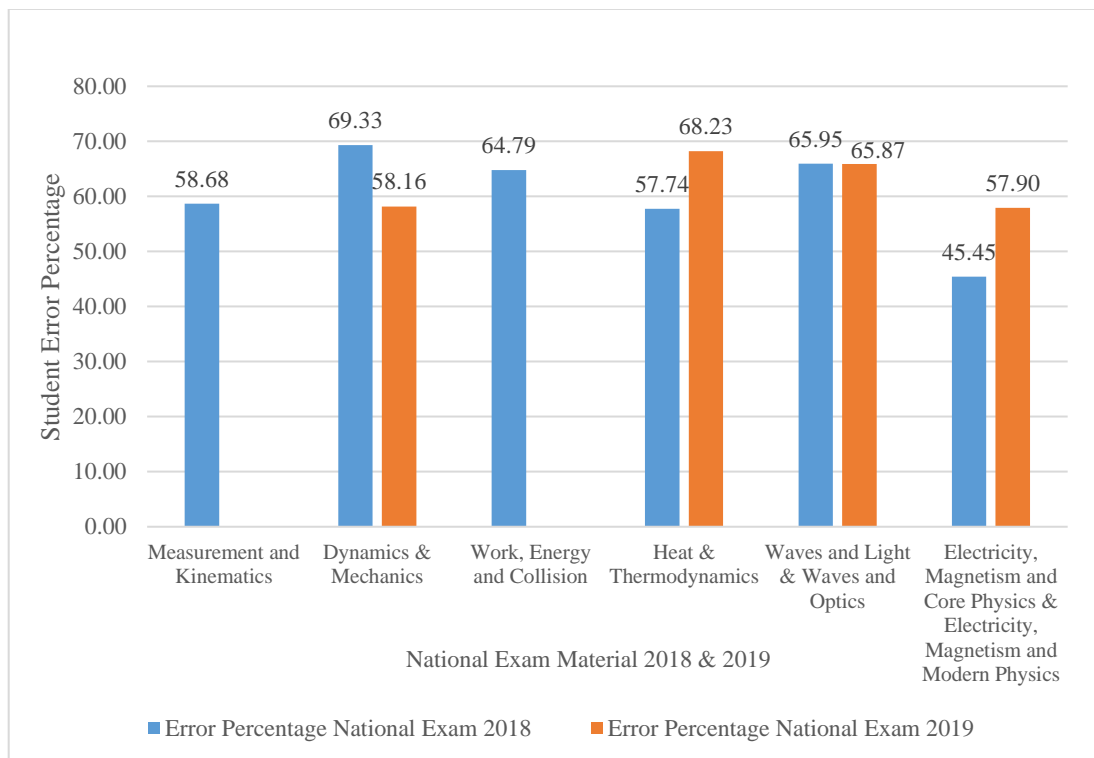
The understanding ability of students can be seen from the test results in solving problems, one of which is in learning physics. Students must be able to develop their thinking skills and not just memorize lessons, but in learning students must be able to understand the concepts being taught, so that students can solve and find solutions to a problem [20]. At Senior High School (SMAN) 1 Lunang, the most problematic physics concepts are in Waves

and Optics with the highest percentage of 78.57% in the high category and the lowest percentage in Electricity, Magnetism and Modern Physics, which is 62.50% in the medium category.

Furthermore, at Senior High School (SMAN) 1 Batang Kapas, the most problematic physics concepts were found in Waves and Optics with the highest percentage of 64.29% in the medium category and the lowest percentage found in Electricity, Magnetism and Modern Physics, which was 56.13% with medium category. At Senior High School (SMAN) 1 Linggo Saribaganti, the most problematic physics concepts are in Waves and Optics with the highest percentage of 78.57% in the high category and the lowest percentage in Mechanics, which is 48.33% in the medium category. At Senior High School (SMAN) 2 Painan, the most problematic physics concepts were in Waves and Optics with the highest percentage being 57.14% in the medium category and the lowest percentage being in Electricity, Magnetism and Modern Physics, namely 45.24% in the medium category.

At Senior High School (SMAN) 1 Pancung Soal, the most problematic physics concepts are in Thermodynamics with the highest percentage being 61.11% in the medium category and the lowest percentage being in Waves and Optics, which is 52.38% in the medium category. From this description, it is known that the most problematic physics concepts in 2019 in 6 schools throughout Pesisir Selatan Regency were Waves and Optics with an error percentage of 65.87% in the medium category.

Based on the research data, the comparison of the results of the 2018 and 2019 National Exam with each percentage of errors in each material is described at Figure 3.



**Fig. 3.** Comparison of the Percentage of Problematic Physics Concepts in Answering National Exam Questions at Senior High School (SMAN) 2018 and 2019

Based on Figure 3 above, a comparison of the results of the 2018 and 2019 National Exam (NE) with different materials is obtained. In 2018, 6 materials were presented with 4 materials compared to 2019. The results of the comparison of 2018 and 2019 materials show that in the Dynamics material, the error percentage is 69.33%, which is greater than the error percentage in the Mechanics material, which is 58.16%. This Mechanics material is also compared with the Measurement and Kinematics and Work, Energy and Collision material which is a combination of Mechanics material with the result that the percentage error is also greater than the Mechanics material, namely 58.68% and 64.79%. Furthermore, in the Heat material, the error percentage is 57.74% which is smaller than the error percentage in the Thermodynamics material, which is 68.23%, in the Wave and Light material, the error percentage is 65.95% which is greater than the error in the Wave and Optical material, which is 65.87%, and in the Electrical, Magnetic and Core Physics material, the error percentage is 57.90% which is greater than the percentage. the error of Electricity, Magnetism and Modern Physics is 45.45%.

Physics is not a material to be memorized, but requires more reasoning and understanding of concepts. As a result, if given an evaluation, students have difficulty in solving problems, even though the form of the questions

is almost the same as the questions they have studied. To solve a problem, a student must know the relevant rules based on the concepts he has obtained [21].

Based on the identification results of the comparison of the 2018 and 2019 Physics National Exam, it was found that the 2018 National Exam results were lower than 2019. This can be illustrated in the graph of research results which show that the 2019 Physics National Exam material is increasing and only Mechanics is decreasing. in 2019.

#### IV. CONCLUSION

Based on the results of the analysis of problematic physics concepts in answering the National Exam (NE) questions studied, in 2018 it discussed 6 main topics of the National Exam (NE), including the material Measurement and Kinematics with an error percentage of 58.68%; Dynamics with an error percentage of 69.33%; Work, Energy and Collision with an error percentage of 64.79%; Heat with an error percentage of 57.74%; Wave and Light with an error percentage of 65.95%; and Magnetism and Core Physics with an error percentage of 45.45%. Then the 2019 National Exam questions only discuss 4 main materials for the National Exam, including material. Then, in 2019 it consisted of 4 main materials including Mechanics with an error percentage of 58.16%; Wave and Optics with an error percentage of 65.87%; Thermodynamics with an error percentage of 68.23%; and Magnetism and Modern Physics with an error percentage of 57.90%.

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