Analysis mastery of concepts physics on the topics of energy for high school students in distance learning during Covid–19

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Abstract. This study aims to analyze the students' mastery of concepts on the topic of energy during the distance learning when Covid-19 pandemic. The method used in this study is descriptive quantitative. The sampling technique used purposive sampling, where the determination of the study sample is based on gender. The sample in this study is 116 people. Students' mastery of concepts refers to Bloom's Taxonomy, namely C1 to C4. The instrument used was a cognitive ability test with 22 multiple choice questions. Data were analyzed using scoring techniques with the Guttman scale. The scores obtained are made into percentages and the results are grouped by category. The results showed that during the distance learning process, the students' mastery of concepts was in the "enough" category with a percentage of 54%. Based on each aspect, the mastery of the concept in the C1 aspect shows an achievement of 81% with the "very well" category, 49% for the C2 aspect in the "enough" category, 57% for the C3 aspect in the "enough" category and 48% for the C4 aspect with the "enough" category. From the results of the study, efforts are needed to improve students' mastery of concepts through appropriate learning strategies.

1. Introduction
At the end of 2019 China was shocked by a very deadly virus outbreak, Covid-19. Then in 2020, this virus outbreak became a global pandemic that resulted in many life settings being forced to change suddenly, one of which was teaching and learning activities in schools. Indonesia also immediately adjusts the conditions to minimize the spread of this virus [1]. An important impact experienced by education in Indonesia, which is also experienced by many countries, is that learning methods suddenly have to be carried out remotely or through online learning modes to help avoid the spread of the virus that causes COVID-19 [2]. Therefore, the government of the Republic of Indonesia through the Ministry of Education and Culture and followed by all local governments stipulates a regulation that teaching and learning activities are still held, but with a different system, namely moved student learning from schools to their homes (Study from Home) [3].

The implementation of distance learning poses challenges for teachers, students, schools and parents. Teachers are required not only to convey the material, but also to find ways so that learning can be conveyed properly and easily accepted by students. Likewise with students who have to adapt to the current learning process [4]. Various other efforts have been made by the government, including policies regarding the COVID-19 emergency curriculum so that the learning process can continue to be implemented. The emergency curriculum is a simplification of basic competencies that refers to the 2013 curriculum. Education or schools can choose from 3 curriculum implementation options, namely continuing to use the 2013 national curriculum, using the emergency curriculum (under special conditions), or simplifying the curriculum independently. This emergency curriculum will facilitate the
learning process during the pandemic, for example: teachers can focus on essential and contextual education and learning, teachers' psychosocial welfare will increase, students will not be burdened with demands to complete all curriculum achievements, facilitate home learning assistance, increase the psychosocial welfare of parents. Therefore, this emergency curriculum is expected to help reduce the obstacles faced by teachers, parents, and children during the pandemic [5].

Learning using digital technology began to be carried out to assist the implementation of learning. Educational technology can improve the quality of education/schools and can increase the effectiveness and efficiency of the teaching and learning process. Educational technology can make it easier to achieve educational goals. In one key area we feel Learning, Media and Technology can and should make a more direct contribution to knowledge and practice during the COVID-19 pandemic [6]. So it can be said that online learning has become the rule to ensure that education continues during this difficult time [7]. One application that can be used is google form (gform).

Distance learning (DL) has given impetus to the use of technology in learning [8]. However, during this distance learning process students become less active. This is certainly in accordance with the researchers in the teacher performance research process (PKG) who stated that passive learning tends to be boring and hinders the development of students' cognitive abilities and student learning activities in the learning process. The problems that occur in science learning are teacher activities that are still very dominant in learning activities, so students become less interested and learning is considered difficult, so it will affect students' cognitive abilities. Meanwhile, the purpose of learning physics in the 2013 Curriculum is to facilitate students to understand the concepts presented.

Mastery of concepts is important in studying physics, because students do not have to memorize formulas but understand the concepts. Mastery of concepts is one of the key aspects in the learning process that involves the level of thinking and is obtained after students go through the learning process. Because mastery of concepts changes students' perception of topics in physics which is motivated by the desire to change the usual passive teaching mode and involve students in active learning enhanced by technology [9]. The level of mastery of students' concepts refers to Bloom's Taxonomy. The level of cognitive domain proposed by Bloom is described in the form of a pyramid which shows that higher levels require more complex thinking skills [10]. Therefore, mastery of concepts will be related to the cognitive abilities of students. Cognitive ability is the tendency of students to process new information they receive with information they have experienced before. Then the information is then processed and analyzed into new knowledge [11]. The cognitive abilities are classified from the simple level of knowledge to the complex level [12]. Therefore, students really need to explore and train their cognitive abilities. Because cognitive abilities result from thinking activities as the controlling center of human activity.

Physics will be easier if we understand the concept. By mastering the concept, it will be able to change students' perceptions of difficult physics to be easy and motivated to participate in learning. However, to obtain a good mastery of student concepts, analysis is needed. Based on this description, this study aims to analyze students' conceptual mastery in learning physics during the Covid-19 pandemic. The expected contribution of this study to physics education is to change students' mastery of concepts by improving students' cognitive abilities in the classroom. Mastery of concepts has an important role in the success of learning physics because it is the basis for understanding the physics material presented.

2. Method

2.1. Research Design

The method used in this study is descriptive quantitative. Descriptive quantitative is a type of study used to analyze data by describing the data that has been collected as it is.
2.2. Population and Sample

Based on the topic used in the study, namely energy, the subjects in the study were high school students in class X. The population in the study were all students in class X science in one of the public high schools in Cimahi City. The sampling technique used purposive sampling, where the determination of the study sample is based on students whose criteria are appropriate to serve as samples. The sample in this study is 116 people, with a female sample of 79 people and a male sample of 37 people.

2.3. Instruments

The instrument used in the study to analyze students' mastery of concepts is a cognitive ability test that refers to Bloom's Taxonomy. The instrument used was a cognitive ability test with 22 multiple choice questions to determine students' mastery of concepts, the instrument of which was assisted by using gform. Before this instrument was used, the researcher first conducted a trial on class XI science students at SMA Negeri Cimahi City. The data obtained were then analyzed with the Biserial Correlation Coefficient using Microsoft Excel to determine the value of the instrument's validity. The mastery of concepts instrument in the form of a cognitive ability test consisting of 22 multiple choice items has a validity value of 0.24 to 0.72 with a validity category from "low" to "high". However, questions with low validity category can be used after the questions are corrected. When the questions have been revised, then the reliability test is carried out using Cronbach Alpha with the help of Microsoft Excel. The reliability test results obtained are 0.92 with the category "very high" and can be said to be reliable.

2.4. Data Analysis

Data were analyzed using scoring techniques with the Guttman scale. The Guttman scale is a measurement scale that can be used in multiple choice questions. On the Guttman scale, the highest score is 1 and the lowest score is 0, for example, correct answers are scored 1 and incorrect answers are scored 0. The scores obtained are made into percentages and the results are grouped by category to determine the students' mastery of concepts in the following way:

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\text{Percentage} \, (\%) = \frac{\text{Total score obtained}}{\text{Total score maximum}} \times 100\%
\]

after getting the results to determine the mastery of students' concepts, the results are categorized based on the categories described in Table 1 [13].

| Category         | Percentage       |
|------------------|------------------|
| Very well        | 81% - 100%       |
| Well             | 61% - 80%        |
| Enough           | 41% - 60%        |
| Less             | 21% - 40%        |
| Very less        | \(\leq 21\%\)    |

Measurements were made to class X students who had studied the topic of energy once.

3. Result and Discussion

3.1. Mastery of Student Concepts on Energy Topics for High School Students

To find out the mastery of concepts for high school students' energy topics, it was measured using a cognitive ability test instrument consisting of 22 multiple choice questions. The questions on the instrument are divided into four aspects, namely C1 (remembering), C2 (understanding), C3 (applying)
and C4 (analyzing). The results of mastering the concept of energy topics in 116 high school students after answering the cognitive ability test instrument are shown in Table 2 below:

**Table 2. Results Mastery of Concepts on Energy Topic in 116 high school students**

| Cognitive Ability Test | Sample | Ideal Score | Min | Max | Percentage | Category |
|------------------------|--------|-------------|-----|-----|------------|----------|
|                        | 116    | 22          | 5   | 22  | 54%        | Enough   |

Based on Table 2, it can be seen that the data on the results students' mastery of concepts for high school students' during the distance learning process are in the enough category with a percentage of 54%, so students need efforts to improve students' mastery of concepts. Student's mastery of concepts needs to be improved because the results of the cognitive ability test of 116 students, the minimum score obtained is 5, and the maximum score obtained is 22. Differences in students' conceptual mastery can be caused by differences in learning styles and students' understanding of the material presented. In addition, during the distance learning process, which should be able to facilitate students to understand the concepts presented, they experience difficulties or obstacles, such as limited facilities and infrastructure that support learning and an unstable internet network during the learning process. The distance learning process during the Covid-19 pandemic generally paid less attention to the learning strategies used that were good and easily accepted by high school students, so that learning became passive and boring. This is in accordance with the results of research conducted, where there are still students who get a minimum score. So mastery of students' concepts can increase if the teacher pays attention to appropriate learning strategies and increases practice questions.

### 3.2. Mastery of Student Concepts on High School Students Energy Topics in Each Aspect

The cognitive ability test to measure students' conceptual mastery consists of 22 multiple choice questions which are divided into four aspects of the cognitive domain, namely two questions of remembering (C1), eight questions of understanding (C2), seven questions of application (C3) and five questions of analysis (C4). The results of students' mastery of energy topics in each aspect will be shown in Table 3 below:

**Table 3. Results Mastery of Concepts on Energy Topic in Each Aspect**

| Number | Question Number | Aspects of The Cognitive Domain | Percentage | Category |
|--------|----------------|--------------------------------|------------|----------|
| 1      | 1 & 20         | C1                             | 81%        | Very well|
| 2      | 11, 12, 14, 15, 17, 18, 19 & 22 | C2                           | 49%        | Enough   |
| 3      | 3, 4, 6, 8, 13, 16, & 21 | C3                           | 57%        | Enough   |
| 4      | 2, 5, 7, 9 & 10 | C4                           | 48%        | Enough   |

The results of the analysis in Table 3 show that mastery of concepts is seen from the four aspects of the cognitive domain which includes C1 to C4. The aspect of remembering (C1) with the highest mastery of concepts is 81% with very well category. This is because the questions in the C1 aspect emphasize remembering relatively simple and easy concepts, so that students can easily answer questions in the C1 aspect without difficulty. However, according to [12] the ability to remember is a cognitive process that will help students in building the new knowledge needed. Even though they have got a very high category, students' memory skills must be further improved, because memory knowledge will help students to develop meaningful learning processes, solve problems and develop knowledge to the level of understanding and applying. In the aspect of understanding (C2) the results of the study showed a percentage of 49% with the enough category. Understanding is a process that occurs because of learning and thinking, because the ability to understand will include the ability to capture the meaning and significance of the topic being studied. This ability can be used to describe the main content of a reading, changing the data presented in a certain form to another form. Mastery of students' concepts in understanding the material can be seen from the results of working on the questions given. The results showed that the understanding
aspect was still in the moderate category, meaning that from the results of the study it was found that students' mastery of concepts in understanding the material presented was still lacking. This is due to the lack of knowledge of students in understanding the questions given so that students must first analyze the questions given. In addition, students rarely find types of questions like those in the instrument. So the teacher needs to provide practice questions with various types so that students get used to if there are new types of questions.

In the aspect of applying (C3) the concepts that must be mastered by students will also be more complex than aspects of C1 and C2. In this study, the concept included in the C3 aspect is the topic of energy in the work and energy chapter. The ability to apply is to carry out and use procedures in certain situations [12]. The ability to apply is applied in the instrument as many as seven questions, with the results of the analysis of students' mastery of concepts in the C3 aspect of 57%, which means that they are in the enough category. Although the concepts that must be mastered by students in the C3 aspect are more difficult than the C2 aspect, the results of the analysis show that the C3 aspect is greater than the C2 aspect. This is because students relatively prefer questions that apply formulas or calculate rather than understand concepts. In addition, during the learning process the teacher more often provides practice questions in the form of counting questions so that students will find it difficult if they get types of questions that emphasize understanding concepts. So that teachers need to improve students' mastery of concepts in the C3 aspect.

And this fourth aspect is the highest aspect in this study, namely analyzing (C4). The concept asked in this aspect will certainly be much more complex than the C3 aspect. The results of data analysis showed that students' mastery of concepts in the C4 aspect was 48% in the enough category. The measurement of the ability to analyze is applied to the instrument as many as five questions. Based on the results of the analysis, the ability to analyze is classified as moderate because of the inability of students to relate concepts to the questions made, so it takes time for a more in-depth study. In addition, the application of learning strategies that are not in accordance with the learning material and the absence of habituation that trains students to develop cognitive abilities in the C4 aspect. Efforts that can be made to improve students' mastery of concepts in analyzing are presenting diagrams, sketches, tables and graphs to help students understand and analyze problems. In addition, the teacher must give students practice questions to analyze.

The Covid-19 pandemic affected the mastery of concept for high school students on energy topics, because based on the results of interviews with teachers at one of the public high schools in Cimahi city, teachers had difficulty implementing appropriate learning strategies so that the material presented was easily accepted and understood by students. Students also have difficulty asking if there is material that has not been understood in understanding the learning material on this energy topic. Although, students' mastery of concepts on the topic of energy is in the enough category, but there are still some students who are in the low category. This is in accordance with the results of observations in one of the public high schools in Cimahi City which shows that student learning outcomes in physics subjects at the high school can be said to be less (low) due to not being happy or bored with studying physics and lacking mastery of concepts, so that it affects their low ability. Learning boredom stems from monotonous routines, such as too many tasks, lack of self-control, high pressure, not being appreciated, rules that are difficult to understand, conflicting demands, being ignored, missed opportunities, and task deadlines. Boredom is commonly presented as an achievement-related emotion that is mostly negative and is known to have a negative impact on student engagement and performance [14]. This means that the boredom experienced by students comes from things that are monotonous and must be changed so that students do not experience boredom.

4. Conclusion

Based on the results showed that during the distance learning process, the students' mastery of concepts on the topic of energy was in the "enough" category with a percentage of 54%. And based on each aspect, the mastery of the concept in the C1 aspect shows an achievement of 81% with the "very well" category, 49% for the C2 aspect in the "enough" category, 57% for the C3 aspect in the "enough" category and 48% for the C4 aspect with the "enough" category. From the results of the study, efforts are needed to improve students' mastery of concepts through appropriate learning strategies and increase the number
of practice questions. And for further research, researchers should also need to conduct interviews with several students in each category as a reinforcement of the test results obtained.

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