The Analysis of Melde Tool as Learning Media on Students Senior High School

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ABSTRACT
Physics is one of the subjects in high school taught by educators. However, in learning physical concepts are not only theoretically studied but in experiments or practicum. However, not all learning of physics concepts uses practice or experiment. This happens due to lack of facilities, time, and the low ability of teachers in making tools. Therefore the writer makes physics practice tools as learning tools and media namely Melde. The purpose of this discussion is as a medium of learning stationary wave material. The test results of making a melde tool on a stationary wave material are that the wave propagation speed on a rope depends on the length and weight of the load, the load mass relationship and the wave propagation speed are proportionally sincere, and the greater the load the greater the faster the propagation. Based on the results of testing the making of medle tool on stationary wave material it is suitable for use as a learning medium in schools.

INTRODUCTION
Education is the most important weapon that must be addressed in order to advance a nation. This is because globalization is getting stronger so that the development of creativity of both a teacher or educator in order to achieve the learning objectives is very necessary. In order to achieve the stated learning objectives, one must have adequate facilities and infrastructure. Bearing in mind the condition of education in Indonesia related to facilities and infrastructure that are still very minimal, therefore it is necessary to be independent creativity in the development of instructional media in accordance with the material being taught.

Abdullah (2017) states learning is a system, which consists of various components that are interconnected with one another comprehensively. These components include: objectives, material, methods, and evaluation. Referring to these components, then in making learning media must be able to facilitate the four components so that learning objectives can be achieved properly. In addition, interactive learning media can support a fun learning model. According to
Agung and Jukri (2015) in the journal Science Education Innovation, the implementation of monotonous learning methods/models, learning processes that are too serious and boring, causes the construction process of students' mindset to be hampered. The overstructuring learning process also impacts on the low motivation to learn and student learning outcomes. To overcome this, the teacher must be able to make new breakthroughs, for example by developing more relevant learning models or using interactive learning media.

Based on the book compiled by the bond of the doctoral alumni of the State University of Malang's 2011 learning technology generation, Physics courses are considered difficult by students and many students do not graduate in physics. Student learning outcomes are not satisfactory as expected even though students have tried to learn and understand this course. After exploring further, it is known that students have difficulty understanding concepts contained in Physics courses. Learning about concepts if not accompanied by practical experience will increasingly add to the difficulties in the Physics learning process. However, all concepts taught in physics are still many materials that cannot be facilitated by available laboratory tools and materials due to the lack of facilities and infrastructure. Therefore, as students of Physics Education study programs, surely we are familiar with learning methods in experimental learning or practicum. In addition, students of Physics Education study programs as prospective educators must be able to guide and present worksheets to students to do practical work on physical concepts that are not only theoretically studied but directly through practice or experimentation. In relation to doing the practicum, not all learning about physics concepts can be done through practicum. This is due to several factors, for example, lack of facilities, insufficient time, and limited ability of teachers to use tools. Rohma (2015) states that learning outcomes are influenced by factors originating from within or internal and factors originating from outside or external. Internal factors consist of physiology and psychology, while external factors consist of instrumental and environment. Please note, instrumental factors consist of curriculum, infrastructure, educators and administration.

Lack of facilities such as the limited availability of practical tools at school or the learning media used. Susilana and Riyana (2009) state that learning media always consists of two important elements, namely equipment or hardware elements and the message elements they carry (message / software). Learning media need equipment to present messages, but the most important thing is not the equipment, but the learning messages or information that is delivered by the media. The learning media emphasized here is object media. Media objects are divided into two groups, namely actual media objects and substitute object media. So, in the context of finding a solution to the lack of practical media facilities in schools, what needs to be emphasized here is the creation of a substitute object media. Making substitute object media, development and innovation are needed in making practical tools that can be made by physics teachers themselves so that they can be used for student practicums. In this regard, we plan to make a physics practicum tool that we can make from materials that are around and can be used.

**METODOLOGY**

Method used in this research is the research and development method. This method was chosen to produce a product that can be applied to help schools that have limited practical tools to support learning media. Sugiyono (2009: 407) argues that, research and development methods are research methods used to produce certain products, and test the effectiveness of these products. To be able to produce certain products used research that is needs analysis (used
survey methods or qualitative) and to test the effectiveness of these products in order to function in the wider community, research is needed to test the effectiveness of these products (used experimental methods). Plomp (2010: 31-32) explains, when development research is conducted, researchers are often faced with difficult situations that will affect product quality, especially learning models. Because research demands collaboration in teams. For example collaboration between researchers and practitioners, collaboration between evaluators and other participants. Sometimes, there are conflicts of interests and needs that will cause different perceptions when the research is carried out in the field. The conditions described by Plomp will cause a dilemma in development research. Richey et al. (2002: 1099) simply explain development research. These explanations are (1) development research is a study of the process and the specific effects of the learning design and development impacts; (2) development research is the use and implementation of product design, development and evaluation of learning activities and (3) development research is a study of the whole process or as part of the learning design, development and evaluation process. Sometimes, development research is also called design research. Where there are several steps carried out in this method including: (1) potential and problems, (2) gathering information, (3) product design, (4) design validation, (5) design improvement, (6) product trials, (6) product revision, (7) usage trial, (8) product revision, (9) final product socialization.

RESULT AND DISCUSSION

Physics is often considered difficult by most students because their biases are faced with calculations and formulas. In addition they are rarely given an understanding of the meanings contained in the formulation. Understanding the formula variables will be meaningful if students apply directly in the form of practicum. One example is the experimental laboratory melde. The melde experiment is a simple experiment that students can apply to find out how stationary waves are formed. Besides that, from the experiment, it can also be known how the relationship between wave velocity and load force. From that request was initiated to make a set of melde experiment tools where the design itself can be seen as shown below.

Table 1. Series of Melde Legal Tool Set

<table>
<thead>
<tr>
<th>No</th>
<th>Tool Name</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Melde Law experiment tool set</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>No</td>
<td>Tool Name</td>
<td>Images</td>
</tr>
<tr>
<td>----</td>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>2</td>
<td>Vibrator</td>
<td><img src="image1.jpg" alt="Vibrator Image" /></td>
</tr>
<tr>
<td>3</td>
<td>Loads and ropes</td>
<td><img src="image2.jpg" alt="Loads and Ropes Image" /></td>
</tr>
<tr>
<td>4</td>
<td>Ruler</td>
<td><img src="image3.jpg" alt="Ruler Image" /></td>
</tr>
<tr>
<td>5</td>
<td>Power supply</td>
<td><img src="image4.jpg" alt="Power Supply Image" /></td>
</tr>
</tbody>
</table>
Melde law is a law that studies the quantities that affect the speed of transverse wave propagation on a rope. In the experiments that have been carried out, Melde found that the wave velocity at the rope is proportional to the root force of the tension force and inversely proportional to the root mass of the string length. Factors that affect the speed of waves on a rope.

Table 2. Observation Results

<table>
<thead>
<tr>
<th>No</th>
<th>M (kg)</th>
<th>F (N)</th>
<th>v (m/s)</th>
<th>(\lambda) (m)</th>
<th>f (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01</td>
<td>0.1</td>
<td>10</td>
<td>30 (\times 10^{-2})</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>0.02</td>
<td>0.2</td>
<td>10 (\sqrt{2})</td>
<td>33 (\times 10^{-2})</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>0.5</td>
<td>10 (\sqrt{5})</td>
<td>62 (\times 10^{-2})</td>
<td>36</td>
</tr>
</tbody>
</table>

Figure 2. Relationship Between Wave Speed and Weight

At the vibrator a long rope is attached through a pulley and then a mass is suspended. The vibrator is then turned on by connecting to a voltage source (power supply). At that time arises transverse waves that propagate from the vibrator to the pulley and are reflected by the pulley to the vibrator, and finally arises stationary waves on the rope so that the knot and abdomen can be observed. The distance between the vibrator and the pulley is arranged in such a way that makes it easy for the practitioner to determine the wavelength. In this practicum,
practice using a distance of 83 cm. The length of the rope between the vibrator and the pulley, divided by the number of waves formed, will get the value of the length of one wave. In this Melde experiment, praktikan conduct experiments with variations in load mass. The relationship between the large tension of the rope with the fast wave propagation on the rope is directly proportional so that the greater the tension of the rope, the faster the wave propagation is also faster. Thus the wave propagation fast on the rope depends on the length and weight of the load used. Whereas the relationship of load mass and wave propagation is proportionally sincere. Because the greater the burden, the greater the propagation speed.

In this experiment, the greater the mass of the load, the greater the wavelength. This causes greater propagation speed too. \[ v = \lambda f \]

When analyzed by Melde's Law, the greater the mass of the load, the greater the tension tension force: \[ F = M \times g \]
With the increase in the tension force of the rope, the wave velocity is even greater. The results of the tool trials conducted in the physics faculty of Unip Faculty where there is compatibility between the variables of the melde experiment formulation. So this set of melde experiment tools is feasible to be used in schools to help students understand the physics concepts of stationary waves. In addition, the presence of this tool is also expected to be able to help the shortage of existing tools in school labs.
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CONCLUSION

Based on the results and discussion that obtained the relationship between the magnitude of the rope with a fast wave propagation on the rope is directly proportional so that the greater the tension of the rope, the faster the wave propagation is also faster. Besides the wave propagation fast on the rope depends on the length and weight of the load used. Whereas the relationship of load mass and wave propagation is proportionally sincere. Because the greater the burden, the greater the propagation speed. Thus the melde trial tool set products are also suitable for use in schools.

REFERENCES


Haviz, M. 2013. Research And Development; Penelitian di Bidang Kependidikan yang Inovatif, Produktif dan Bermakna. Jurnal Ta’dib, 16(1) : 30-31


