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DEVELOPMENT OF MEDIA TRAINER KIT CHARGING SYSTEM TO IMPROVE EFFECTIVENESS AUTOMOTIVE ELECTRICAL PRACTICES

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ABSTRACT

The research aims to find out; (1) The process of developing a media trainer kit charging system; (2) The feasibility of the developed media trainer kit charging system; and (3) The effectiveness of the developed media trainer kit charging system. This type of research is a research development using the 4-D model. The research subjects consisted of 20 students, while the object of research was the media trainer kit charging system. Data collection uses observation, questionnaires, and tests. Data were analyzed with descriptive (qualitative and quantitative) and inferential gain test statistics. The results showed that: (1) The process of developing a media trainer kit charging system with a 4-D includes 4 stages, namely define, design, develop, and disseminate; (2) The feasibility test of the media trainer kit charging system by the material expert is 82.5% categorized very good; by the media expert is 81.67% categorized very good; by course lecturer is 72.5% categorized good; by limited trial is 81.25% categorized very good; and extensive trial is 84.62% categorized very good; and (3) The results of the effectiveness test showed that the media trainer kit charging system developed was effectively used in lectures.

Keywords: *media trainer kit, charging system, automotive electrical*

INTRODUCTION

The practice of automotive electrical is the main course for students of Mechanical Engineering Education, especially automotive concentrations at Universitas Sarjanawiyata Tamansiswa (UST) Yogyakarta. This practical course consists of each meeting held for 2 x 170 minutes in the workshop. In the practice of automotive electrical, the material to be discussed is regarding electrical devices on four-wheeled vehicles.

In automotive electrical lectures, the majority of students consider this subject very difficult. Unlike the other automotive learning in the chassis and engine parts, automotive electrical is an invisible item but can be felt (Ardiyanto 2016). This often becomes a fear for students because students still cannot capture the abstract description of electricity to be understood. The indicator that can be felt that students experience obstacles in the practice of automotive electrical is the low practicum with details above C as much as 46% and the remainder is below C.

Efforts that can be made to overcome these problems are to improve the learning process, especially learning media (Balakrishnan and Gan 2016). With the learning media, student learning outcomes can improve (Handoyono and Hadi 2018). Learning media is very suitable for use in lectures that are practical as a vehicle for teaching aids (trainer kit). Learning media can carry messages or information that are instructional in purpose or contain teaching purposes (Hobbs and Jensen 2009). The proverb says I hear I forget, I see I know, I do I understand. Acquisition of learning outcomes through the sense of sight around 75%, through the senses of hearing around 13%, and through the other senses around 12% (Azhar 2011). Based on this statement it can be concluded that the presence of a media trainer kit can help success in the process of automotive electrical practice.

In some automotive electrical practice competencies, the least competent student is in the charging system section. The level of understanding of students in the charging system has not been fully mastered, even though the charging system is an electrical system that is very important in a vehicle that functions to recharge the batteries and at the same time as a source of electricity (Perreault and Caliskan 2004). The obstacle faced by the majority of students is the difficulty in measuring voltage and charging currents.

Actually, the media trainer kit for the charging system is available, but it is not suitable to be used. This is indicated by the unavailability of a voltmeter to measure the charging gap and ampere meter which is not in accordance with the specifications of the output current of the charging system, so that the measuring instrument is unable to measure the current accurately. In the practice test, many obstacles were encountered when the media trainer kit charging system was assembled, many

sockets were already loose so the cables could be disconnected by themselves.

A lecturer must consider the quality of the media, not just use it (Smaldino, Lowther, and Mims 2015). Media criteria must be practical, flexible, and last long, meaning that media must be practical and made of something that is available and easily found, then it can be brought or moved anywhere (Mahnun 2012). The development of a media trainer kit is an effort to improve the quality of learning in the hope that it can help solve problems faced by students. The media trainer kit charging system that will be developed is analyzed based on the weaknesses of the previous media trainer kit.

Media Trainer Kit

Media is defined as middle, intermediary, or introduction (Azhar 2011). The media is an intermediary tool in communication. Demonstration media can help lectures to achieve learning goals more effectively and efficiently (Sudjana 2009). Media in this context is the media trainer kit as a vehicle charging system simulation tool. Media trainer kits can provide responses and encourage students to do the right practices (Purnawan 2017).

In addition to achieving effective and efficient learning goals, the media also functions to: (1) clarify the message so it is not too verbal; (2) overcoming limitations of space, time, energy, and senses; (3) generate enthusiasm for learning, direct interaction between students and learning resources; (4) enables students to learn independently according to their talents and visual, auditory, and kinesthetic abilities; and (5) giving the same stimulus, comparing experiences, and giving rise to the same perception (Sadiman et al. 2011).

The media trainer kit consists of several categories, namely drawings, sketches, projected images with projectors, diagrams, charts, original objects, specimens, mock-ups, dioramas, exhibitions (Juwairiyah 2013). The media trainer kit that will be developed in the form of a model is a simplification of the vehicle charging system, then it will be packaged as a simulation tool. With the media trainer kit developed, students can see and observe lecture material in the form of objects that were not previously described.

Charging System

The charging system is a system on the vehicle that functions to charge the battery when the engine is running so that the battery voltage remains at the full condition and does not drop when used (Bosch 2008). In the charging system, the most important component is the generator with the working principle of movement that cuts the lines of the magnetic field to generate electrical energy. Generators are often also referred to as alternators. The current produced by the alternator is in the form of AC, while the battery is in the form of DC, therefore in the charging system there is a diode which serves to rectify the AC current into a DC current. The charging system is one of the electrical

energy charging systems by using a regulator to regulate the charging voltage to the battery (Emadi 2017). The charging voltage regulated by the regulator is 13.8 to 14.8 V.

METHOD

Research using the Research and Development (R&D) method with a 4-D model consisting of stages: (1) define; (2) design; (3) develop; and (4) disseminate (Thiagarajan, Semmel, and Semmel 2016).

The research subjects were Mechanical Engineering Education students consisting of 20 students. The object of research is the media trainer kit charging system.

Data collection techniques using observation, questionnaires, and tests. Observation is used to determine the needs of the developed media trainer kit charging system. The questionnaire contained an assessment of the feasibility of a media trainer kit charging system by media expert, material expert, course lecturer, and students as users. For limited trial using 10 students and extensive trial using 20 students. The test is used to determine the effectiveness of the media trainer kit charging system developed in learning.

Data were analyzed using qualitative descriptive and quantitative descriptive. Qualitative data in the form of descriptive obtained from the results of validation by experts, the results obtained are used as a reference for product revision. Quantitative data is obtained from changing qualitative data using a Likert scale with a scale of 4 (excellent), 3 (good), 2 (enough), and 1 (less). Next, calculate the percentage of eligibility by using the formula:

$$\% = \frac{\text{observed score}}{\text{expected score}} \text{ x } 100\%$$

The percentage of feasibility is calculated by referring to table 1 to determine the feasibility category of the resulting media trainer kit charging system. The minimum feasibility category is a minimum of "Good"

Table 1. Percentage Scale and Categories

Percentage of Achievement	Categories
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Enough
21 – 40%	Less
0 – 20%	Very Less

Media trainer kit charging system developed effectively used viewed from the learning outcomes which include improving learning outcomes using the gain test formula as follows:

$$\text{N gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Ideal Skor} - \text{Pretest Score}}$$

Based on the calculation of N-gain obtained then use table 2 to determine its category. To fulfill the category of increasing learning outcomes, it must reach at least in the medium category.

Table 2. Distribution of Gain Scores

Nilai N-gain	Kategori
g > 0,7	High
0,3 < g < 0,7	Medium
g < 0,3	Low

RESULTS AND DISCUSSION

Define Stage

At this stage consists of 5 steps, namely: 1) initial and final analysis; 2) student

analysis; 3) task analysis; 4) concept analysis; and 5) specification of learning objectives.

The initial and final analysis is done by observing and interviewing the lecturer of automotive electrical practice subjects. In this analysis, problems were found during the learning process, especially in charging system competencies, lecturers using media trainer kits are not suitable to be used. This is indicated by the unavailability of a voltmeter to measure the charging gap and an ampere meter that is not in accordance with the current specifications of the charging system so that the measuring instrument is unable to measure the current accurately. In practice tests, many problems were encountered when the media trainer kit charging system was assembled with many sockets that were loose so that the cables could be disconnected by themselves. With this result, it can be considered to develop a media trainer kit charging system that can be used in automotive electrical practices.

In the analysis students obtained the results that automotive electricity is an item that is not visible but can be felt. This is often a problem for students because they cannot yet imagine an abstract picture of electricity in the mind. The availability of the media trainer kit charging system should make it easier for students to clarify the abstract picture, however, the media trainer kit charging system that is owned by the Mechanical Engineering Education Study Program is not feasible to use, so it inhibits student practice. The problems faced by students in the implementation of automotive electrical practices are almost the same as those expressed by the lecturer, many sockets are already loose so that the cables can be disconnected by themselves, as well as measuring devices that are not appropriate. This is the basis for the consideration of the need to develop a media trainer kit charging system that can be used properly at the practicum.

The charging system media trainer kit can be used as teaching material related to the charging system, so students can practice automotive electricity independently. With this in mind, some of the automotive electrical competencies developed are charging systems because students are the least competent in the charging system section.

Based on the analysis of the concept, the specifications of the learning objectives to be achieved in the development of the media trainer kit charging system are students understanding: 1) the charging system; 2) charging system components as well as the workings of the charging system series; and 3) how to check and measure the charging system.

Design Stage

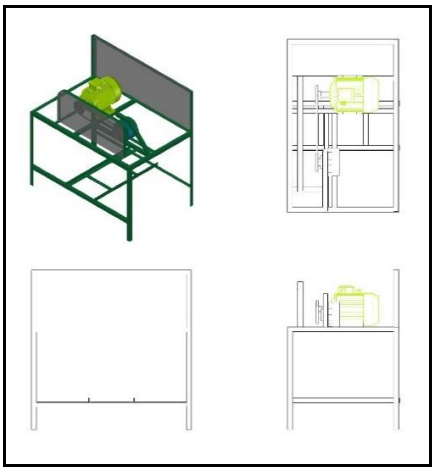
At this stage, the steps are: 1) instrument preparation; 2) media selection; and 3) format selection.

The preparation of the instrument is a questionnaire to test the feasibility of experts,

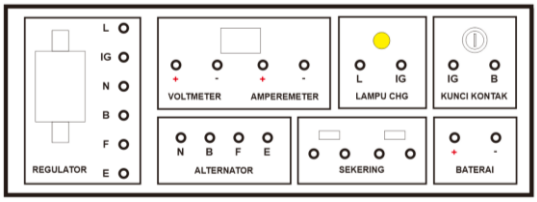
including material experts and media experts. Aside from the experts, in the development of a trainer media kit charging system, a feasibility test will also be conducted by the lecturer and students for limited trial and extensive trial as revision input. The feasibility test aspects for media experts include material, cohesiveness, simplicity, form, and material. The feasibility test aspects for material expert and lecturer include the compatibility of the media with the material, the ease of students in studying the material, the time efficiency of arranging the media trainer kit path, the clarity of the material images in the media trainer kit, and the suitability of the media trainer kit to achieve the expected goals. Student responses as limited trial and extensive trial include understanding the material in the media trainer kit, the layout of the images in the media trainer kit, the effect of the media trainer kit on learning outcomes, the effect of the shape of the media trainer kit in the clarity of the material, and the clarity of the material images in the media trainer kit.

Media selection is done by mapping the material in accordance with the aspects listed in the preparation of instruments for experts, lecturer, and students. In addition, the selected learning media is in accordance with the needs of lecturers, namely improving learning media that are no longer suitable for use. In this case the developed media is a trainer kit as a charging system simulator on the car.

The choice of learning media format developed was in the form of a trainer kit. This is due to the consideration to improve the simulator of charging systems in cars owned by the Mechanical Engineering Education Study Program. This media trainer kit can support the achievement of student competencies, namely: 1) Understanding the charging system; 2) Understand the charging system components and the workings of the charging system series; and 3) Understand how to check and measure the charging system. The initial concept description was designed using AutoCAD and CorelDraw software which is divided into two parts, namely the design of the frame and the electrical panel which can be seen as follows:



Picture 1. Media Trainer Kit Charging System Frame



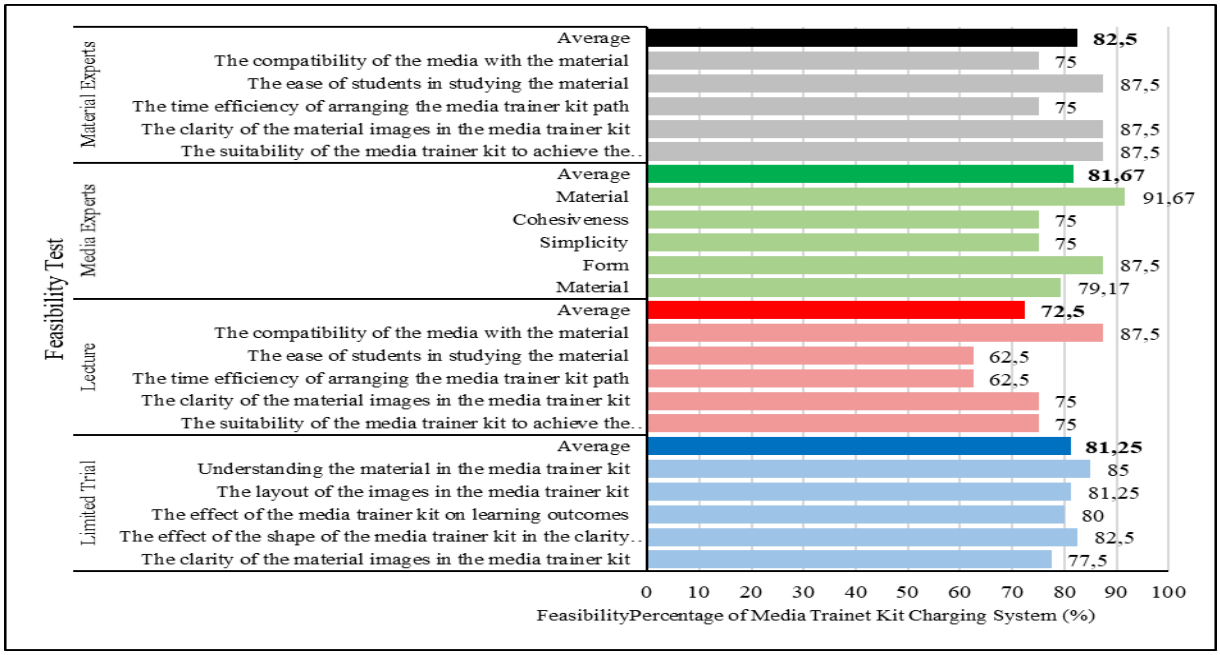
Picture 2. Media Trainer Kit Charging System Panel

Design Stage

The development phase is revising the media trainer kit after getting suggestions from the material expert, media expert, lecturer, and limited trial. First, the suggestions from a material expert are to provide wiring diagrams of the charging system in accordance with the media trainer kit and the additional load on the media charging trainer kit. Secondly, suggestions from a media expert are to strengthen the panel board in the media system trainer kit and the need for a switch for an electric motor. Third, input from a lecturer is the need to add a job sheet that fits the charging system media trainer kit. Fourth, the suggestions from the limited trial are that the plugs in the media trainer kit hole and on the banana jack are not suitable so that they cannot be installed correctly and are loose. Some of these suggestions were then revised by the media trainer kit system by providing job sheets which included wiring diagrams, adding light as load and electric motor switch, and sorting banana plugs and jacks that were sized so they could be installed correctly and tightly. The final product of the developed media trainer kit charging system can be seen as follows:

Picture 3. Final Product Media Trainer Kit Charging System

Retrieval of the data of the feasibility test of the media trainer kit charging system was carried out using a questionnaire instrument. The results of the feasibility test can be seen as follows:



Picture 4. Feasibility Test Results for Media Trainer Kit Charging System by Material Expert, Media Expert, Lecturer, and Limited Trial

The average assessment of the feasibility test of the media trainer kit charging system by material expert is 82.5% categorized very good with details, namely: 1) the aspect of compatibility of the media trainer kit with the material is 75% categorized good; 2) the aspect of ease of students in studying the material is 87,5% categorized is very good; 3) the aspect of the time efficiency of arranging the media trainer kit path is 75% categorized is good; 4) the aspect of the clarity of the material images in the media trainer kit is 87,5% categorized is very good; and 5) the aspect of the suitability of the media trainer kit to achieve the expected goals is 87,5% categorized very good.

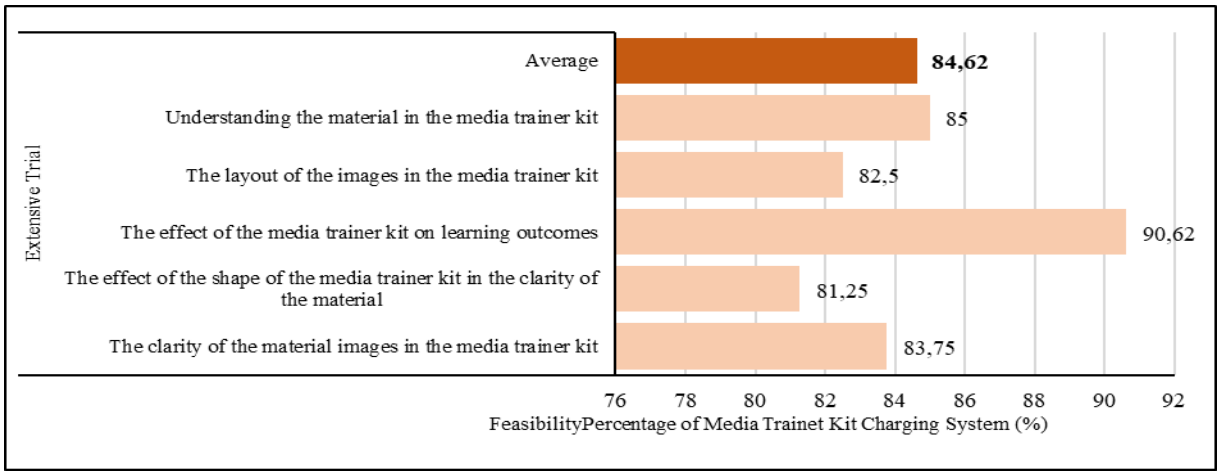
The average assessment of the feasibility test of the media trainer kit charging system by media expert is 81,67% categorized very good with details, namely: 1) the aspect of material is 91,67% categorized very good; 2) the aspect of cohesiveness is 75% categorized very good; 3) the aspect of simplicity is 75% categorized good; 4) the aspect of form is 87,5% categorized very good; and 5) the aspect of material is 79,17% categorized very good.

The average assessment of the feasibility test of the media trainer kit charging system by lecture is 72,5% categorized good with details, namely: 1) the aspect of compatibility of the media trainer kit with the material is 87,5% categorized very good; 2) the aspect of ease of students in studying the material is 62,5% categorized is good; 3) the aspect of the time efficiency of arranging the media trainer kit path is 62,5% categorized is good; 4) the aspect of the clarity of the material images in the media trainer kit is 75% categorized is good; and 5) the aspect of the suitability of the media trainer kit to achieve the expected goals is 75% categorized good.

The average assessment of the feasibility test of the media trainer kit charging system by limited trial is 81,25% categorized very good with details, namely: 1) the aspect of understanding the material in the media trainer kit is 85% categorized very good; 2) the aspect of layout of the images in the media trainer kit is 81,25% categorized very good; 3) the aspect of effect of the media trainer kit on learning outcomes is 80% categorized good; 4) the aspect of effect of the shape of the media trainer kit in the clarity of the material is 82,5% categorized very good; and 5) the aspect of clarity of the material images in the media trainer kit is 77,5% categorized good.

Disseminate Stage

At this stage, the distribution of the media trainer kit charging system is carried out through learning as an extensive trial. The extensive trial results can be selected as follows:



Picture 5. Feasibility Test of Media Trainer Kit Charging System by Extensive Trial

The average assessment of the feasibility test of the media trainer kit charging system by extensive trial is 84,62% categorized very good with details, namely: 1) the aspect of understanding the material in the media trainer kit is 85% categorized very good; 2) the aspect of layout of the images in the media trainer kit is 82, 5% categorized very good; 3) the aspect of effect of the media trainer kit on learning outcomes is 90,62% categorized very good; 4) the aspect of effect of the shape of the media trainer kit in the clarity of the material is 81,25% categorized very good; and 5) the aspect of clarity of the material images in the media trainer kit is 83,75% categorized very good.

The effectiveness test of the media trainer kit uses 2 types of data, namely the pretest and posttest. The results of the pretest and posttest can be seen as follows:

Table 3. Pretest and Posttest Score Results

Score	The Number of Students	Min.	Max.	Mean	Standard Deviation
Pretest	20	27	76	51	12,62
Posttest	20	61	88	72,9	7,50

From the results of the pretest and posttest scores, the effectiveness test can be calculated using the gain test with the results of 0.45 including the medium category. These results indicate that the media trainer kit charging system that was developed is effectively used in lectures. By using learning media can improve learning outcomes (Nurtanto et al. 2019). The media trainer kit charging system which is one form of media as a means of delivering learning messages can stimulate students' thoughts, feelings, concerns, and skills so as to encourage the learning process.

The charging system, which was initially difficult for students to understand, is too risky, and too abstract to learn. The selection of media trainer kits as learning media aims to demonstrate that students get concrete descriptions or explanations of material (Mclaughlin et al. 2007) (Smaldino, Lowther, and Mims 2015). With this media trainer kit, it will give students experience in learning

the charging system so that learning objectives can be achieved.

CONCLUSION

The process of developing a media trainer kit charging systems using a 4-D model includes 4 stages, namely define, design, develop, and disseminate. The feasibility test of the media trainer kit charging system by experts gets results worth using. The developed media trainer kit charging system is effectively implemented in automotive electrical practices.

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