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Development of learning media for motorcycle battery charging systems for students of Vocational School

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Abstract— This study aims to design a learning medium for a motorcycle battery charging system in class XII Motorcycle Engineering students. Especially in the subject of motorcycle electrical engineering at the Lhokseumawe Beringin Private Vocational School. This learning media is expected to make it easier for students to understand the material taught by the teacher. The research conducted is a type of research and development or Research and Development (R&D) using the ADDIE (Analysis, Design, Development and Implementation, Evaluation) method. The method of data collection is done by means of observation, documentation, and questionnaires. The results of the feasibility test of praga tools that have been tested and validated for material experts are with a decent predicate. Furthermore, the media expert a decent predicate. It can be concluded that the teaching aids are very suitable for learning media in the subject of motorcycle battery charging systems so that they are suitable for use as effective and efficient learning media in schools.

Keywords— Learning media design, Motorcycle battery charging system.

INTRODUCTION

Education is a process oftraining and teaching, especially for children and youth, both in schools and on campuses, with the aim of providing knowledge and developing skills. In the Indonesian National Education Law No. 20 of 2003 states that: National Education aims to develop a generation of students to become human beings who believe and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent and intelligent [7] [20] [21].

According curriculum management and teaching programs. The most important thing and implementation of education management or school management (NMS) is the management of the components of the school itself. The components of SBM are the same as the scope of Education Management as revealed by several sources above. The components of education management include (l) curriculum management; (2) student management; (3) personnel management; (4) management of educational facilities; (5) school administration management; (6) financial management; (7) school organization; (8) school relations with the community (PR). In accordance with the research focus and based on the conclusions mentioned above, it is clear that student management, curriculum management, personnel management,

Herein after referred to as this school facility upholds the effectiveness of teaching and learning in schools so its procurement is very important. Acilities and infrastructure are all movable and immovable objects needed to support the implementation of teaching and learning activities, both directly and indirectly. Adequate learning facilities, fluency in learning activities will be realized". In the SISDIKNAS Law No. 20 of 2003 Chapter XII concerning Education Facilities and Infrastructure, article 45 also discusses the importance of providing facilities and infrastructure in every unit of formal and non-formal education.

Based on the results of observations of researchers at the Karya Beringin Private Vocational School, it shows that learning the motorcycle battery charging system for automotive engineering at the Karya Beringin Private Vocational School still does not use teaching aids. Student learning outcomes also have not shown the expected knowledge achievement and still have difficulties in learning the material because learning media does not yet exist. Educators still use sub-learning which is still less detailed when explaining, this is evidenced by demonstration learning from teachers without teaching aids, there are still many students who do not understand the concept of a filling system properly.

Based on the above observations, the demonstration that needs to be made is a simple, communicative, interesting display that can cover all aspects of competence in identifying and assembling a battery charging system on a motorcycle. So it is necessary to do research entitled designing a motorcycle battery charging system as a learning medium in the subject of motorcycle electrical engineering at the private vocational high school by banyan. To be a useful teaching aid for students, especially for schools.

Based on the background above, the formulation of the problem which is the subject of discussion in this study is:

1. How to design and assemble learning media for motorcycle battery charging systems As in the subject of motorcycle electrical engineering at Karya Beringin Private Vocational School?
2. How is the feasibility of a motorcycle battery charging system as a learning medium in the subject of motorcycle electrical engineering at SMK Karya Beringin SMK?

I. EASE OF USE

A. Definition of design

[19] reveals in his book entitled "system design analysis" that design is the process of developing new specifications based on recommendations from system analysis results. [16] [17] reveals that design is a process for defining something to be done using a variety of techniques and it involves a detailed description of the architecture of the components and also the limitations that will be experienced in the process. Based on some of the opinions above, it can be concluded that design is a process of integrating components with design stages to process information that can solve problems using various techniques based on recommendations from system analysis results [5] [6].

B. Learning media

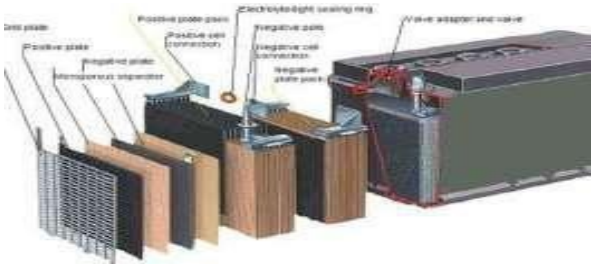
Sadiman [4]. Media can also be interpreted as all tools and materials used both physically and technically in the learning process that can help teachers to facilitate the delivery of subject matter to students so as to facilitate the achievement of learning objectives that have been formulated (Tofano, 2018: 105). Furthermore, [18] [8] [9] defines media in a narrow sense as a component of tool material in the learning system that is used to achieve certain learning goals.

Learning media has a very important role in the teaching and learning process. [18], mentions the benefits and functions of learning media as follows.

1. Changing the focus of formal education, which means using learning media that was previously abstract to become concrete. Learning that was previously theoretical becomes practical functional.
2. Generating learning motivation, in this case the media becomes extrinsic motivation for learning, because the use of learning media becomes more interesting and focuses learning attention.
3. Provide clarity so that knowledge and learning experiences can be clearer and easier to understand, so the media can clarify this.
4. Providing learning stimulation, especially curiosity needs to be stimulated so that curiosity always arises which must be fulfilled through the provision of media.

*C. **Battery***

Battery is a chemical process of electricity, where when charging the electrical energy is converted into chemical energy and when discharging chemical energy is converted into electrical energy. Furthermore, [1] [2] [3] said the battery is a storage of electric power generated by the charging system, electrical energy is converted into chemical energy. The battery also functions as a temporary provider of electricity (in the form of AC voltage) needed by motorcycle electrical systems, supported by a charging system. Another opinion conveyed by [9] [10] [11] said that the battery functions as a DC type voltage source. Motorcycle batteries can be classified into two types, namely batteries that require the addition of distilled water and those that do not.



Figures112 volt battery components

[5] The motorcycle charging system is an electrical system that functions to supply electrical energy to recharge and maintain the electrical condition of the battery so that it remains stable. Furthermore, it shows that the battery capacity is very limited, so it will not be able to supply electricity continuously. The battery must always be fully charged so that it can supply electricity at any time required by the electrical system on the motorcycle, namely the lighting and starter system. For this reason, motorbikes need a charging system that produces electricity to recharge the battery while at the same time supporting battery performance to supply electricity needs.

Distribute the component names and functions of the filling system components as follows When the engine is

off; The battery will supply electricity to accessories and signals such as neutral lights, brake lights, turn signal lights, horns and others.

a) When the engine starts; The battery function is to provide electrical energy to rotate the starter motor and ignition system during start.

b) When the engine is running; When the electric power generated by the generator is higher than that required by the electrical components, the battery stores the electricity it receives from the generator.

1) Regulator rectifier or Kiprok

[13], said that the rectifier regulator or commonly called kiprok, is a series of electronic components, the main function of the rectifier regulator is to rectify the alternating current produced by the alternator into direct current. In a motorcycle charging system, the rectifier also functions as a regulator or limiter (regulator) of the charging current and voltage that goes into the battery or into the lights when the battery voltage is full or at high speed.

There are many types of rectifiers used in motorcycle charging systems, including: 1) silicone rectifiers; 2) silicon regulators; 3) selenium rectifiers; and 4) rectifier regulators. The 4-terminal rectifier regulator is a type of rectifier that has recently been popularly used in motorcycle charging and lighting systems. The process of rectifying AC to DC electric current on a motorcycle can be divided into three phases, namely: (1) half-wave (half-weve) rectifier. ; (2) full wave rectifier (full wave); and (3) 3 phase rectifiers.

Figures2SH707A Rectifier Regulators

2) *Electrolytic capacitor*(elko)

Figures3Figure 2.3 Electrolytic Capacitor 2200 micro

[5] electrolytic capacitors are also known as elko capacitors (electrolyte capacitors) which are the type of capacitor that is widely used and generally in the form of a tube. In the installation must be careful because it has a polarity (+) and polarity (-). If it is reversed in the installation, the consequences are very fatal because the capacitor can explode. Later the capacity is also usually of great value. The greater the value of the capacity, the greater the explosive power if something goes wrong in the installation of the polarity terminal of the capacitor. The capacity of electrolytic capacitors or elko can be in the range of 0.47 uF to units of Farad [4]. The insulating material consists of a liquid electrolyte to store electrical energy which is then wrapped again with aluminum.

3) *Diode*

Figures46A diode

A diode is a two-electrode device in a certain current direction. Diodes can work as conductors and can work as insulators[12] [13] [14] . Furthermore, [23] said that the diode is used as a rectifier of electric current because of its nature that electric current can only flow in one direction. In the opposite direction electric current cannot flow. The diode regulator is used as a voltage regulator.

4) *SOLDER/STAIN*

Soldering is a joining process between two or more metals by using heat to melt additional materials as a connector. And the plate material that is connected does not melt. In terms of the use of heat, the soldering process is divided into two groups, namely soft solder and hard solder. The use of solder from various types of materials, usually focuses on the density of the connection, not on the strength of the connection, especially on soft solder. In carrying out this soldering process, a flux is needed which functions to clean the material as well as an integrating and protective element for a soldering process to occur [22].

5) *Transformers/transformers*

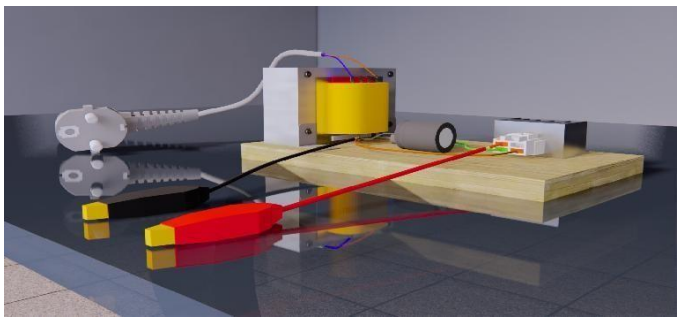
[1] says that a transformer is a tool used to transform voltages, namely increasing the voltage (step up

transformer) and lowering the voltage (stop down transformer). The apparent power (kVA) of the distributed transformer ranges from 5 to 1600 KVA, while the apparent power (KVA) above 1600 KVA is classified as a power transformer. Transformers are divided into several types, including: single-phase, two-phase, and three-phase transformers.

Figures5Travo/ Transformer (5 A cd 0-12 V)

BATTERY CHARGING DESIGN

The form of a series of teaching aids that the researcher will carry out is a combination of several electronic components related to motorcycle electricity to make teaching aids for Karya Beringin Private Vocational High School students as a form of researchers' efforts to carry out the research process at the school as a supporting medium in carrying out the research process. using the flowchart as follows.



METHODOLOGY

The research conducted is a type of research and development or Research and Development (R&D). This method aims to produce a product and test the feasibility of the product. The product developed is a learning medium for charging motorcycle batteries in motorcycle electrical subjects (PKSM). This learning media development model uses ADDIE (Analysis, Design, Development and Implementation, Evaluation) which was adapted from [15].

The learning media that will be made is a form of teaching aid that applies a model (trainer) composed of several tool components that are put together following the standards imposed in schools and in the workshops of Karya Beringin Lhokseumawe Private Vocational School. It is intended that the learning media that will be made into one of the tools of media practice in the Motorcycle Engineering School (TSM) Beringin Lhokseumawe Private Vocational School. The media that will be designed is a battery charging system (charging) utilizing electrical energy in terms of strengthening the electric storage power in a motor battery that lacks power.

Feasibility Test for Material Experts and Media Experts

The feasibility of the instrument for interactive learning media charging motorcycle batteries as a learning medium for material experts contains the suitability of learning media in terms of material aspects, learning design, and benefits. The feasibility instrument for interactive learning media charging motorcycle batteries as a learning medium for media experts contains the suitability of learning media in terms of visual communication aspects, media suitability and benefits.

The learning media development data referred to are data in the form of criticism and suggestions for product improvement obtained from media experts, material experts and students. then used as input to make product revisions.

Questionnaire is a data collection method that is carried out by giving a set of written questions to respondents to respond according to usage requests. The questionnaire was used by researchers to obtain data regarding needs analysis, validation results from material experts, teaching aids media experts, and response questionnaires (teachers and students), then this data was used to determine the feasibility of the product developed by the researcher. The final product of data collection through questionnaires is generally in the form of numbers, tables, statistical analysis and descriptions and conclusions of research results.

Documentation comes from the word document, which means written things. In carrying out the documentation method, researchers investigate written objects such as books, magazines, documents, regulations, meeting minutes, diaries.

table1Analysis of the calculation of the data of material

No	Component name	Measuring instrument	Prisoner	Score	Information
1	*Transformo r*/transformer	Multitester	Ohm	2 Amperes	It works
2	Elko / electrolytic capacitors	Multitester	Ohm	03.5	It works
3	*Diode*	Multitester	Ohm	03.9	It works
4	*Regulators*	Multitester	Ohm	03.7	It works

5	Battery clamp	Multitester	Ohm	0.06	It works
6	Switch	Multitester	Ohm	2 Amperes	It works
7	*input plug* 220 volts	Multitester	amperes	2 Amperes	It works

C. Learning media development data

No	Assumption data	Average score (points)	category
1	Material expert validation feasibility	point	Very worth it
2	Media expert validation feasibility	point	Very worth it

D.Instrument Reliability

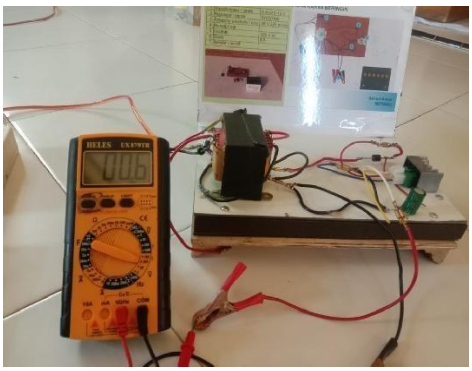
The instrument has an adequate level of reliability if the instrument is used to measure aspects that are measured several times and the results are the same or relatively the same.

Reliability Coefficient	Reliability Level
0.800 – 1.000	Very high
0.600 – 0.799	Tall
0.400 – 0.599	Enough
0.200 – 0.399	Low
Less than 0.200	Very low

FINDING AND DISCUSSION

Design

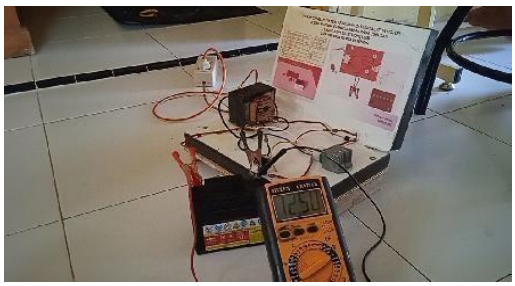
In the teaching aid design stage, there are 4 core stages that are carried out to make the teaching aid work as expected. These stages include preparation, assembly of components, testing and writing conclusions.



Figures6Props Out-Put Results per second

Figures712 volt battery initial check

Figures930 Minute Test



Figures8Battery Full Test 73 Min

table2Material expert validation value I

Criteria	**Total value question n**	**Highest value (Ni)**	**Number of percent indicator value (Y)**
Feasibility of the content of the material	**38**	**40**	**95%**
Feasibility of presentation of the material	**12**	**12**	**100%**
Media benefits	**22**	**24**	**91.6%**

The total number of validation results	**72**	**76**	**94.73%**

table3Material expert validation value II

Criteria	Total value question (JN)	Highest value (Ni)	Amount percent value indicator (Y)
Feasibility of the content of the material	38	40	95%
Feasibility of presentation of the material	11	12	91.6%
Media benefits	24	24	100%
The total number of validation results	73	76	96052

table4Media expert validation value I

Criteria	Total value Indicator (JN)	Score highest (Ni)	Total percent value of the indicator
Props media feasibility	20	20	100%
Aesthetic aspects	23	24	95.83%
Benefit	15	16	93.75%
Amount	58	60	96.6%

table5Media expert validation value II

Criteria	Amount Indicator value (JN)	The highest i value (Ni)	Amount percent indicator value
Appropriateness medi a props	**20**	**20**	**100%**
Aesthetic aspects	**22**	**24**	**91.6%**
Benefit	**16**	**16**	**100%**
Amount	**58**	**60**	**96.6%**

Criteria Aspects of learning media.

In the aspect of learning media, there are 3 (three) questions in the questionnaire's and the appropriate answers that have been provided in the questionnaire, among others, are not appropriate, not appropriate, researcher, and very appropriate. Students were asked to fill out questionnaires with the aim of getting results regarding teaching aids as well as students' knowledge and understanding in learning by using motorcycle battery charging system media

The results show that;

1. The highest score on the criteria for the learning media aspect shows that it is very appropriate to what is expected on each of the indicators/questions having a score on question 1 = 64%, on question 2 = 64% and on question 3 = 68 %
2. The lowest value on the criteria of the learning media aspect shows that it is not suitable for the question 1 = 0%
3. So, it can be concluded that students can easily understand aspects of the electrical system learning media on motorcycle battery charging. Most of them stated that in the aspect of learning media, they stated that they were very suitable in learning.

Argonomic aspects

In the argonomic aspect, there are 4 (four) questions in the questionnaire's and the appropriate answers that already exist in the questionnaire include, not appropriate, not appropriate, appropriate, and very appropriate researchers. Students are asked to fill out a questionnaire with the aim of getting results from the ease of moving the components of the teaching aids and understanding the symbols in the teaching aids as well as the consequences of the frequent use of learning media for the motorcycle battery charging system

So, the results shown in the agronomic aspect diagram above are

1. Questions 1,2, and 4, in the diagram above, students are more dominant in choosing answers after having a value of 78%, less appropriate answers have a value of 78% and very appropriate answers have a value of 68%.
2. while in question 3 dominant students prefer less appropriate answers have a value of 71% and 28% of students choose appropriate answers

3. The lowest score from the diagram above shows that the student did not choose an inappropriate answer at all so that it has a value of 0%.
4. The conclusion from the diagram above shows that, most students understand and understand the procedures for both moving and replacing teaching aids components, as well as the advantages and disadvantages that have been explained by the researcher along with the questions provided by the researcher to the questionnaire .

Aesthetic aspects

In the aesthetic aspect, there are 3 (three) questions in the researcher's questionnaire and the appropriate answers that already exist in the questionnaire pool include, inappropriate, less appropriate, appropriate, and very appropriate. Students were asked to fill out a questionnaire with the aim of assessing the appearance and interest of students in learning media in learning and using teaching aids for charging motorcycle batteries. So, the results that show the aesthetic aspect diagram above are

1. The highest value of the aesthetic diagram is that it is very appropriate to question 1 = 72%, question 2 = 60 % and question 3 = 68 %.
2. The lowest value of the aesthetic diagram is that it is not appropriate, and it is not appropriate, the student does not choose the two answers at all so that it has a value of 0%.
3. Meanwhile, according to the value each student chooses question 1 = 28% question 2 = 40% question 3 = 32%.
4. The conclusion from the diagram above shows that, most students are very interested and like the appearance of the props because of the instructions and symbols the symbols on the props are easy to understand.

K3 aspect (occupational safety and health)

In the K3 aspect, there are 2 (two) questions in the questionnaire's as well as the appropriate answers that already exist in the questionnaire pool, namely, not appropriate, not appropriate, researcher, and very appropriate. Students are asked to fill out a questionnaire with the aim of seeing media safety and safety when using teaching aids.

1. The highest score from the K3 diagram (occupational safety and health) is very suitable for question 1 = 68% and question 2 = 72%.
2. The lowest score from the K3 diagram (occupational safety and health) is that it is not suitable, and it is
1. Furthermore, the dominant 2nd value of the 4 questionnaire aspects that the researcher did indicate the "appropriate" value. With the sum (22.6%), (26%), (0%), (0%) with the total value (36.975%).
2. The next 3rd value of the 4 questionnaire aspects that the researcher did shows the value of "not appropriate." With the sum (5.33%), (26%), (0%), (0%) with the total value (7.8325%).
3. The next 4th value of the 4 questionnaire aspects that the researcher did shows the value "Not appropriate." With the sum (6.66%), (0%), (0%), (0%) with the total value (1.665%)

CONCLUSIONS AND RECOMMENDATIONS

motivationAfter designing, testing and analyzing, the results of testing the tool can be concluded that the motorcycle battery charging system is functioning properly. With the advantages and disadvantages that have been known.

1. In testing teaching aids, students fully support teaching aids for school practical teaching materials, as well as the feasibility of teaching aids that have been tested in schools very satisfactorily, 84% of students are safe when using teaching aids
2. The results of the analysis of students' conceptual understanding tests using the questionnaire scores in the class obtained a value of 53.46% with very satisfying results using the praga tool 85% of students very easily understood learning by practice

No	Aspect development criteria	Sang at sesu ai	Corresponding	Not suitable	Inappropriate	Results %
1	Aspect media learning	65.3 %	22.6 %	5.33%	6.66%	99.9 %
2	Poor argonomics	12 %	62 %	26 %	0 %	100 %
3	Aesthetic aspects	66.6 %	33.3 %	0 %	0 %	99.9 %
4	K3 Aspect	70 %	30 %	0 %	0 %	100 %
	Amount flat-Flat	53.475 %	36,975 %	7.832%	1.665%	99.9%

3. The results of the response questionnaire analysis showed that the student responses strongly agreed with the application of learning by using motorcycle battery charging aids in the learning process. The data shows that learning models using teaching aids can improve students' understanding of electricity by using teaching aids for charging motorcycle batteries

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