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Miniature Magnetic Levitation Train Model for Physics Learning

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ABSTRACT

This research aims to produce products such as the development of Magnetic Levitation Train miniature models that can be used by teachers and students in the learning process to improve their knowledge of physics and scientific thinking skills of students in learning the material physics of magnetic induction and magnetic forces in the class XII school. The research was conducted in March 2012-January 2013 at the Laboratory of Physics Department, Faculty-UNJ. This study uses the research & development (research and development). The study was conducted in several stages:(1) assess the demands ofthe standard SBC, (2) media design, manufacture and test experts (3) the implementation phase, students are tested on high school students. Assessment instruments using Likert scale. The trial results Magnetic Levitation Train miniature model of the experts and students get an excellent level of assessment that are in the range of interpretations of scores80-100%.

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1. INTRODUCTION

The success of students in learning is largely determined by the learning strategies undertaken by the teacher as a facilitator. Learning activities carried out by two actors, namely teachers and students. Teacher behavior is teaching and student behavior is learning. The task of the teacher is not merely teaching (teacher centered), but rather to learn students (children centered). Learning implementation is a form of organizing learning activities that integrate systematically and continuously learning activities carried out in the classroom or outside the classroom in the form of providing a variety of learning experiences for all students. One of the most important factors of learning is the active involvement of students in the learning process. Students are actively involved in observing, operating tools, or practicing using concrete objects as part of the lesson (Supriyono, 2003). In the learning process, teachers should be able to do teaching using media. This is important because the situation of students in the class is very heterogeneous. These media can be models, objects, props, miniatures and other media that can help teachers maximize learning so that students can more easily understand the lesson.

But in reality the use of media for high school physics learning is still inadequate, as revealed by the Ministry of Education's Research and Development Agency Report National 2008. The limitation of the media makes it difficult for students to find examples of physical phenomena. 22, 23, and 24 of 2006 require more students to have special competencies in all lessons after the learning process. Especially in science education that directs students to "find out" and "do" so that it can help students gain a deeper understanding of the natural surroundings. So the physics learning process in KTSP places more emphasis on providing direct experience to develop competencies so that students explore and understand the natural environment scientifically (BSNP: 2006). One of the phenomena in physics is magnetic fields. In this concept also explains the magnetic induction of events that produce electric current that flows in the conductor and magnetic force that is the force acting on an electric current conductor in a magnetic field. And there are applications of magnetic force for everyday life, one of which is the Maglev Train, but if we look at some physics books for high school, it is only limited to train images and minimal working principles are explained. Moreover, there are no kits that are available in high school schools that explain the working principle of the Maglev Train. Therefore, the authors are interested in developing the Maglev application in the form of a miniature media.

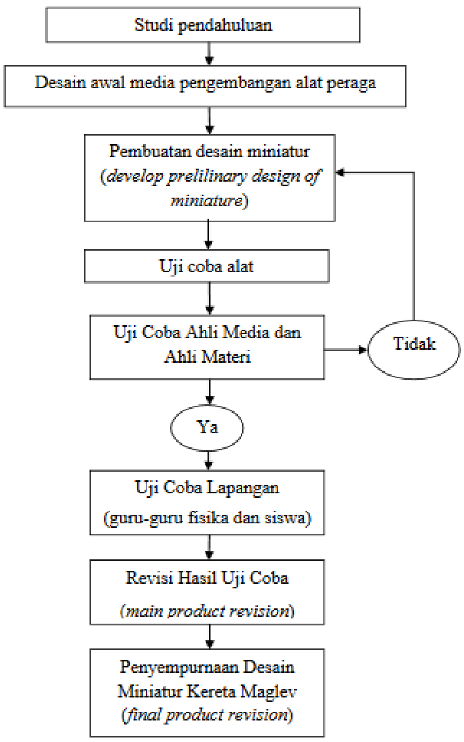
Miniature media is one of the alternative media that can be reached if the models, tools or materials are difficult to carry while learning. Moreover, in physics learning that is constantly experiencing progress. By tracing the standard of competence, that is applying the concepts of electricity and magnetism in various problem solving and technological products, then the basic competence is to apply magnetic induction and magnetic force on several technology products, with the existence of the Miniature Train Maglev, it is expected that applications for learning magnetic forces can be seen clearly in physics learning and can be developed especially in Indonesia.

2. METHOD

The research method used is development (Research and Development). Development research is a process or steps to develop a new product or improve existing products, which can be accounted for. Development research is a process used to develop and validate packages educational materials, such as learning materials, textbooks, learning methods, instructional designs, which are used in a research development. The resulting product is a miniature model of the Magnetic Levitation Train. A miniature model of the Magnetic Levitation Train was developed through the study of literature using several textbooks, journals and internet searches. Research on the development of a miniature model of the Magnetic Levitation Train was carried out in several stages, namely:

1. Preliminary studies. Preliminary studies are carried out by studying the SBC. The things done in the SBC study are: (1) determining competency standards and basic competencies; (2) study the demands of content standards; (3) make indicators according to competency standards and basic competencies. 2. The making phase. The initial design development starts from determining the material to be made and making drawings or schemamemini models of Magnetic Levitation Trains. The process of making miniatures is divided into three parts, namely: a. Maglev Train Magnetic Levitation is made of sterefoam, the bottom of the train uses a permanent magnet that serves as a regulator of the progress of the train back and forth with a diameter of 1.1 cm thick 0.2 cm. The drift section uses two coils / coil with a diameter of 0.24 mm / 2.46ohm with the core using a nail with a diameter of 10 mm and then connected using an acrylic length of 11 cm in the middle there is a permanent magnet as a stabilizer /

calibration of the train. There is also at the top of the coil in the form of an infrared sensor and photo diode reader sensor. The serving section also has a series of publishers. In the flight and train sections are connected using ice sticks. The bottom part uses long iron as the weight and stabilizer of the train (pictures 1, 2) b. The rail section of the Maglev train. The bottom part as a base uses wood measuring 100 x 7.5 cm. For the Maglev Train, ferromagnetic material is used, namely iron with a length of 100 cm and an outer diameter of 2.04 cm and an inner diameter of 1.8 cm. And the top of the coil is turned 80 times with a width of 5 cm and strung along 100 cm (this coil is made three times). Socket at the end of the coil as a connection for current flow. (figure 3) c. Control and power supply set. Protective, bottom, left, right and back casing designs using wood. The bottom is 22x19.5 cm, the left and right are 19.5x10 cm, the back is 22x20 cm. The Power Supply uses a 220 Volt voltage source made into a DC current. For drift currents use 24 Volts each for one drift coil and for controllers use 18 Volts. There is a microcontroller IC that is used, the AT-Mega 16A AVR IC, also 1 button to advance the train, 1 backward train button, 1 stop button, and 1 on / off button for the controller and 1 button on / off currents for train movement (figure 4) 3. Initial trials by power experts. Miniature Magnetic Levitation Train models that have been made are then tested by experts. The trial was conducted by 7 people consisting of 2 material expert tests (lecturers), 2 media expert tests (lecturers) and 3 Physics teachers. Each expert is given a questionnaire sheet containing statements relating to the suitability of the media with the intended aspects. 4. Media testing of students. The field testing of students is carried out at Widya Nusantara Secondary High School with the target population being high school students in class XII. The trial was conducted by demonstrating a miniature model of the Magnetic Levitation Train in the learning process. Then the students filled out the questionnaire sheet which consisted of 9 questions about students' interest in learning. 5. Improvement of the design of miniature steam power plants. The perfection of the design of miniature steam power plants was based on input, suggestions and opinions from the results of trials that had been done previously. From the research stage, the development that has been carried out will result in a miniature model of the Magnetic Levitation Train with all its equipment.



Sample
The validated miniature model of the Magnetic Levitation Train will be tested on high school students in class XII. Students who take one class

Instrument
The instruments used in this study were questionnaires given to experts and high school students in class XII. Experts are physics education practitioners who are experienced in their fields. The rating scale used in each of the questionnaires for the development of a miniature model of the Magnetic Levitation Train consists of five categories, namely:

Score 1: Not Good
Score 2: Less
Score 3: Medium
Score 4: Good
Score 5: Very Good

The limits of the accuracy and appropriateness of developing the miniature model of the Magnetic Levitation Train as a learning aid are based on the criteria of interpretation of scores for the Likert scale (Ridwan, 2005: 87), namely:

0 –20%: Strongly disagree
21 –40%: Less
41 –60%: Medium
61 –80%: Good
81 –100%: Very good

The expert test validation instrument consisted of four aspects, namely (1) the content suitability aspect, (2) the concept suitability aspect, which was based on competency standards, namely applying the concept of electricity and magnetism in various problem solving and technological products, then the basic competency was applying magnetic induction and magnetic force on several technology products, and indicators that apply the principle of magnetic induction and magnetic force in technology, (3) aspects of the media based on application as learning media, and (4) design aspects based on the state of the miniature model of the train Magnetic Levitation.

3. RESULTS AND DISCUSSION

In this study, learning media developed were miniature Magnetic Levitation Train models. This miniature model of the Magnetic Levitation Train is expected to help complete the physics learning media available at school so as to improve students' scientific thinking and scientific skills in learning physics in magnetic material in high school class XII semester I. The steps taken in the research of this teaching aid to produce a miniature model of Magnetic Levitation Train.

1. Preliminary Study
Preliminary study is done by studying the SBC. The things done in the KTSP study are: (1) determining the standard of competence and basic competencies that students must achieve in the magnetic field material; (2) study the demands of content standards that students must achieve; and (3) making indicators that are in accordance with competency standards and basic competencies. From the preliminary study, it was found that the basic competence of the application of magnetic induction and magnetic

force on several technology products contained in the SBC.

2. Description of the miniature model of the Magnetic Levitation Train

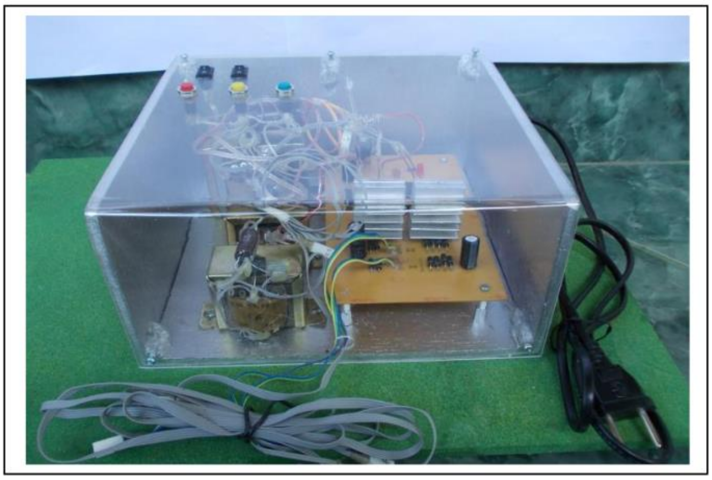
The design of the miniature model of the Magnetic Levitation Train is made by considering the intended use, practicality in use and utilization in the learning process. The components contained in the Miniature Magnetic Levitation Train model include:

I. Magnetic Levitation Train

Magnetic Levitation Train is made of sterefoam, the bottom of the train uses a permanent magnet that serves as a regulator of the progress of the train back and forth with a diameter of 1.1 cm thick 0.2 cm. The drift section uses two coils / coil with a diameter of 0.24 mm / 2.46ohm with the core using nails with a diameter of 10 mm and then connected using acrylics along the 11 cm length in which there is a permanent magnet to stabilize / calibrate the train. There is also at the top of the coil in the form of an infrared sensor reader and photo diode. The delivery section also has a series of publishers (as shown in Figure 4.3). In the flight and train sections are connected using ice sticks. The bottom uses a long iron as a ballast and stabilizer train.

II. Magnetic Levitation Train Railroad
The bottom part as a base uses wood measuring 100 x 7.5 cm. For the Maglev Train, ferromagnetic material is used, namely iron with a length of 100 cm and an outer diameter of 2.04 cm and an inner diameter of 1.8 cm. And the top of the coil is turned 80 times with a width of 5 cm and strung along 100 cm (this coil is made three times). Socket at the end of the coil as a connection for current flow.

III.Set control and Power Supply
Design of the protective (casing) the bottom, left, right and back using wood. The bottom is 22x19.5 cm, the left and right are 19.5x10 cm, the back is 22x20 cm. While the top and front use acrilycbening (mica) with the size of the top 22x19.5cm and the front 22x10 cm. The Power Supply uses a 220 Volt voltage source made into a DC current. For drift currents use 24 Volts each for one drift coil and for controllers use 18 Volts. There is a microcontroller IC that is used, the AT-Mega 16A AVR IC also 1 button to advance the train, 1 rewind the train button, 1 stop button, and 1 on / off button for the controller and 1 current on / off button for train movement.



3. Trial Model of the Miniature Magnetic Levitation Train
Miniature Model of the Magnetic Levitation Train has been made, tested on experts and students, physics education practitioners who are experienced in their fields. In this study, an observation sheet in the form of a questionnaire was used when testing the miniature model of the Magnetic Levitation Train that had been made. The purpose of this questionnaire is:

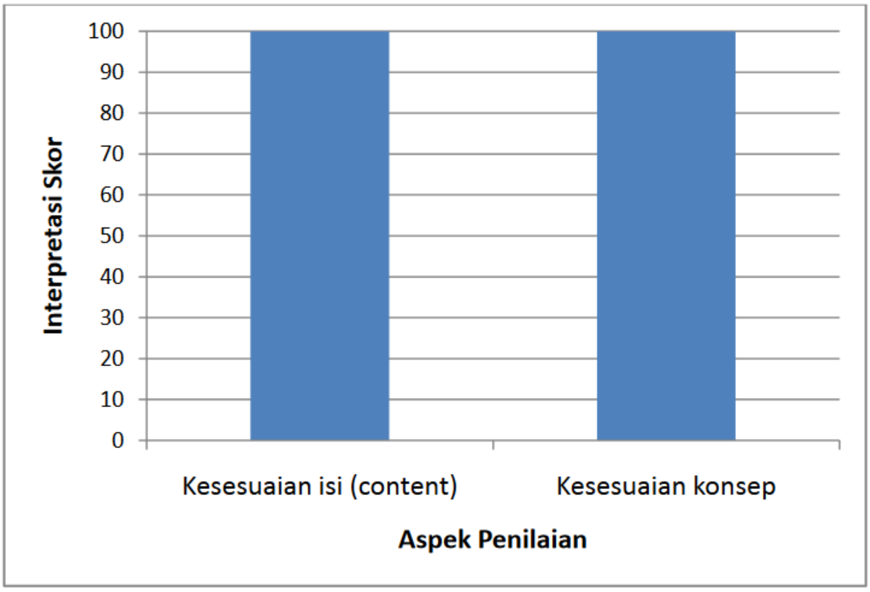
A. Experts
Giving questionnaires to experts namely four physics lecturers including two material experts and two media experts as well as three high school physics teachers aim to find out the suitability of the miniature model of the Magnetic Levitation Train with KTSP both in terms of competency and material as well as its use in the learning process.

B. High school students in class XI
The aim of giving questionnaires to 25 students of class XII SMAWidya Nusantara Bekasi is to find out the students' assessment of the miniature model of the Magnetic Levitation Train as a tool to facilitate students understanding the concept of the magnetic field, especially to applications and students are more interested in learning the concept of a magnetic field using a miniature model of the Magnetic Train The Levitation. The rating scale used in each of the miniature Magnetic Levitation Train model questionnaires consists of five categories, namely:

Score 1: Not good
Score 2: Less
Score 3: Medium
Score 4: Good
Score 5: Very good

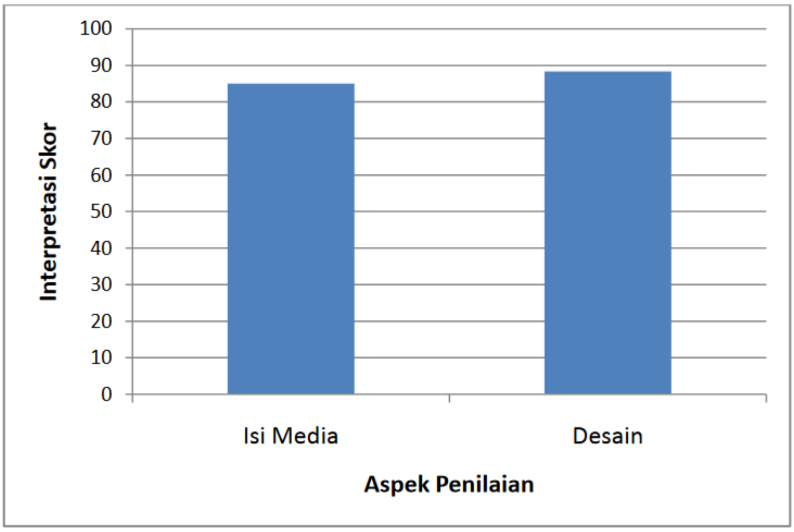
The limits on the accuracy and suitability of the miniature model of the Magnetic Levitation Train to be used as a learning aid are based on the criteria for interpreting scores for the Likert scale (Ridwan, 2005: 87), namely:
0-20%: Strongly disagree
21 –40%: Less
41–60% : Medium
61 -80%: Good
81 -100%: Very Good

Discussion
1. Material Expert Validation Test
The validity of the miniature model of the Magnetic Levitation Train is assessed from the material aspect, namely the suitability of the content and the suitability of the concept.



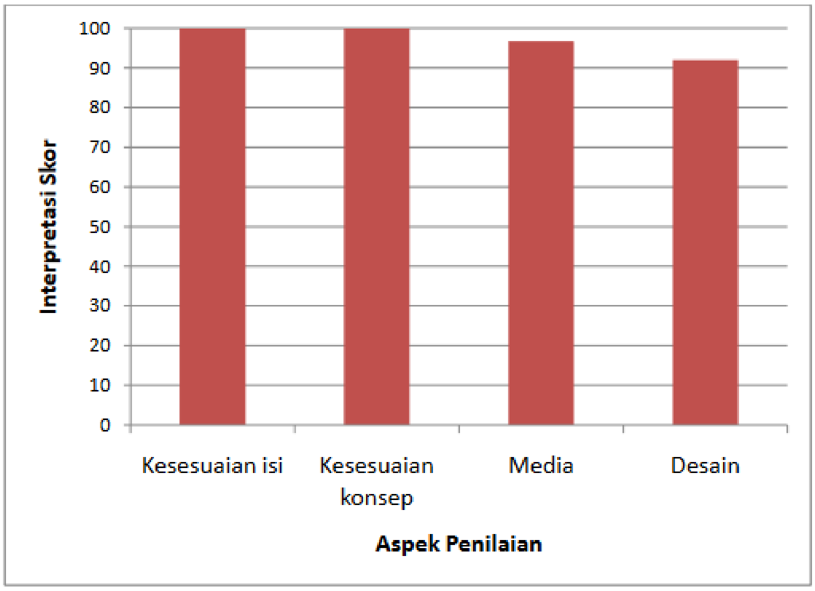
Based on the graph above, the two rating scales of content validity and conceptual relevance have achieved a very good rating that is within the 80-100% (very good) interpretation range.

2. Media Expert Validation Test
The validity of the miniature model of the Magnetic Levitation Train is assessed in terms of media content and design aspects.



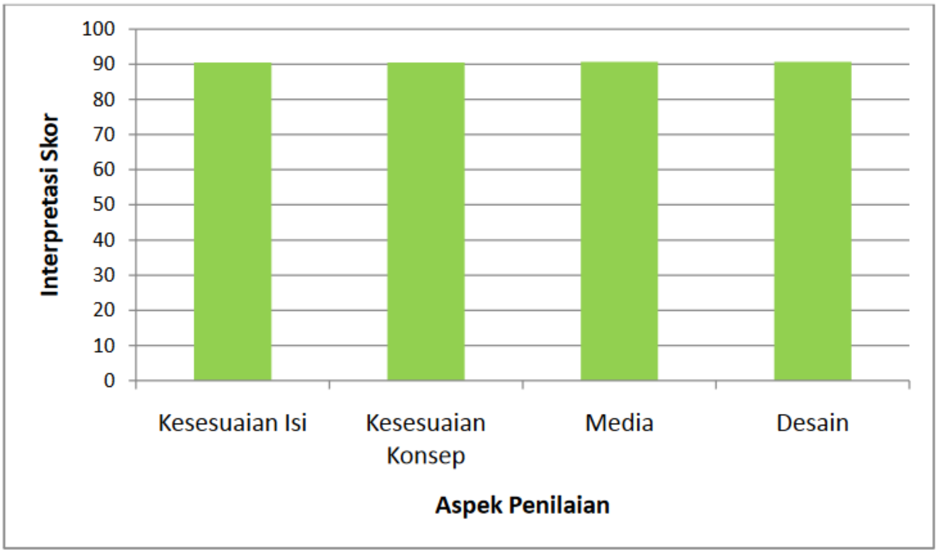
Based on the graph above, the two aspects of assessment namely imitation and design get a very good assessment level which is in the range of interpretation of the score 80-100% (very good). For the assessment of the level of media content obtained 85% and for the assessment of the design level obtained 88.3%.

3. Validation test by experts (teachers)



Based on the graph above, because aspects of content suitability and conceptual appraisal are put together so that the level of content appraisal and conceptual appropriateness are 100%. For the assessment level the media aspect gained 96.65% and for the assessment level the design aspect gained 91.96%, so that of the four aspects obtained an excellent assessment level which is in the range of interpretation of the score 80-100% (very good).

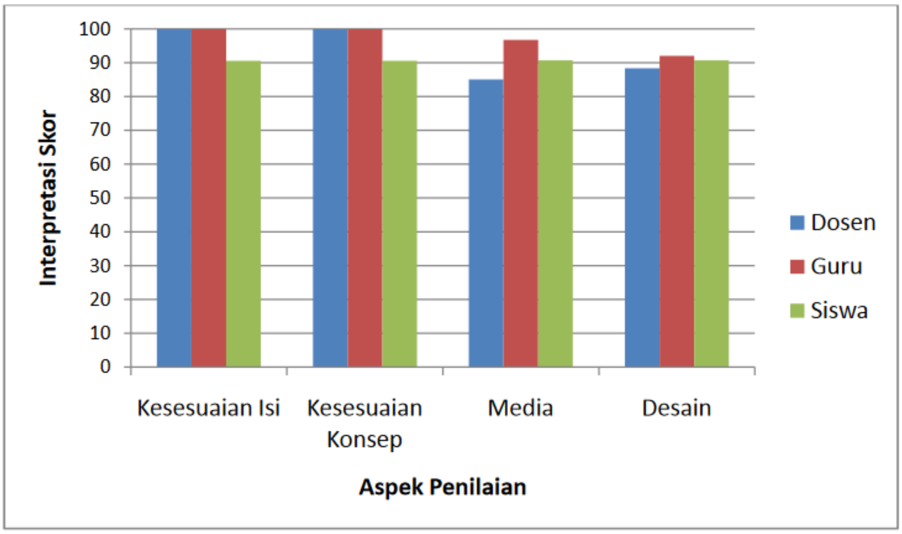
4.Test validation by high school students
After students observe the miniature model of the Magnetic Levitation Train, students are asked to fill out a questionnaire. The students who took part in the trial were 25 students of Class XII SMAWidya Nusantara Bekasi.



Based on the chart of the results of the miniature model of the Magnetic Levitation Train above, the interpretation of student scores for aspects of content suitability, concept suitability, media and design is in the range of 90-191% (very good). With the content suitability aspect which is united with the concept suitability aspect gets an assessment level of 90.53% and the media aspect which is united with the design aspect gets an assessment level of 90.66%. From the results of the questionnaire, students stated that it was easier to understand the application of the concept of magnetic induction and magnetic force using a miniature model of the Magnetic Levitation Train.

5. Comparison of the Validation Test Results of Experts (lecturers) with Experts (teachers) and Students.

The validation of the miniature model of the Magnetic Levitation Train was assessed by several experts (lecturers and teachers) and students who could assess the advantages and disadvantages to be suitable for use in physics learning in high school.



In the aspect of assessment that discusses the suitability of the content in accordance with competency standards, basic competencies and indicators are only for lecturers and teachers. In this case, it can be seen from the interpretation of the scores that both received 100% rating (very good). It can be concluded that the miniature model of the

Magnetic Levitationini Train is in accordance with existing competency standards and basic competencies.

In the assessment aspect that discusses the appropriateness of the concept of understanding magnetic induction and magnetic force in the miniature model Magnetic Trainitation gets 100% assessment from lecturers and teachers and 90% from students. So that this aspect gets a very good rating. In the assessment aspect which discusses the media on the use of miniature Magnetic Levitation Train models in physics learning, more than 90% is obtained from teachers and students. While the assessment rate from the lecturers is 88%. So that this aspect gets a very good rating. In the design aspect of the Miniature Model of the Magnetic Levitation Train, an assessment of more than 90% is obtained from teachers and students. While the assessment rate from the lecturers is 88%. So this aspect gets a very good rating.

4. CONCLUSION

This research develops the making of a miniature model of the Magnetic Levitation Train. In the physics learning process the miniature model of the Magnetic Levitation Train can be used by the teacher as a learning medium to help improve students' knowledge and scientific thinking abilities, especially in magnetic force material. Based on the data obtained from the results of the study and based on the formulation of the problem made, conclusions can be drawn including: 1. Making a miniature model of the Magnetic Levitation Train fulfilling the requirements including being relevant to competency standards, basic competencies in SBC and indicators.

2. Miniature Model Magnetic Levitation Train qualifies as a very appropriate learning media for application material from magnetic induction and magnetic force.

3. With a miniature model of the Magnetic Levitation Train makes it easy for students to observe the process of the concept of magnetic induction and magnetic force.

4. According to the opinion of Experts (Lecturers and Teachers), the miniature model of the Magnetic Levitation Train has conformity with aspects of the assessment of content standards, media, accuracy of concepts and design, which gets very good ratings.

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