Conditions of learning physics and students' understanding of the concept of motion during the covid-19 pandemic

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Abstract. An urgent learning problem in the Covid 19 pandemic is the unavailability of IT-based teaching materials that support online learning. In addition, in learning physics there are also fundamental problems, namely students' low understanding of concepts. Misconceptions often occur in learning physics, especially in the concept of motion. Therefore it is necessary to know the problems and supporting factors of learning, especially in motion material, so that the right solution can be found. This study aims to determine students' understanding of the concept of motion and to determine the conditions of learning in one of the high schools in Padang Pariaman Indonesia. This type of research is descriptive research, in the form of survey research. The instrument used was a concept test of motion taken from the FCI (Force Concept Inventory), this test is equipped with questions of belief and answers to the students' reasons. Another instrument is a student and teacher questionnaire. The sample consisted of 31 superior class students and 3 physics teachers. The results showed that 36% of students had misconceptions, 34% of students did not understand the concept and only 30% of students understood the concept even though they had studied the topic being tested. Teacher learning is also lacking in identifying misconceptions (50%), less experimental activities (50%), discussions (58%) and other activities that actively involve students. Meanwhile students want learning that involves them actively even in the conditions of online learning during the current Covid19 era.

1. Introduction

In the 21st century, the development of technology and information is very rapid. Various technological products were created to facilitate human work. Technology is a product of science, so that the two cannot be separated, including physical science. The development of science and technology cannot be separated from research in the field of physics [1]. Through various physics research results, the development of science and technology is faster in accordance with the times. Physics is one of the most basic sciences, which is essentially understanding how the universe works. The basic concepts of physics not only support the development of physics, but also support other sciences and technology. In the development of physics, human resources (HR) who think scientifically, are skilled and analytical in solving every physics problem are needed. This is in accordance with the objectives of learning physics, including fostering scientific attitudes, scientific thinking, and scientific communication of students [2]. In essence, the purpose of learning physics is to lead students to develop experiences and be able to formulate problems.
Understanding the concept is important in learning physics. The concept is the idea of a person or a group of people who are expressed in definitions, laws and theories [3]. Student success in learning physics is determined by the understanding of the concepts achieved. Understanding the concepts of physics is the level of students' ability to re-express the concepts and principles of physics. Concept understanding is also defined as the ability to grasp an understanding, express the material presented in a more understandable form, and be able to interpret and apply it [4]. It can be concluded that understanding the concept of physics is the level of thinking or a person's ability to grasp the concepts of physics and can translate them into language that is easy to understand and apply in life.

Physics learning that is carried out must also be able to foster mastery of generic competencies including the ability to collaborate, creativity, communication, character education, literacy and critical thinking [5]. Supported by the currently developed curriculum, namely through a student-centered learning approach, which emphasizes students to have skills in thinking [6]. The curriculum also requires students to be more active, independent and skilled in both the affective, cognitive and psychomotor domains. Teachers, as the spearhead of the success of education, should be able to create a conducive learning atmosphere, so that students' self-potential can develop optimally [7].

Since the outbreak of Covid19 in Indonesia, the Ministry of Education and Culture has decided that the learning process is carried out at home online. Regarding learning from home. The Minister of Education and Culture emphasized that online / distance learning is carried out to provide meaningful learning experiences for students, without being burdened with demands to complete all curriculum achievements for class promotion and graduation. Online / distance learning is focused on increasing students' understanding of the corona virus and the Covid-19 outbreak. The learning activities and assignments may vary between students, according to their respective interests and conditions, including in terms of gaps in access / learning facilities at home [8]. The gap in access or facilities that many students experience when carrying out online learning is the limited tools to access information such as the absence of handphone, computers, laptops or the location of students' homes that are not networked. This can reduce the level of students' understanding of the concept of the subjects being studied, especially learning physics.

The fact shows that various problems are still found in learning physics. Among the problems raised by researchers are related to how students understand physics concepts and solve their solutions [9]. In addition, the problem of misconception and low understanding of concepts is quite common in schools [10]. Misconception problems in the field of mechanics are more widely studied than in other fields, one of which is material about motion and force [11]. According to Asep D. Sutrisno [12] states "that there are still students who cannot distinguish between distance and displacement, both in terms of understanding and magnitude and there are still students who think that the concept of distance and displacement is the same and other research suggests that it also reveals that students are confused about the position of an object or the velocity of an object ". This is in line with the opinion of Ma'rifa, H. Kamaluddin & H. Fihrin [13] showing "that the understanding of the concept of straight motion is still very low, so there needs to be attention and remediation regarding the concept because it will affect the concept of students to the next level". Misconceptions occur in the concepts and principles of Newton's law [14], free fall motion, parabolic motion and circular motion [15]. This misconception problem must be overcome so as not to interfere with the learning process at a later stage. Misconceptions can persist, if not addressed, and can affect students up to a higher level of education. The misconceptions experienced by students are related to the learning process carried out by teachers at school. Learning which is dominated by teacher lecture activities, tends to lead to low understanding of the concept [10]. Students need to be actively involved in discovering concepts and principles of physics.

Therefore, teachers need to create learning conditions that support conceptual understanding and prevent misconceptions. Teachers must be able to apply appropriate learning methods and pay attention to the completeness of facilities and learning support factors. Especially during the Covid19 pandemic, which demands online learning. The problem increases with the lack of IT-based teaching materials and school facilities that do not support online learning. Therefore, it is necessary to conduct
research to find out the problem of student concepts about motion and the conditions of learning physics in schools in online learning. This study aims to reveal the initial conditions of learning physics and students' understanding of the concept of motion at SMA Padang Pariaman. This study aims to see students' understanding of the concept of motion and to know the conditions of learning at SMAN 1 VII Koto Sungai Sariak, Padang Pariaman, including the problems and supporting factors during the Covid19 pandemic.

2. Methods
This research is the initial stage of the Plomp model development research. This preliminary research was conducted to determine learning problems in schools and students' understanding of concepts, especially in motion material. There are 3 instruments used in this research, namely: 1) a test concept about motion, 2) a questionnaire for students, and 3) a questionnaire for the teacher. Students' understanding of the concept of motion material is known to use the FCI (Force Concept Inventory) concept test instrument, which is a standard objective test (multiple choice) of motion and force that has been widely used in various countries. In this study, the FCI test was modified into a two-tier multiple choice test with open-ended reasons. The two tier multiple choice test consists of objective questions accompanied by the level of student confidence in the selected objective answers. The FCI concept test was given as many as 20 items to a sample class consisting of 31 students. Concept tests were analyzed using coding techniques [10] regarding the level of understanding of students' concepts. There are 5 levels of understanding the initial concept of students (Table 1) which is reduced to 3 levels of understanding the concept (Table 2), namely: Sound Understanding (SU), Specific Misconception (SM), and No Understanding (NU).

| Concept Understanding Level | Code | Objective test | Confidence | Reason |
|-----------------------------|------|----------------|------------|--------|
| Sound Understanding         | SU   | True           | Very Sure/ Sure Enough | Responses that included all components of the validated response |
| Partial Understanding       | PU   | True           | Very Sure/ Sure Enough | Responses that included at least one of the components of validated response, but not all the components. |
| Partial Understanding with Specific Misconception | PUSM | True | Very Sure/ Sure Enough | Responses that showed understanding of the concept, but also made a statement, which demonstrated a misunderstanding |
| Specific Misconception      | SM   | True or False  | Very Sure/ Sure Enough | Responses that included illogical or incorrect information. |
| No Understanding            | NU   | True or False  | Not Sure/ Less Sure | Repeated the question; contained irrelevant information or an unclear response; left the response blank |

Table 1. Categories of Concept Understanding Level [10]

| Initial Code | Final Category       | Final Code |
|--------------|----------------------|------------|
| SU           | Sound Understanding  | SU         |
| PU           |                      |            |
| PUSM         | Specific             | SM         |
| SM           | Misconceptions       |            |
| NU           | No Understanding     | NU         |

Table 2. Reduction of Concept Understanding Level [10]
3. Result and Discussion

The problem of understanding students' concepts about motion and the conditions of learning physics at school during the Covid19 pandemic can be explained as follows:

3.1. Understanding Student Concepts

The results of students' understanding of the concept of motion material can be seen in Figure 1.

![Figure 1. Students' understanding of the concept of motion](image)

Figure 1 shows that students' understanding of the concept of motion is still low, only 30% of students understand the concept. Meanwhile 34% of students do not understand the concept and 36% of students are classified as misconceptions, even though the students have studied material about motion. In the superior class there will be problems in understanding the concept, of course in the ordinary class there will also be concept problems. The low understanding of students' concepts and the occurrence of misconceptions, among others, is caused by learning in schools that has not involved students finding concepts or constructing knowledge. This can be explained further from the results of the teacher's questionnaire. Matter of motion is one of the materials that is difficult to observe, because the process of motion is fast, difficult for the human eye to follow. Suppose a student pushes a marble on the floor, it will be difficult for students to determine whether the motion of the marbles is included in regular straight motion (GLB) or regular changeable straight motion (GLBB). Likewise, when students see a coconut falling from the tree, it will be difficult for students to observe and measure whether the motion of the coconut includes GLB or GLBB. Likewise, when students see a soccer player taking a free kick in a soccer game, it is difficult to observe whether the ball's path is parabolic. The phenomenon of movement in everyday life that is difficult to observe and measure can cause misconceptions for students. Misconceptions caused by students' prior knowledge or initial concepts as a result of their interaction with the environment often occur. Students already have initial knowledge or concepts that are different from expert concepts, before they enter formal institutions or schools. If at school, the teacher only explains motion material by introducing formulas or equations of motion, then discussing only calculating problems, the potential for misconceptions will occur. Students tend to only memorize formulas or equations without understanding the physical meaning of the formula or equation of motion [15].

Many studies reveal that students do not understand concepts and misconceptions often occur. Students find it difficult to understand concepts and prefer memorizing formulas rather than prioritizing understanding [16]. Students also rarely get serious attention from the teacher and prioritize solving problems mathematically compared to solving using pictures, diagrams, or computer simulations and animation [17]. Students who can understand the concept well are more able to
transfer and generalize their knowledge when compared to students who only memorize [18]. In the 2013 curriculum, students' understanding of concepts is one of the objectives of learning physics. Therefore, educators need to know the understanding of students' concepts and detect whether there are misconceptions in students so that solutions or remediation are found.

3.2. Learning Conditions in Schools Based on Student Questionnaires
Learning conditions in schools based on the results of students' questionnaires include preferred learning methods and learning resources used by students.

3.3. Preferred Learning.
Based on the results of the questionnaire, students did not like learning dominated by the lecture method (60%). Students prefer learning with the method of discussion, experimentation, digital-based, contextual and example questions. The results of the analysis can be seen in Figure 2.

![Preferred Learning](image)

**Figure 2.** Learning that students like

The dominance of the lecture method in learning can make learning meaningless. Learning becomes boring for students, creativity and scientific potential of students become confined. The dominance of the lecture method or the teacher center, students will become passive because they only act as listeners, the teacher is still the main role in learning activities [19], the concepts given by teachers are not well understood by students [20]. In learning, educators need to facilitate students' creativity, potential and conceptual understanding by varying learning models and methods. Educators need to apply more creative learning models and methods.

3.3.1. Learning Resources Used By Students.
Based on student questionnaires about learning resources and teaching materials used by students. Students use more student books (81%) and use their smartphones in searching for information on the internet (75%). Textbooks (66%) and worksheets (67%) are also widely used by students. However, in the current era of information technology, ICT-based learning resources and teaching materials are needed to support 21st century learning. The availability of e-books, e-modules and other interactive multimedia needs to be developed by educators in facilitating online learning or blended learning according to the times. Moreover, learning in the current Covid19 pandemic conditions, IT-based teaching materials that can improve students' conceptual understanding, are needed. The results of student questionnaires about the learning resources used can be seen in Figure 3:
The development of information and communication affects the development of teaching materials, one of which is a combination of print and digital [21]. Based on this research, teachers provide more printed teaching materials than non-print / digital teaching materials. However, the need for IT-based teaching materials needs to be provided by educators in welcoming 21st century learning, so that students remain active, learning is interesting and meaningful in building conceptual understanding. This is in line with research conducted by Mufit at al (2020) which states that in learning, teaching materials are not yet available that can increase student literacy in accordance with 21st century learning. Teaching materials are needed that can activate students (student centered) and involve students in the discovery of physics concepts and principles, learning to train communication and collaboration skills between students by facilitating students to discuss and presentations. One solution to overcoming the limitations of IT-based teaching materials and learning resources is to develop electronic teaching materials, one of which is in the form of an e-book based on cognitive conflicts, to improve students' understanding of concepts.

3.3.2. Learning Conditions Based on the Results of Educator Questionnaires. Based on the results of the teacher questionnaire, information was obtained about physics learning in schools, namely: 1) physics learning activities carried out by educators, 2) the use of IT-based teaching materials in physics learning, and 3) the completeness of facilities and infrastructure that support physics learning. The results of a questionnaire for 3 educators at SMAN 1 Sungai Sariak Padang Pariaman can be seen in Figure 4.
3.3.3. Learning activities at school. Figure 4 shows that educators provide more sample questions to students (83%) and provide more practice questions in the form of numbers or counts (83%) compared to providing concept questions (67%). Emphasis on giving examples of questions and giving practice questions in the form of numbers or calculation questions will make students tend to memorize physics formulas or equations. Students do not understand the concepts and principles of physics in the material. This relates to the results of students' concept tests, in which students experience many misconceptions and do not understand concepts. Educators' activities in identifying students' prior knowledge (50%) and student misconceptions (50%) were also lacking. This causes educators not to know the problems in understanding students' concepts. Low understanding of concepts is often experienced by students with low academic abilities, while misconceptions occur in students with high academic abilities [22]. The results of the questionnaire also showed that experimental activities were also lacking in learning (50%), as well as discussion activities (58%) and student presentation activities (58%). Students are not actively involved in discovering the concepts and principles of physics. Therefore, it is necessary to develop teaching materials that facilitate students to actively experiment, discuss, present in determining concepts and principles of physics. IT-based teaching materials that facilitate online learning or blended learning according to 21st century learning.

3.3.4. Utilization Of IT-Based Teaching Materials In Schools. In general, IT-based teaching materials that are widely used in schools are only green audio materials (75%), multimedia, animation, E-books and Phet simulation are still lacking. The lack of use of IT-based teaching materials because the teaching materials are not yet available in schools and the lack of ability of educators in developing IT-based teaching materials. The results of the analysis of the use of IT teaching materials in schools can be seen in Figure 5:
Figure 5. Utilization of IT-Based Teaching Materials in Schools

IT-based teaching materials are teaching materials that combine the sophistication of science and technology. Advances in science and technology require educators to continue to be able to develop teaching materials in accordance with the times. The use of IT-based teaching materials is an interestingly packaged teaching material while facilitating student involvement and activity in building concepts and physics principles. IT-based teaching materials make it easier for students to understand abstract concepts [23]. IT teaching materials support student learning interest and if the availability of teaching materials in schools is inadequate, it will be one of the reasons for low student learning outcomes because student knowledge is very dependent on teacher explanations [24].

3.3.5. Completeness of Facilities and Supporting Factors. Based on the results of the questionnaire analysis, it was also found that the completeness of the facilities and supporting factors for offline physics learning was lacking. This is a common problem. Lack of physics laboratory skills (42%), sufficient physics laboratory equipment available (67%). Likewise, the availability of computer laboratories is still lacking (42%), the availability of a projector / LCD (50%). However, in schools a Wifi network is available (100%) and has implemented an electronic learning system (e-learning). The availability of wifi and e-learning is a supporting factor for the application of IT-based teaching materials in online learning or blended learning. The results of the analysis of the availability of facilities and supporting factors for learning can be seen in Figure 6.

Figure 6. Completeness of Facilities and Supporting Factors

Basically, the existence of a physics laboratory and physics subjects cannot be separated, but not all schools make good use of the laboratory, there are still schools that ignore the existence of a physics
laboratory [25]. For this reason, there must be an increase in the lack of facilities and learning support factors, especially those that support online learning according to 21st century learning guidance.

Supporting facilities and factors are important elements needed in the teaching and learning process. Means that will be able to motivate students in learning. This aims to create a willingness and enthusiasm for students in the learning process. The more complete the means and support for offline (offline) and online (online) learning, the more enthusiastic students will be in learning. Conversely, if the facilities and learning support are lacking, it will affect student learning outcomes. For this reason, supporting facilities and factors must be considered and the development of IT-based teaching materials is carried out. One of them is the development of a cognitive conflict-based e-book integrating real experimental video analysis to improve students' conceptual understanding of motion material, as an online learning facility.

4. Conclusion
Preliminary research on learning conditions in schools as well as students' understanding of concepts about motion during the Covid19 pandemic has been carried out. Students' understanding of the concept of motion, both straight motion, parabolic motion and circular motion is still low and there are misconceptions. One of the contributing factors is previous learning which is dominated by the lecture method. Educators still rarely identify students' prior knowledge before starting learning. In learning, educators also rarely identify misconceptions experienced by students. Educators rarely involve students in discussions, experiments and presentations in finding physics concepts. There are not yet available IT-based learning resources and teaching materials that support the implementation of online learning. Meanwhile students want learning that involves them actively in learning. School facilities support the implementation of online learning through the availability of wifi and e-learning. Likewise, student smartphones are also often used as a tool to find learning resources. The implication of this research is that it is necessary to develop IT-based teaching materials that support online learning and also support the improvement of students' conceptual understanding, especially about motion. One way is to develop a cognitive conflict-based ebook integrating real experimental video analysis. The implication of this research is that it is necessary to develop IT-based teaching materials that support online learning and also support the improvement of students' conceptual understanding, especially about motion. One way is to develop a cognitive conflict-based ebook integrating real experimental video analysis. The implication of this research is that it is necessary to develop IT-based teaching materials that support online learning and also support the improvement of students' conceptual understanding, especially about motion. One way is to develop a cognitive conflict-based ebook integrating real experimental video analysis.

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