

The Development Of 1 Phase Induction Motor Training Kits

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Abstract: The use of instructional media in the Electrical Motor Maintenance and Repair (EMMR) learning process has not been optimal to achieve the stated learning goals. Therefore, it is necessary to develop practical learning media like a training kit. this research develops a 1 phase induction motor training kits that can be used in the learning process. The purpose of this study is to produce a valid and practical 1 phase induction motor training tools for use in the EMMR learning process. The research method used is the Research and Development (R&D) research method. The research phase begins with the needs analysis, product design, product manufacturing, and product testing phases to determine the level of validity and practicality of the product being developed. The validators consisted of instructional media experts, electrical motor experts, and EMMR subject teachers. Product validity is known based on the opinion of the validator (Expert Judgment) of the developed training kits. The practicality of the Training Kits is seen through the opinions of the teacher and students after using the Training Kits in the learning process. The results of the validation conducted by the validator stated that the 1 phase induction motor training kits is valid with a percentage of 89%. Then, the results of practicality by subject teachers and Students get a percentage of 83% with the practical category. It can be concluded that the Instructional media of 1 phase induction motor training kits is valid and practical as a practical learning media in the EMMR learning process for electrical engineering students at basic level.

Index Terms: 1 Phase Induction Motor, Training Kit, Electrical Motor Maintenance and Repair (EMMR).

1. INTRODUCTION

The globalization era, which is marked by quality competition, demands all parties in various fields and development sectors to continuously improve their competence. Quality of Human Resources (HR) has an important role in meeting the demands of national development in various fields, this is closely related to the progress and prosperity of a nation. To make quality human resources start from the field of education, especially the results of its graduates must be able to compete with other nations [1], [2]. Creating quality human resources is not easy if it is not matched with proper education. Education can shape the character and be able to equip students with the skills needed in the world of work. The right type of education for situations like now is education that can equip students with skills, through applicative abilities that can later be applied in the community environment. In Indonesia, educational institutions that aim to print their students to have independent skills and expertise are Vocational High Schools (SMK). As the Minister of National Education Regulation number 22 of 2006 explains that SMK is one of the means of formal education, having the aim of preparing students to become workers who have knowledge, skills, expertise, and finally have work readiness after completing their education [3], [4]. In-Law Number 20 of 2003 concerning National Education System Article 15 explains that vocational education is secondary education that prepares students to work in certain fields. Vocational education is a combination of theory and practice in

a balanced manner with an orientation to the work readiness of its graduates. The curriculum in vocational education focused on learning systems of special skills and vocational training. The advantages of vocational education include that students can directly develop their expertise in accordance with the needs of the field or field of assignment to be faced [3], [5].

To develop the expertise of vocational students requires the use of learning technology. Educational Technology is the application of scientific knowledge about learning and learning conditions to improve the effectiveness and efficiency of teaching and training [6]–[8]. Meanwhile, Education Technology is a study and ethical practice to facilitate learning and improve performance by creating, using, and managing appropriate technological processes and sources. From the explanation from several experts, it can be concluded that educational technology is the application of knowledge regarding learning facilities in the form of learning media in order to increase the effectiveness and efficiency of learning. Learning facilities in the form of innovative learning media [3], [5]. Learning media is a component or a physical vehicle containing instructional material in the student environment that can stimulate students to learn. Learning media aims to facilitate the delivery of messages from the message source to the recipient of the message. The proper use of the media will make the presentation of abstract material more concrete [9], [10]. Especially in the subject of Electrical Motor Maintenance and Repairs (EMMR). Many abstract or imaginative things that are difficult to understand can be presented in a 1 phase motor trainer media. This abstract is interpreted as material that is difficult to understand if presented theoretically, it is necessary to have a 1 phase motor media trainer to further simplify the way students think about EMMR material [11], [12], [13]. EMMR subjects are productive subjects taught in class XI TITL of SMK Negeri 5 Padang. The teaching and learning process in EMMR is supported by 1 phase induction media as the object to be studied. However, learning to use 1 phase induction motor media one of which is a type of water pump that has constraints, namely (1) Having difficulty in disassembling the media, (2) The time needed in learning is longer, (3) Does not describe the principle of motor work in real terms, (4) Existing motor media is not practical in

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operation. This is the background of the 1 phase induction motor trainer media developed [14]–[16]. The media trainer is designed to provide solutions to the weaknesses of the induction motor media used with the intention of facilitating the achievement of learning objectives namely students skilled in caring for and repairing 1 phase electric motors. EMMR subjects are divided into four Basic Competencies (BC), one of which is the dismantling of a coil motor. In this material, change the specifications of 1 phase induction motor and 1 phase induction motor. Before explaining this material, of course, students are required to learn the basic construction and working principles of a 1 phase induction motor to make it easier for students to understand the material about a 1 phase induction motor stretch. 1 phase induction motor media coach can help explain the material stretch motor easily because with media coaches students can know the construction and working principles of a 1 phase induction motor [17], [18]. In addition, media coaches also play a role as a varied learning media because they not only teach construction, work principles, and stretch of 1 phase induction motor media trainers can facilitate students in testing the function of 1 phase induction motors. This can motivate students to learn EMMR subjects and can train students in repairing and repairing damage to 1 phase induction electric motors. Abilities are given by students after learning consists of cognitive abilities (knowledge) and psychomotor (skills). So it has a balance between ability in the field and practice. With a motor trainer, students can learn on their own and the teacher acts as a facilitator during the learning process. Students are also required to be able to analyze all aspects of construction, working principles, stator stretches, and how to check also understand electric motors. Therefore the motor trainer is designed to be interesting so that students are more motivated in electric motors that are difficult to facilitate [14], [19]. The results of observations of the implementation of learning activities of EMMR subjects class XI L2 TITL at SMK Negeri 5 Padang show that learning media that are not yet optimal affect the achievement of learning objectives. The weakness of the media used so far is not directing students to think critically and creatively. In addition, old media is difficult to observe so students find it difficult to understand the material. These weaknesses affect student learning outcomes. These problems require a form of development of learning equipment for electric motors that is valid, practical, and effective, as an effort to improve quality in EMMR subjects. To develop a quality media trainer, of course, have a good standardization in terms of validity, practicality, and effectiveness [20]–[22]. The validity of the media is measured using a questionnaire with the validator is an electric motor expert and a learning media expert. As for the practicality of the media using a questionnaire with respondents being EMMR subject teachers and students. Besides that, the level of effectiveness of the media is measured using an objective test with the respondent being a class XI L2 TITL student at SMK Negeri 5 Padang as a user of a phase motor media trainer. Efforts to improve quality are needed because EMMR subjects require concrete and more varied learning media. Therefore, the 1 phase motor trainer is designed not only to present the motor construction and working principles but also to teach students how to arrange electrical 1 phase electric motors that provide direct learning experiences to students [23], [24]. Direct experience will give the most complete and meaningful impression about the information and ideas contained in that experience".

Responding to the weaknesses of the media above, a single-phase motor media was developed in the EMMR subjects in class XI L2 TITL SMK Negeri 5 Padang. Where in this study, researchers will look for the level of validity, practicality and effectiveness of the 1 phase motor trainer media.

2 METHOD

The type of research used is research and development. Research and Development is a research method used to produce certain products and test the effectiveness of these products [20], [25]. This study developed a 1 phase induction motor training kits to optimize the learning process of class XI L2 students in the Electric Power Engineering expertise program (EPE) in EMMR Subjects at Vocational High School (SMK) in Padang City, West Sumatera Provinces, Indonesia. The study was conducted in class XI L2 EPE. The subject of this research development was a 1 phase induction motor training kits and the respondents were EMMR subject teachers and class XI L2 TITL students in SMK Negeri 5 Padang, totaling 26 people. Research and Development research steps as follows: 1) Needs Analysis, SMK as a reliable HR producer requires infrastructure in the learning process. Means in this case are learning media that guide students in learning. Media is a learning model that is best used in shaping student skills because it provides direct experience and can explain verbal material to be more concrete. This is the problem in this study. The unavailability of instructional media that matches the characteristics of the subjects certainly hinders the achievement of learning objectives. In this stand also the collection of information aimed at knowing the needs of the media in terms of subject characteristics, student characteristics, and the results of discussions with teachers. 2) Design and manufacture of products, after collecting information researchers have identified the weaknesses of the learning media used in SMK in Padang City. Referring to the weaknesses of learning media in this SMK especially for EMMR learning processes, the researchers made a 1 phase induction motor training kits design that refers to the principles of good learning media. In this stage, the researcher has made a 1 phase induction motor training kits. Activities at the product design stage include Planning, Written design, Component Preparation, and Media makes [26], [27]. 3) Product Validation, Product validation is the process of assessing whether the product design in the form of an induction motor training tools will be more effective than the old one or not. The validation instrument was in the form of a questionnaire conducted by 4 experts namely electric motor lecturers and instructional media lecturers besides the EMMR subject teacher at SMK Padang City. 4) Limited Trial, after making product improvements the product is tested. The limited sample in the first try out was class XI L2 TITL student in SMK at Padang City. This trial aims to measure the practicality of the learning media that is being developed. The instrument used in the practicality test was a practicality questionnaire [13], [20], [28].

3 RESULT AND DISCUSSION

Development research conducted aims to produce products in the form of practical learning media in the form of 1 phase induction motor training kits. Trainers developed must meet valid and practical criteria.

3.1 Need Analysis

In educational development research, students are potentials which if maximally managed will have added value. Literature studies state that students at the vocational level are able to think abstractly. Students who are in their teens have in principle be able to analyze and make their own hypotheses. Vocational students are more interested in exploring their own knowledge through the demonstration of tangible objects rather than verbally listening to information. Therefore, the presentation of material using training kits is more interesting for vocational students. The use of real media, models, and replicas triggers students' desire to learn learning material. This factor is a consideration for the design of the training kits to fit the age characteristics of vocational high school students.

3.2 Product Design and Manufacturing

Product design refers to student characteristics, interview results, and potential problem sheets. Product design must be realized in drawings or charts so that it can be used as a guide to assessing and making it [20], [28]. The initial design of a 1 phase induction motor training kits in the form of images is presented in Figure 1.

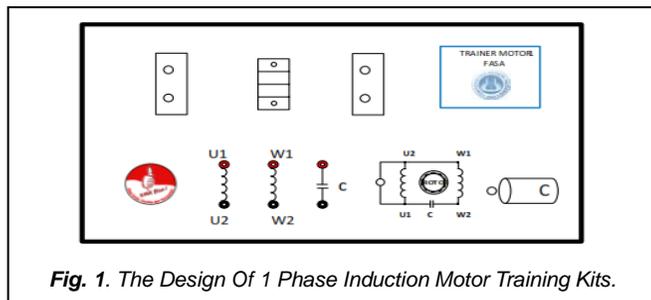


Fig. 1. The Design Of 1 Phase Induction Motor Training Kits.

This initial design was made by utilizing an induction motor (water pump) with a type of capacitor induction motor. Therefore in the terminal design, there are 6 connectors where the U1 - U2 connector is the main coil, W1 - W2 is the auxiliary coil and C which means capacitor. The terminal is designed in such a way as to make it easier for students to assemble electricity in a single-phase induction motor. To improve the trainer, it is equipped with a nameplate as a place of information in the form of basic specifications of a 1 phase induction motor training kits and a single line 1 phase induction motor training kit with a type of run-capacitor motor. This design was made aiming to facilitate the learning process of 1 phase induction motor so that learning objectives can be achieved. The first step is to divide the components of the induction motor into several important parts then arranged on the trainer board. In this study, the induction motor used was a 1 phase induction motor presented in Figure 2.



Fig 2 1 Phase Induction Motor

Making the motor position is based on the results of measurements of the rotor axle length and rotor height to the ground. The position of the rotor is the most difficult part of the manufacturing process because the balance of the rotor inside the stator is influenced by its position. If the position of the rotor is not balanced against the height of the stator, the rotor will not rotate when current flowed. The position of the rotor in this training kit is presented in Figure 3.

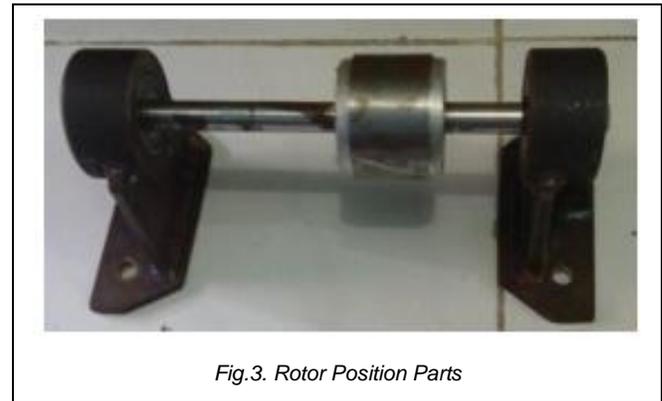


Fig.3. Rotor Position Parts

The next manufacturing step is making the position of the training kit, the position of the training kit is made of wood with an additional iron plate at the bottom. The selection of wood as a holder because the motor load is heavy enough with an iron base to strengthen the position of the media trainer. With a length of ± 43 cm and a width of ± 25 cm. The process of making the training kit's position is carried out from drilling the

TABLE 2
PRACTICALITY TEST RESULT

Respondent	Practicality Score	Practicality Score (%)	Level of Practicality
A	92	76	Quite Practical
B	113	94	Very Practical
C	102	85	Practical
D	100	83	Practical
E	99	82	Practical
F	96	80	Practical
Mean		83	Practical

board, sanding to unifying with the iron plate the activity is carried out in the workshop. The final results of making the trainer as a whole are presented in Figure 4.

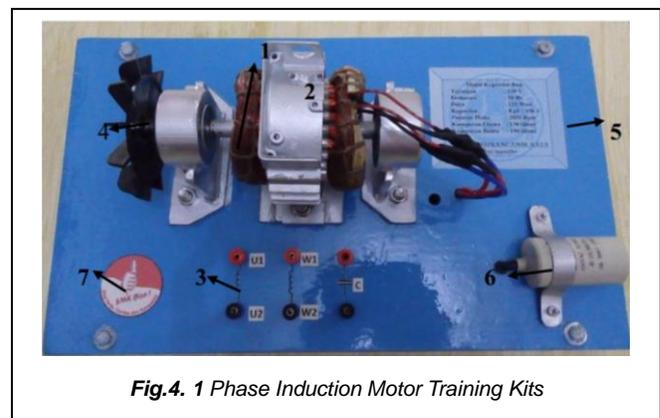


Fig.4. 1 Phase Induction Motor Training Kits

3.3 Validity Test Analysis

The validator consists of 4 experts in their fields consisting of 1 instructional media lecturers, 2 lecturers in electrical machine fields, and 1 teacher in EMMR subject. The validation activities of the 1 phase induction motor training kit are preceded by media observations by the validators, demonstrations, interviews, and then fill out the validation questionnaire by the validators. After the 1 phase induction motor training kit is validated by the validators, then a data recapitulation of the validation results is then performed data analysis. Validation results are presented in Table 1.

Validators	Validity Score	% Validity	Level of Validity
A	62	82,7 %	Valid
B	65	86,7 %	Valid
C	68	90,6 %	Very Valid
D	72	96,0 %	Very Valid
Mean		89 %	Valid

Validation conducted by 4 validators resulted in 89% categorized as Valid, meaning that the 1 phase induction motor training kit could be used to students in the EMMR learning process. The comments and suggestions given are also a consideration to perfect the 1 phase induction motor training kit.

3.4 Practicality Test Analysis

Practicality testing is done by first carrying out limited trials. The limited test is carried out with the use of a developed training kit by the teacher and some students. The validated training kit is used by teachers and students in implementing the EMMR learning process. Then the teacher and students are asked to fill out the training kit practicality assessment sheet that has been provided. The results of the filling are then analyzed by analyzing the product practicality data. The results of the practicality analysis of 1 phase induction motor training kit are presented in table 2. Based on the results of the average practicality analysis of the respondents consisting of 1 teacher and 5 students, the value of 83% was obtained. If interpreted by the practicality table, it is at the practical level. This proves that 1 phase induction motor training kit is used by teachers and students as an instructional media of practical learning in the EMMR learning process.

3.5 Discussion

This study produced a product in the form of instructional media for practical learning of 1 phase induction motor training kit to be used in the EMMR learning process for teachers and students. The development of a training kit based on the level of media needs in EMMR subjects. In the process of developing the training kit, has gone through several stages of evaluation, testing, and improvement as an effort to improve [12]–[14]. In addition, the developed product has gone through the validation stage by the Validator who is an expert in their field. Product validation is done by presenting several expert experts or experienced experts to assess newly designed products so that weaknesses and strengths can be known as expert judgment [20], [28]. The results of development research are expected to be able to provide new innovations in the world of education, especially on EMMR subjects. The results of the validation by 4 Validators of the 1 phase

induction motor training kit stated that the training kit was valid, meaning that the training kit was good to be used as a learning media in EMMR subjects. The assessment given by the Validator revealed that the material contained in the trainer was in accordance with the contents and objectives of the EMMR subjects. Information conveyed using the training kit becomes clearer. This is in accordance with the terms and criteria for media selection which is in accordance with the objectives to be achieved, right to support the content of the lesson. The role of the training kit as a learning media makes learning abstract in a more concrete way [13], [29]. The implementation of a training kit in the learning process makes students active, more independent, and increases student learning motivation. Evaluation of validity has not sufficiently met the requirements of development research, it needs practicality and effectiveness tests to complete it. Practicality refers to the ease of use of developed media. A practicality test is done by spreading the practicality questionnaire. Respondents in the practicality test were 1 EMMR subject teacher and 5 students of SMK at Padang City. The purpose of the practicality test was to find out the teacher's response and the student's response to the media developed [14], [24]. Requirements that must be met in a practicality test include ease of use, time efficiency, easy to interpret, and have equivalence. Based on the questionnaire distribution, it was found that the practical phase 1 phase induction motor training kit was used as one of the learning media because it had fulfilled practicality requirements [14], [21], [30]. Based on these results it can be seen that the 1 phase induction motor training kits are valid and practical to be used as practical learning media in the EMMR learning process. This training kit is made to be used by teachers in carrying out the learning process and can be used as a learning media to be attended by students both in workshops or theoretical learning in class.

5 CONCLUSIONS

This research resulted in a product in the form of instructional learning media for students of vocational education at the basic level of the field of electrical engineering studies. The learning media is in the form of 1 phase induction motor training kits that are developed based on an analysis of the needs of the learning process and student characteristics. After going through several stages of development, the results obtained in the form of 1 phase induction motor training kit that is valid and practical are used and applied as a media for practical learning in the EMMR learning process in the workshop. In addition, this 1 phase induction motor training kit can also be used as an instructional media for learning theory in the classroom as a demonstration-based learning media so that it can help students understand EMMR learning materials that are abstract in nature.

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