JISPHED 1 (1) 2021: 44 – 55

Journal of Innovation Science and Physics Education

Journal homepage: http://journal.unj.ac.id/unj/index.php/jisphed/index
p-ISSN XXXX e-ISSN YYYYY

Development of Miniature Teaching Aids Conversion of Motion Energy into Electrical Energy as a Learning Media for High School / Vocational Physics in Jakarta

Muhmad Pauji[1*], Vina Serevina[2], dan Rai Hanati[3]

[1.] Department of Physics Education, Universitas Negeri Jakarta, Indonesia
[2.] Department of Physics Education, Universitas Negeri Jakarta, Indonesia
[3.] Department of Physics Education, Universitas Negeri Jakarta, Indonesia

ARTICLE INFO

Article History:
Received
Accepted
Published

Keywords: props motion energy conversion into electrical energy is very good to be applied in physics learning

ABSTRACT

This research aims to develop learning tools as a medium of learning physics in high school/vocational school. By using this props, teacher were expected to easily convey the material to the students, so that PAKEM learning could be created in the learningprocess. This research was conducted from September to January 15thof 2013 is in the final stages of data collection at school. The methods used in this research is development research. In this research conducted a few stages. The first phase of preliminary studies. Preliminary studies concluded that common literature discuss about the conversion of electrical energy into heat. While for the conversion of the energy of motion into electricity is not deeply discussed and also found no props in the school. The next stage is tool-making. In making props adapted to the material and content of the existing standards in the practice so that students are able to understand the concepts theoretically and practically. Further validation phase and the implementation phase aims at providing an assessment of the experts and also from students that this learning tools could be useful in schools. In validation phase and the implementation phase using the instrument refers to Likert scale. From that research obtained some information from compliance concepts and interactive aspects of students. From that taking data produced an overall average show props motion energy conversion into electrical energy is very good to be applied in physics learning , so that learning PAKEM can be realized.

*Correspondence address:
Name of Corresponding Author,
Departement of Physics Education,
Universitas Negeri Jakarta,
Rawamangun Muka Sreet, Jakarta Timur, Indonesia 13220.

1. INTRODUCTION

World Education is the world for self-development so that people become able to compete in the environment both local and international environments. In addition to self-development education is a place for the development of knowledge through teaching and a place to develop moral values adopted in the environment. In the teaching and learning process sometimes there are not a few problems in learning as well as students do not pay attention when the teacher delivers teaching material, besides the teacher less clear in presenting the teaching material and many other examples that cause ineffective teaching and learning.

Educator experts so far have not ceased to find solutions so that learning problems can be overcome so that educational and teaching goals can achieve satisfying goals, but the solutions have not been able to achieve what is targeted, so that research does not stop here it needs to be developed so as to achieve what is expected. The learning process is essentially a communication process, namely the process of delivering learning messages from educators (message sources) to students (message recipients). In delivering learning messages needed tools (media) called learning media (Arif Sadiman, 2006: 11).

Teaching aids as learning media is one of the solutions offered by educational scientists to overcome educational problems based on the theory presented by Edgar Dale. Edgar Dale said that everyone's learning resembles a pyramid, the best learning is learning that is based on direct experience. Actually Schools can get tools for learning physics from various sources, for example from the government (Diknas) in the form of procurement, proposals, buying for example from suppliers, factories, shops and ordering from certain agencies or individuals, however, the teacher's need to develop and conduct physics learning is not 100% will be fulfilled by existing tools (sustrisno: 2009). For now the demands of learning physics must be fully prioritized at school, so that learning can be maximized at school because learning physics at school no longer recognizes the practice of independent practice separate from ordinary learning processes in the classroom (learning sustrisno: 2009). Based on the experience of Drs. Winarto (2010: 1) some time ago when there was a visit to the Department of Physics (workshop) from a high school in Malang, a tool as a learning media really attracted the attention of students. However, with regard to the subject matter not a few students as learning objects experienced difficulties in things understand the concept of Energy. The difficulty is understanding the change of motion energy into electrical energy in daily life cannot be described by students. Even in daily life students are not aware of many events related to the law of conservation of energy.

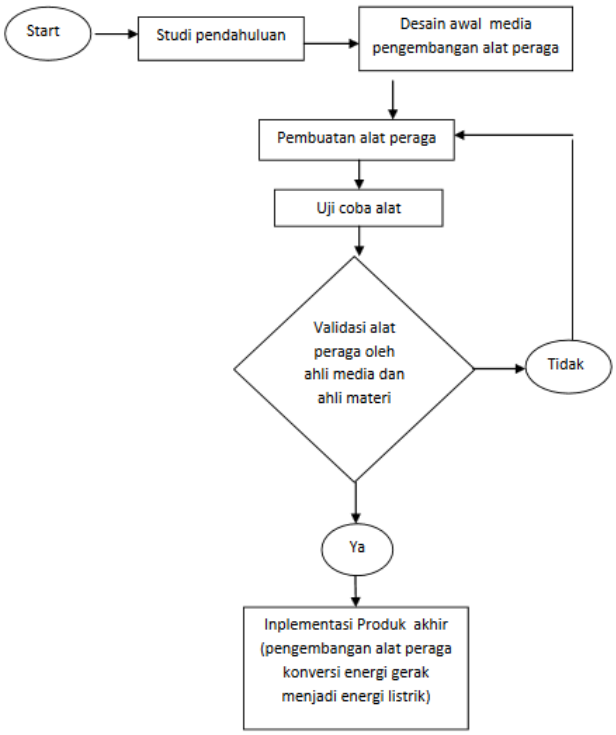
The difficulty is because usually the teacher only describes on the blackboard and tells the process of changing the energy without showing the real conditions so that the students only imagine it so that the students feel bored in understanding the students so that the other effect is the student's score below average. The condition is a problem but the problem is not an effort to avoid problems, but rather the need to deal with the problem intelligently by identifying and understanding the substance to then look for a solution (Hasanudin Sirait: 2011). This can basically be overcome by practicum but from the results of a preliminary study at one of the vocational schools in Jakarta to in 2012, practicum was analyzing static and dynamic electricity, analyzing electro magnetic induction, but analyzing the application of teaching aids The nature generator has not yet been implemented because there are several obstacles in between, financial and financial, there are no props that can be modified. Sealin is one possible solution to overcome the problem above a teacher in delivering his learning material using modeling tools directly in the class, in the form of media related to the material to be taught for example the delivery of energy concept material, but is it possible to help in explaining the energy concept material so students understand about the concept of energy explained by his teacher. Besides that, in learning to use media, it is likely that students will play an active role in learning, among others, preparing media actively and fun because learning today is prioritizing active, creative, innovative and fun learning (pakim). So with the research "Development of Conversion Props of Energy into Electricity as a Media for Learning Junior High School / MTs in Jakarta" it is hoped that students can understand the concept of energy conversion in daily life.

Basically a good learning is learning that can demonstrate all the activities that have been carried out in the learning, if students are able to demonstrate learning outcomes, then a more achievement for these students. In a special sense students have been able to master the material fully. Today's development in Indonesia in particular has not been so much research

in the development of teaching aids for physics learning media. Although Edgar Dale has said that the best learning is through direct experience, but it has not been specifically tested in what material should be applied. Thus, the research of the development of teaching aids on the concept of converting electricity into motion needs to be tested against the theory expressed by Edgar Dale. In addition to the media used in direct learning to support learning a teacher must be able to master the class. Sri Esti Wahyuni D revealed that teachers who manage the class well would tend to students prefer to learn in class (Sri Esti Wahyuni D, 2006). If you prefer to learn in class then it is likely to have a positive effect on student learning outcomes. Basically a good environment is one that is challenging and stimulates students to learn, provides a sense of security and satisfaction in achieving goals (Mantabjaya: 2011). However, these conditions can be conducive or not for learning in the classroom using teaching aids

2. METHOD

The method used in this research is the Research and Development method which refers to the Borg and Gall formula. According to Borg and Gall, development research is a process used to develop and validate educational material packages, such as learning materials, textbooks, instructional methods, instructional designs, and others used in a research development (Borg and Gall, 1983: 772). The product being developed is the media for teaching the conversion of motion energy into electrical energy. The use of these teaching aids is expected to be the media of choice that can be used in physics / SMP learning, especially in energy conversion material.



As for the research development steps, there are seven main stages, namely: (1) Preliminary Study; (2) Design; (3) Manufacturing Stage; (4) tool testing phase; (5) validation of material expertise; (6) validation of material expertise; (7) the final product implementation.

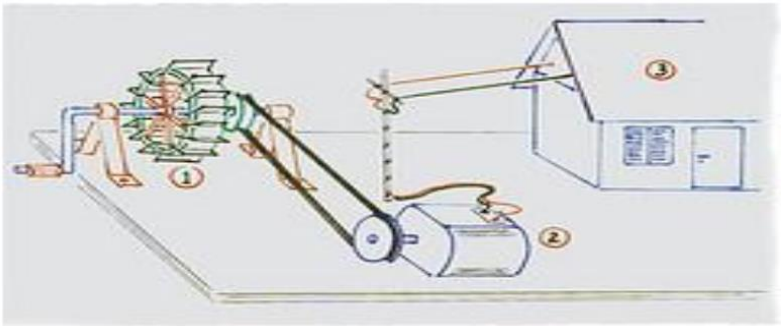
1. Preliminary study (needs analysis)

The preliminary study was conducted to obtain information and analyze the problems in the teaching aid of the conversion of motion energy into electrical energy that already existed at

school also analyzed the needs of teachers and students in school learning material on the conversion of motion energy into electrical energy. The preliminary study consists of several stages, namely: The first step, the literature study aims to gather information and theories related to existing problems, especially in the discussion of energy conversion material. The second step, which is conducting a field survey to obtain data about real conditions in the teaching aid of the conversion of motion energy into electrical energy that already exists and is used by teachers in schools.

2. The initial design stage

The manufacturing stage begins by determining the initial design of the conversion props of motion energy into electrical energy, the initial design is made based on the development of the means of converting motion energy into electrical energy with. The circuit is arranged as in the picture below:



3. Making tools

This stage is in the form of props which are basically made from electric motors, windmills, led lights and houses. Then the combination is combined as in the initial design

4. Test the tools

Tools that have been made and then tested in the laboratory until the teaching aids can function as desired, if the props are functioning according to their functions, then the teaching aids are already functionally suitable for the next test.

5. Material expert validation Material validation is the assessment of the appropriateness of teaching aids relating to the teaching aids and the material to be discussed

6. Media expert validation

Media validation is an assessment of the appropriateness of visual aids relating to the design, beauty and condition of the device itself as expected or not.

7. The Implementation Stage

The validated model tools will be tested on SMP / MTs class students. Students who took part in the observation of modeling tools as much as one class. After the students take part in the testing tool, the students are asked to fill in the questionnaire.

Sample

Validated teaching aids will be tested on SMP / MTs class students. Students who took part in the observation of modeling tools as much as one class.

Instrument

The instrument used in this research is a questionnaire. The questionnaire was given to experts and students of class XI SMP / MTS. Experts are physics education practitioners who are experienced in their fields. The rating scale used in each of the questionnaires in the development of the conversion props of motion energy into electrical energy consists of five categories, namely:

Score 5: Strongly Agree

Score 4: Agree

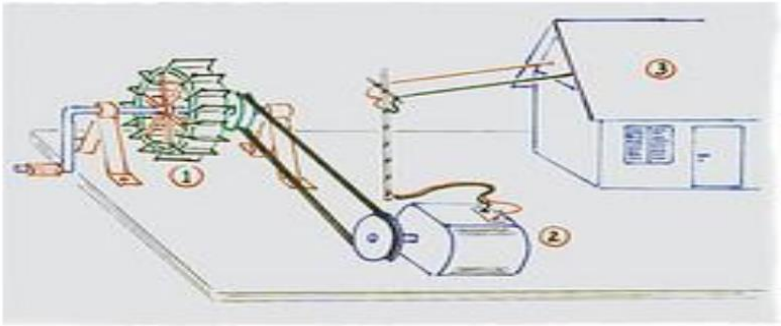
Score 3: Neutral
Score 2: Disagree
Score 1: Strongly Disagree
The limits of the assessment of the accuracy and appropriateness of the teaching aid of the conversion of motion energy into electrical energy to be used as a learning aid tool are based on the criteria of interpretation of scores for the Likert scale (Ridwan, 2005: 87), namely:
0 –20%: Strongly disagree
21 –40%: Disagree
41 –60%: Enough
61 –80%: Good
81 –100%: Very Good

3. RESULTS AND DISCUSSION

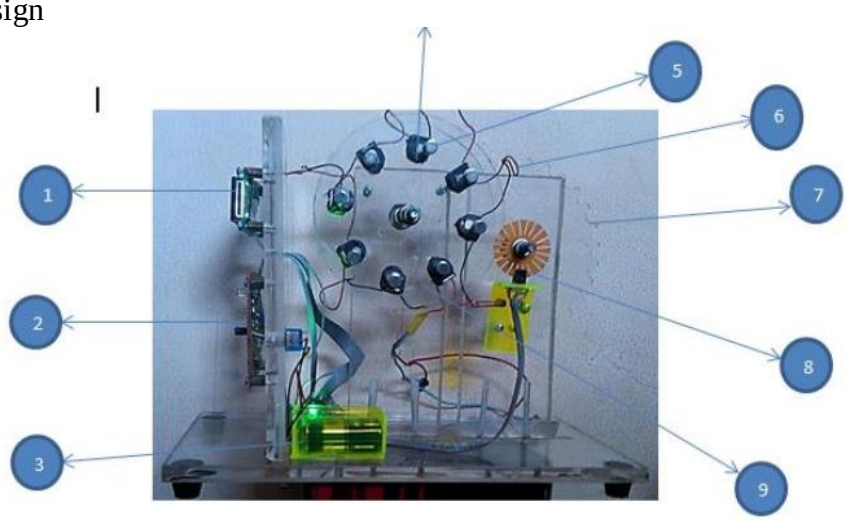
Research props developed are the development of energy conversion props for energy to electricity. It is hoped that this study students as teaching objects will more easily understand the concept of changing energy of motion into energy, in addition to that the teacher who teaches is also assisted in delivering material about converting motion energy to energy and in learning students are able to be active, creative, effective and fun (PAKEM). To create the learning environment mentioned above, it is necessary to make the following research steps:
1. Introduction Study
a. Preliminary studies
The Preliminary Study was conducted to obtain information and analyze the problems in the teaching aid of the conversion of motion energy into electrical energy that already existed at school and also analyzed the needs of teachers and students in school in learning the material of conversion of motion energy into electrical energy. The preliminary study consists of several stages, namely: The first step, the literature study aims to gather information and theories related to existing problems, especially in the discussion of energy conversion material. The second step, which is conducting a field survey to obtain data on real conditions in the teaching aid of the conversion of motion energy into electrical energy that already exists and is used by teachers in schools.

b. Discussion of the Study Introduction
After the literature study on energy conversion, that in the book guide many concepts of energy conversion. Most of the energy conversion concepts used as examples are the concepts of converting electrical energy into heat energy and the concept of business and electric power. Whereas the example of the concept of converting motion energy into electrical energy is only described from gravitational potential energy to electrical energy managed by a Hydroelectric Power Plant and this concept is not discussed in detail. This research will discuss the concept of converting motion energy from rotational kinetic energy to electrical energy. Subsequent observations were made at the school. The results obtained from observations that these props do not yet exist.

2. Initial Design Stage
a. Preliminary Design
The manufacturing stage begins by determining the initial design of the conversion props of motion energy into electrical energy. The initial design is made based on the development of a means of converting motion energy into electrical energy. The series is arranged as in the image below:



b. Finished Design



Information:
1. LCD
2. LED
3.Battery
4. Coil
5. Magnets
6.Cable
7. Gear
8. Sensor
9. generator

3. Making Tools
a. Initial Manufacturing Stage
This stage is in the form of props made from electric motors, windmills, LED lights and houses and then combined to be as in the initial design.
b. Production Discussion Phase The initial plan of making teaching aids for the generator will be made from an electric motor, if it will produce electricity. But how to work on an electric motor that is used as a generator can not be visualized. Therefore, this study was made so that the workings of the generators can be directly visualized by making the design model above (Figure 1.) The steps in making these props are collecting tools and materials used, such as acrylic glass, magnets, nut baud, coil windings, cables, lead and LED lights. After gathering all, then made gird and magnetic holder with a coil and made poles and props. After the props body parts are made, the components of the props are installed, such as magnets, coils, cables and LED lights.

4. Testing

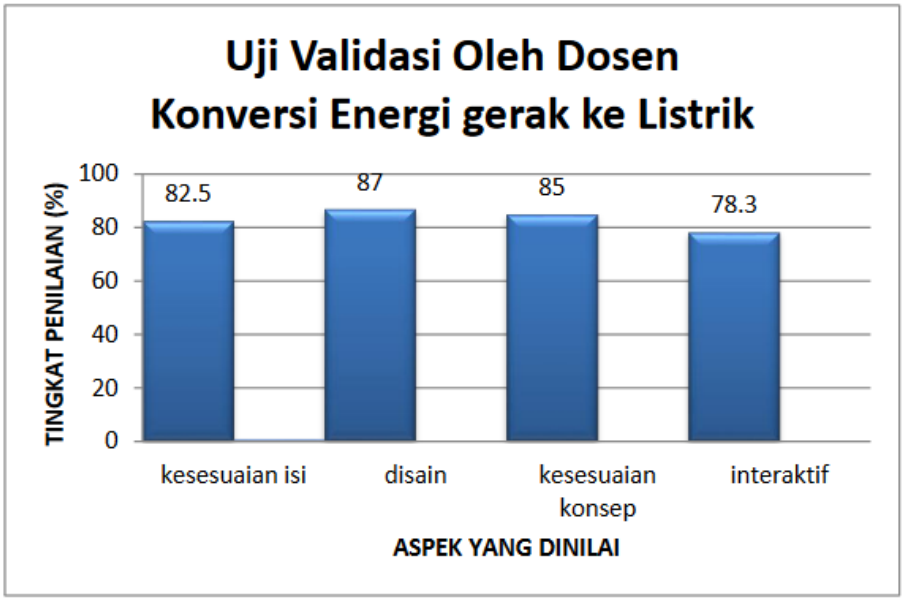
The Demonstration Tool has been tested in the physics laboratory of the State University of Jakarta so that the demonstration tool can function as expected. If the props have worked according to their function, then the props are already worthy of further testing. Stages of testing the voltage indicator. In the first stage of testing, testing one coil and one magnet produces a voltage of 0.87 volts. The resulting voltage is an unstable voltage. Furthermore, two magnets and two coils are installed which produce a voltage that is doubled up to its diameter. The installation of all magnets and coils produces a maximum voltage of 12 volts. In LED installation, the resulting voltage is reduced to 2 volts. This reduced voltage is caused because there is a voltage loss.

5. Tool Validation

In this stage, an assessment and validation by experts related to this research is carried out. The validation stage is determined by four documents and three teachers.

a. Discussion of validation by Lecturer

Discussion of validation by Lecturer validation of the development of the conversion of motion energy into electricity is rated by four lecturers. Assessment parameters are the suitability of the content, the suitability of the concept, design and interactive students in the use of this teaching aid. The results of the validation by the lecturer are as follows.



If seen from the graph above, the suitability of the contents between the teaching aids and the material to be delivered, the percentage of the average value is 82.5% given by experts. A value of 82.5% means the props of converting motion energy into electrical energy are categorized as "very good". Likewise for the design of visual aids, experts rate an average score of 87 which means the value of the teaching aid of the conversion of motion energy into electrical energy is categorized as "very good". Aspects of the suitability of the concept, the experts assess an average of 85% which means the value of the props for the conversion of motion energy into electrical energy is categorized as "very good". But for the interactive aspect, the experts rated 78.3%, which means that the props for the conversion of motion energy into electrical energy are categorized as "good". The interpretation of scores in this validation test uses a Likert scale (Ridwan, 2005: 87).

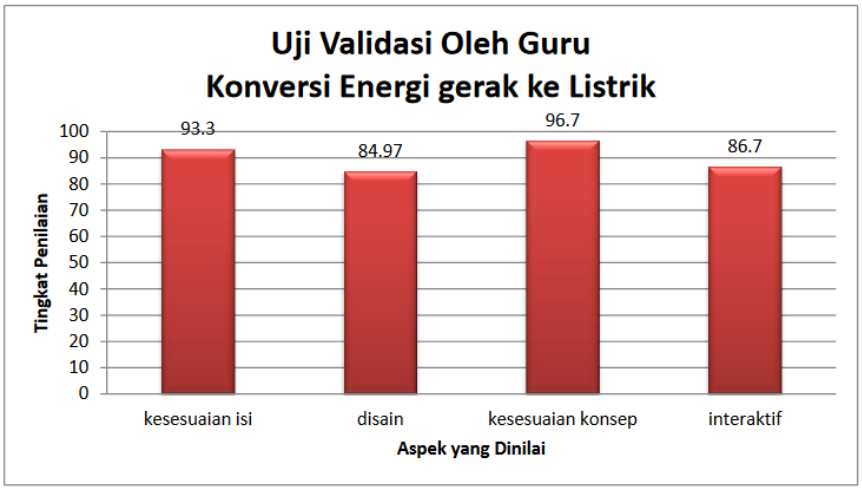
In addition to assessing the Likert Scale instrument, experts provide suggestions including, the addition of angular velocity indicators (ω), Voltage (V) and Current (I)

indicators so that they can be seen at the same time when props are used. On this suggestion can already be realized. Another suggestion from one of the lecturers was that in order to improve the teeth and precision of the teeth so that a better and stronger magnetic field could be varied as well as the number of turns could be varied. Suggestions for improving the crank can not be varied due to time constraints, whereas for the number of turns and the number of magnets can already be varied. Suggestions for the addition of technological and energy aspects that can be stored in batteries so that current flowing constantly in this study cannot be realized because of the need for additional tools and materials and quite a long processing time. Therefore, it is hoped that these two suggestions will be carried out in further research.

Based on the above suggestions, before validation testing is done to the school teacher, the props are repaired first. Improvement of teaching aids in accordance with suggestions that can be realized. The results of the validation test to school teachers are as follows:

a. Validation by Teacher

Validation by the teacher is done after the validation test stage to the experts, namely lecturers who are related to this research. Parts of teaching aids that are considered to be still lacking by experts, repaired and added some aspects that have been mentioned above. After everything is summarized, a validation test of the teaching aids is carried out by three physics teachers at SMK Negeri 26 Jakarta.

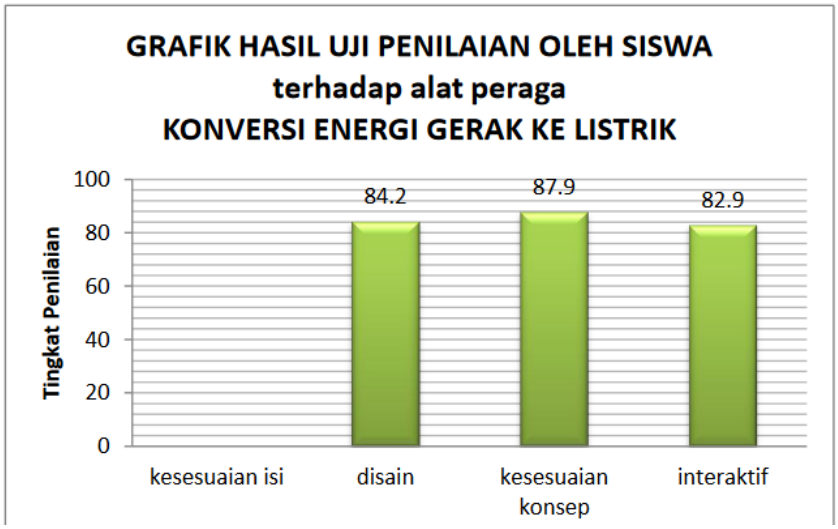


The results of the validation test by the three Physics teachers at SMK Negeri 26 Jakarta, gave an average percentage of 93.3% based on aspects of content suitability. This assessment is in the range of 80-100%, which means that the aspect of content conformity in the props for the Conversion of Motion Energy to Electrical Energy is categorized as "very good". Desian aspect, obtained an average percentage of 84.97% which means it belongs to the category of "very good". In the aspect of conceptual conformity, the teachers gave an average percentage of 96.7%. The percentage of this aspect was the biggest among the other aspects, which were assessed by the three teachers. This indicates that this aspect is in the category of "very good" which means that this teaching aid can help teachers explain the concept of motion energy into electrical energy. On the student interactive aspect, paraguru gives an average assessment of 86.7% which means it is in the category " very good ". The results of the assessment on the interactive aspects of students on this teaching aid can help students understand the material of the conversion of motion energy into electrical energy and assist the teacher in explaining the material. After being given an evaluation through a validation test by the teacher, the teacher gives suggestions for improvement of the teaching aids. As for the suggestions given, the selection of materials must be free of electrostatic

properties which can result in induction in the magnetic section. This suggestion cannot be realized in time constraints but this suggestion can be used as a reference in further research. The next suggestion is that the application of learning must take longer to get maximum results, both voltage, current and angular velocity need to be more significant.

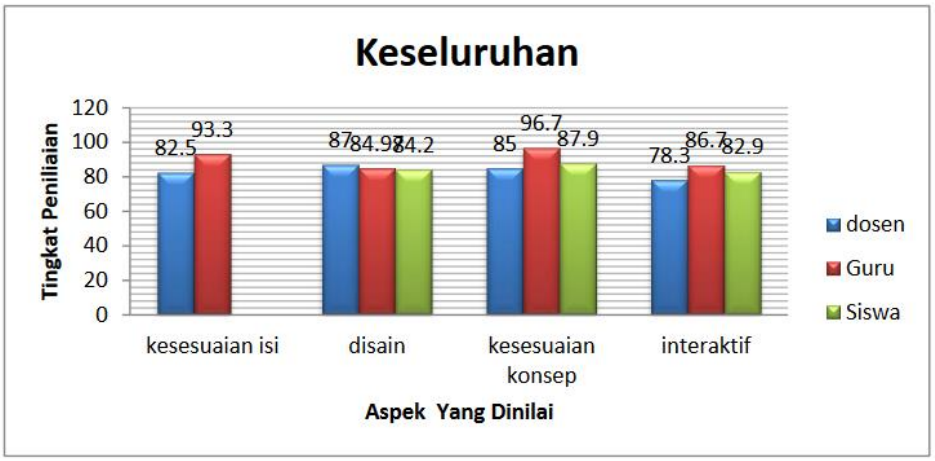
6. Implementation Phase

The teaching aids that have been validated by the three Physics teachers at SMK Negeri 26 Jakarta, then an implementation phase is carried out on the students who have previously made the improvements in accordance with the suggestions given. This implementation phase was carried out on February 15, 2013 at SMK Negeri 26 Jakarta with 32 students. These students are students majoring in electronics class XII. Before the implementation or testing phase is conducted to students, the first stage explains the concept of teaching aids made based on the conversion of motion energy into electrical energy, then explains the tools and materials used and how they are made, as well as the costs used to make these props. When explaining the concept of teaching aids to costs, students were quite enthusiastic, as seen in the attached documentation. Students can also answer the questions given. After giving the concept, a trial is conducted to students by forming groups to be able to install the props and measure the voltage, current and speed given to the props. There are four groups formed and all of them can install these props. These groups can install props for ± 20 minutes. After that, given the opportunity for students to give questions. The question asked is how to make girdroda teaching aids and the costs used to make it cheaper for students to reach. Questions about making gears.



The design aspect has an average percentage of 84.2% susceptible at 80-100% which means it is included in the "very good" category. This assessment of design aspects illustrates that the design of these visual aids attracts the attention of students so that students do not feel bored in the learning process and students directly see concrete examples on the material conversion of motion energy into electrical energy. This concrete example makes it easy for students to understand the concept of the material. In addition, the design shows "very good" on the validation test to students indicating that using this teaching aid can provide a "very good" learning process as well.

When compared to the assessment between Lecturers, Teachers and students of these teaching aids can be seen in the following graph.



After two validation tests conducted by the physics and physics lecturer, as well as an implementation of the students, the average percentage of the overall content is 87.9% (without the students' assessment). the highest level of assessment given by the teacher is 93.3%, then the average rating of 87.7% of students and the lowest 82.5% is given by lecturers. In the assessment of all aspects of the design has an average value of 85.39% which means it belongs to the category of "very good" because it is in the range of 80-100%. Therefore, the design of the teaching aids made can help teachers to attract students' attention in understanding the material conversion of motion energy into electrical energy and students become more focused on the delivery of material. In the aspect of conformity the concept of having an overall average of 89.9% on the tool visuals made. This presentation is in the category of "very good" because it is in the range of 80-100%. These results indicate that the props for the conversion of motion energy into electrical energy are "very good" used in the process of learning physics with the material conversion of motion energy into electrical energy and minimize the differences in concepts or errors in understanding the concept of matter. While the interactive aspect, the average overall percentage value is 82.6%. This percentage is in the range of 80-100%, so it can be categorized as "very good". If physical learning, especially in the matter of converting motion energy into electrical energy using teaching aids, then PAKEM (active, creative and fun learning) has been proven to be realized according to the results of this study.

4. CONCLUSION

In this research, the formulation of the problem is "Is the Development of Props to Convert Energy from Energy to Electrical Energy as Learning Media for High School / Vocational Physics in Jakarta worthy of being used as learning media?". Props to the conversion of motion energy into electrical energy as a medium for learning physics in high schools / vocational high schools in Jakarta deserve to be used as a learning medium for the conversion of motion energy into electrical energy.

REFERENCES

Arissunandar dan S. Kuwahara. 1993. Teknik Tenaga Listrik. (Jilid III). Jakarta : PT. Pradya Paras

Asnawiar, H dan Basyirudin Usman. 2002. Media pembelajaran (alat peraga)(Edisis Ke I). Jakarta: Ciputat Perst

Mulyas , E. 2005. Menjadi Guru Propesiona Menciptakan Pembelajaran Kretif dan Menyenangkan. Bandung: Pt Remaja

Arsyad, A. 2002. Media Pembelajaran, edisi 1.Jakarta: PT. Raja Grafindo Persada.

Asim, Dr. M.Pd. 2001. Sistematika Penelitian Pengembangan. Malang : Lembaga

Penelitian-Universitas Negeri Malang.
Borg W.R. and Gall M.D. 1983. Educational Research An Introduction, 4 th edition. London: Longman Inc.
Halliday & Resnick. 1996. Fisika. Jilid 2. (Diterjemahkan Pantur Silaban & Erwin Sucipto). Edisi ketiga, Jakarta: Erlangga
Sadiman, A.S., Rahardjo, R., Haryono, A., & Rahadjito. 1990. Media Pendidikan: pengertian, pengembangan dan pemanfaatannya, edisi 1. Jakarta: Penerbit CV. Rajawali.
Sugiyono. 2008. Metode Penelitian Kuntitatif, Kualitatif dan R&D. Bandung: Alfabeta
Young, Hugh D. & Freedman, Roger A., 2002, Fisika Universitas (terjemahan), Jakarta : Penerbit Erlangga
Sudisman, A. Ari, dkk. 2003. Media Pendidikan-Pemngembangan dan Pembelajaran. Jakarta