ELINVO (Electronics, Informatics, and Vocational Education), *Mei 2023; vol 8(1): 96-102*
ISSN 2580-6424 (printed), ISSN 2477-2399 (online) DOI: https://doi.org/10.21831/elinvo.v8i1.57884

Development of Electrical Machine Training Kits to Increase Competency in Practical Learning and Work Readiness in The Industry

Pramudita Budiastuti[*], Eko Swi Damarwan[2], Adhy Kurnia Triatmaja[3], Barry Nur Setyanto[4]
[1,3,4]Electronic Engineering Vocational Education Department, Universitas Ahmad Dahlan
[2]Electrical Engineering Education Department, Universitas Negeri Yogyakarta
[*]E-mail: pramudita.budiastuti@pvte.uad.ac.id

ABSTRACT

This study aims to develop Electrical Machine Training Kit for electrical machine practice media in vocational education. This type of research with Analyze, Design, Development, Implementation, and Evaluation (ADDIE) model. The background of this research is that the need for electrical machine competency, which students should have mastered, is still insufficient due to inadequate tools. Many graduates still have difficulty getting a job in the industry because competence has not been fulfilled during college. Electronic engineering vocational education is a study program that has the goal of producing superior graduates in achieve electrical machine competence and being ready to work in the industry. Electronic engineering vocational education is a new study program that is still in the development stage to achieve this goal. The media aspect obtains a minimum value of 87.5% and a maximum value of 90%. Material aspects get a value of 88.40% for suitability material and 90.2% for the quality of learning. The user feasibility test obtained a value of 89.80% in review from motivation, 88.0% in terms of convenience, and 90.3% in terms of material. It is concluded that the Electrical Machine Training Kit is included in the "very feasible" category.

Keywords*:* competence, development, electrical machine, training kits

INTRODUCTION

Graduates who have quality are indicators of the success of the education implementation process. Graduates who have quality are one of the determinants of the existence of a study program in the long term. Study programs that have quality graduates have an impact on increasing demand from stakeholders. Stakeholders will have high confidence in recruiting workers from a study program. The study program has the function of forming graduates who have quality so that stakeholders have high confidence in recruiting workers [1]. In reality, there is intellectual unemployment. Based on the Central Statistics Agency, the population of Indonesia in 2020 is estimated to reach 134.92 million women and 136.14 million men, 26.3% have an age of 0-14 years, 67.7% have an age of 15-64 years, and 6.2% have an age > 65 years. The ranged age of 15-64 years is the population's productive age, including students who are looking for work [2]. The productive age is expected to actualize discipline, cooperation, responsibility, and skill in work [3].

Profile of graduates from the Electronic Engineering Vocational Education study program is working in the industry. Based on the National Work Competency Standards in the electrical panel industry in the technical production process, electrical machine competence is one of the main units of expertise from the National Work Competency Standards in the electrical panel industry in the technical production process. The implementation of education related to electric machines in the Electronic Engineering Vocational Education study program is an electrical machine practicum course. The background of this research is that the need for electrical machine competency, which students should have mastered, is still insufficient due to inadequate tools. Many graduates have difficulty getting a job in the industry because competence has not been fulfilled during college. Electronic engineering vocational education is a study

program that has the goal of producing superior graduates in achieve electrical machine competence and being ready to work in the industry [4]. The results of the discussion by the lecturer of the Electrical Machines practicum course found that there was inadequate practicum supporting equipment. The practical support equipment is an important role in the learning process. Practicum supporting equipment, namely training kits, can help students practice the competencies they want to master. In addition to studying the theory of electric machines, maximum mastery of electric machine practices needs to be carried out and the study program complements the practical learning of electric machines with an adequate training kit [5].

This research has paid attention to other relevant research so as to avoid duplication. Research by Yakti, W. N. [6] with the title Development of a 3-phase external amplifier trainer generator for electrical machinery courses at the State University of Malang. Research has a main focus, namely the development of electric machine trainers to understand the concept of generators in an applicative manner and students can try to make more complex applications using generators. Agreeing with this by Putra et al., with the title Making a 3-Phase Motor Installation Trainer, the focus of this research is the development of an electric machine trainer to understand a circuit to run a 3-phase motor. Research has a main focus on mastery of competencies for star delta sequences/relationships [7]. Research by Huzaini et al., with the title Development of a Contactor-Based Electric Motor Control Trainer Kit to Improve Student Learning Outcomes. The main focus is the development of a contactor-based motor control trainer kit [8]. Research by Irvawansyah and Mustafa, S (2020) with the title Design and Build of an AC Electric Machine Trainer. The research has a main focus, namely the development of an electric machine trainer to see the use of voltage, current, and rotational speed in a no-load motor state, as well as a loaded motor state. In addition, this tool can also show the relationship between rotational speed, and the voltage generated by the generator, to the effect of the generator terminal voltage on the resistive load [9]. Research by Yanto et al., with the title Feasibility Test Analysis of Power Electronics Trainer Kit: 3 Phase Half-Wave and Full-Wave Uncontrolled Rectifier. The main focus of this research is the development of an electric machine trainer for a 3-phase full-wave uncontrolled rectifier [10].

In general, it can be concluded that "Development of Electrical Machine Training Kits to Improve Electrical Machine Competence" has a different focus from existing research. The development of the Electrical Machine Training Kit in this study is that the learning achievement subsection of the subject is assembling a series of electrical machines that run for a moment. Based on the above background, this research tries to do "Development of Electrical Machine Training Kits to Improve Electrical Machine Competence". This research is to develop an Electrical Machine training kit to increase competence in the electrical machine practicum course. The urgency of this research is that the training kit for competent students in the field of electrical machinery in the electronic engineering education study program is not sufficient, so the main expertise of the National Work Competency Standards in the electrical panel industry in the technical production process has not been achieved optimally.

METHODS

The development model uses ADDIE Approach. The ADDIE approach includes analyzing, designing, developing, implementing, and evaluating. The research is to produce an Electrical Machine Training Kit and to increase the competence of electric machines equipped with a user guide [11]. The research analysis used quantitative descriptive analysis techniques. Feasibility is a review of material and media aspects from user response [12]. The

picture of the implementation cycle ADDIE shown in Figure 1.

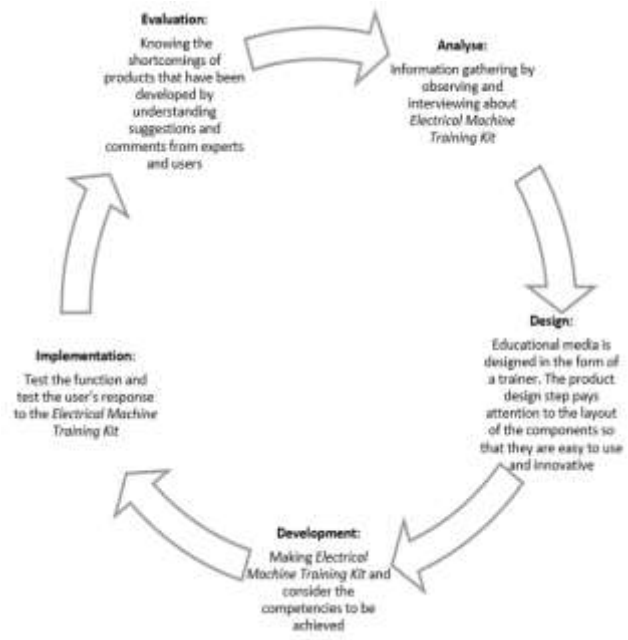

Figure 1. The implementation cycle of the ADDIE approach

The explanation of the steps taken is based on Figure 1, namely at the analysis stage, interviews and observations are at this stage. After analyzing, next is the design process. At this stage makes a plan that will be carried out after getting the observation data. Design process focus making Electrical Machine Training Kit which will be developed according to the problems found during the analysis stage. The design phase includes 2 stages, namely: product design and manufacture of user guides. The product design is made by considering the needs based on the analysis that has been done [13]. The results of the Electrical Machine Training Kit design are shown in Figure 2.

Development is the process of creating or developing a trainer tool and validation. Development is a real stage to make Electrical Machine Training Kit. Process development includes making trainers, and guidebooks, developing instruments, instrument feasibility tests, feasibility trials, and product revisions to get product revision results. Products are reviewed by experts for media and material and declared feasible so that the product is ready to be implemented [14].

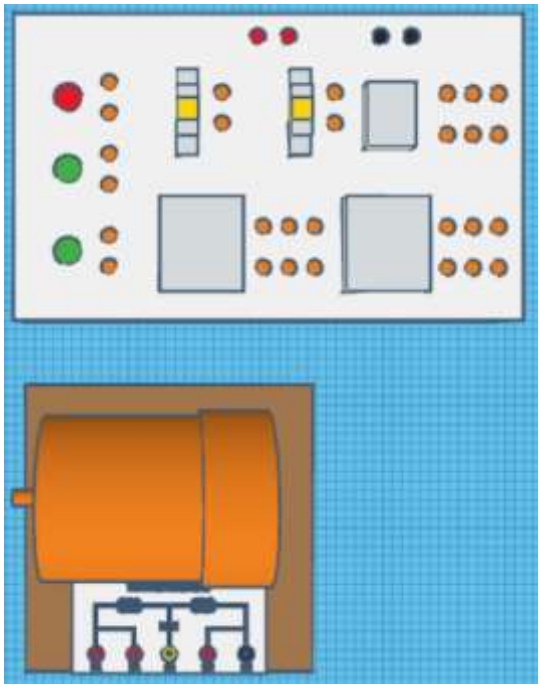

Figure 2. Design of electrical machine training kit

The implementation stage is for students of the Electronic Engineering Vocational Education study program. Implementation to test responses students with Electrical Machine Training Kit [15]. The evaluation stage, knowing the deficiencies, and developing the product. Evaluation can find suggestions and comments from experts and users. Suggestions and comments become material for analysis to improve the product as needed. After the evaluation stage, a Feasibility Study is carried out. After the evaluation stage, a Feasibility Study report for the Electrical Machine Training Kit product was developed [16].

RESULT AND DISCUSSION

In this study, the learning achievement subsection of the subject is assembling a series of electrical machines that run for a moment. The learning experience gained is drawing, assembling, and operating the control circuit and the power of the electric machine circuit running for a moment. The picture of the control circuit and the power of the electric engine running momentarily is shown in Figure 3 and Figure 4 below.

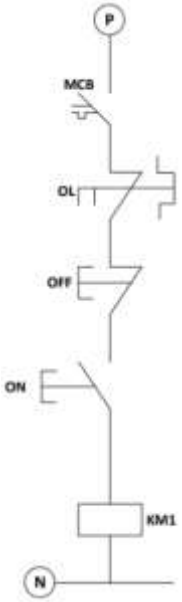

Figure 3. The control circuit of the electric machine circuit runs for a moment

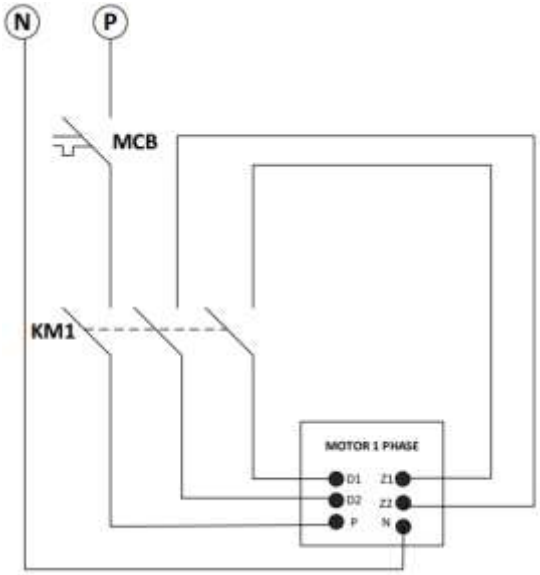

Figure 4. The power circuit of the electric machine circuit runs for a moment

The trial was carried out in the Electronic Engineering Vocational Education study program. Functional trials were carried out to determine the performance of the Electrical Machine Training Kit in the learning achievement subsection of assembling a series of electrical machines running for a moment. The first trial was carried out by identifying the practical work steps of the learning achievement subsection, assembling a series of electrical machines running for a moment. The practical work steps of assembling a series of electrical machines running for a moment are shown in Table 1.

Table 1. Practical work steps for assembling a series of electric machines running for a moment.

Practical Learning (Action/Act)	Work method
	Power Circuit
Act 1	Connect the phase to MCB
Act 2	Connect the MCB output to the KM1 input (NO L1)
Act 3	Connect the KM1 output (NO L1) with the phase (symbol P) on the 1 Phase motor module
Act 4	Connect input KM1 (NO L2) with Z2 on 1 Phase motor module
Act 5	Connect output KM1 (NO L2) with D2 on 1 Phase motor module
Act 6	Connect input KM1 (NO L3) with Z1 on 1 Phase motor module
Act 7	Connect output KM1 (NO L3) with D1 on 1 Phase motor module
Act 8	Connect neutral to neutral (symbol N) on 1 Phase motor module
	Control Circuit
Act 1	Connect the phase to MCB.
Act 2	Connect the MCB output to the overload input.
Act 3	The overload output is connected to the input push button off.
Act 4	The push button off the output is connected to the push button on input
Act 5	The push button on output is connected to the KM1/A1 coil input
Act 6	KM1/A2 coil output is connected to neutral

The practical work steps of assembling a series of short-running electric machines that have been carried out get practical test results. The test results of a short-running electric machine circuit are shown in Table 2.

Table 2. Results test the electric machine circuit running for a moment.

Test	Work method	Test result
Test 1	MCB 1 Phase "ON" power circuit and closed control circuit	1 phase voltage source connected
Test 2	Overload "OFF" closed	Overload connected/closed state, if there is an overload the overload will work (not connected/disconnected)
Test 3	Closed "OFF" Push Button/	Magnetic contactor/MC not connected
Test 4	PB "ON" opens	MC not connected
Test 5	PB "ON" closed	MC connected and motor 1 phase rotating
	PB "OFF" opens	The magnetic contactor is not connected and the 1 phase motor stops rotating
Test 6	MCB 1 Phase "OFF" is open	1 phase voltage source is disconnected.

Based on the application of rare practical work and analyzing the results of testing the electrical machine circuit running for a moment, it can be concluded that the installation conditions and component performance of each Electrical Machine Training Kit module are described in Table 3.

Table 3. Installation conditions and component performance of each module Electrical Machine Training Kit

Module	Installation Conditions and Component Performance	
	Good condition	Bad condition
MCB 1 Phase	√	-
Overload	√	-
PB OFF	√	-
PB ON	√	-
Magnetic Contactor	√	-
Motor 1 Phase	√	-

Based on the description of Table 3, the Electrical Machine Training Kit all components are running well. The components are MCB 1 Phase, Overload, PB OFF, PB ON, MC, and Motor 1 Phase. After knowing the results of the performance test, the next step is the validity test which is reviewed from two aspects, namely the media and the material. The results of the media validity test include four things, namely usability, hardware, operation, and visual communication. The results of the media validity test are shown in Figure 5.

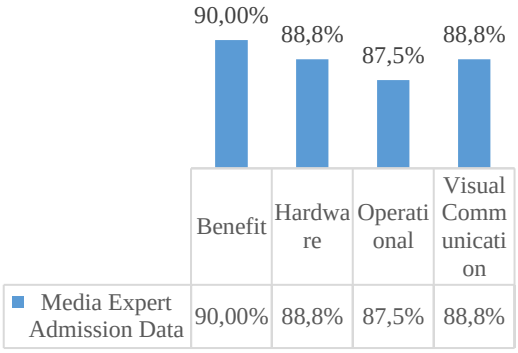

Figure 5. Media Expert Test

Figure 5 shows that the media aspect values are 87.5% (minimum value) and 90% (maximum value); this means Electrical Machine Training Kit for media aspect is "very feasible" category. Material validity test is suitability material and quality of learning. The results material validity test is shown in Figure 6.

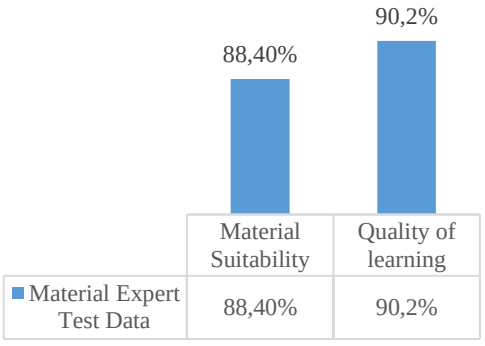

Figure 6. Material Expert Test

Material aspects have 88.40% for the suitability of the material and 90.2% for the quality of learning. The results of the material validity test the product in the "very feasible" category. The results of the user feasibility test include three things, namely motivation,

convenience, and material. The results test shown in Figure 7.

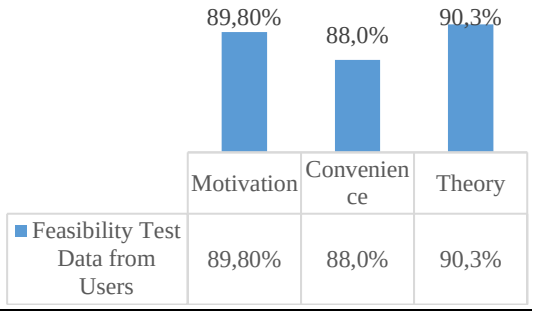

Figure 7. User Feasibility Test

The user's feasibility test obtained a score of 89.80% in terms of motivation, 88.0% in terms of convenience, and 90.3% in terms of material. The feasibility test results from the user can be interpreted as the Electrical Machine Training Kit in the "very feasible" category.

CONCLUSION

The conclusion that can be drawn is that the installation conditions and component performance of each Electrical Machine Training Kit module are very feasible. The components are 1 Phase MCB, overload, PB OFF, PB ON, MC, and 1 phase motor. Media validity tests include four things, namely usability, hardware, operation, and visual communication. The results media validity test has a minimum value of 87.5% and a maximum value of 90%; this means the media aspect is in the "very feasible" category. Material validity tests include two things: the material's suitability and the learning quality. The result's material validity is 88.40% for the suitability of the material and 90.2% for the quality of learning. Based on the results, the material validity Electrical Machine Training Kit is "very feasible" category. User feasibility tests include three things, namely motivation, convenience, and material. The results feasibility test from the user is 89.80% in terms of motivation, 88.0% in terms of convenience, and 90.3% in terms of material. Based on the results feasibility test Electrical Machine Training Kit is included "very feasible" category.

REFERENCES

[1] Putri, A. Z., & Mukhaiyar, R. (2021). Perbandingan Luaran Lulusan Pendidikan Teknik Elektro Dengan Non-Kependidikan. *Ranah Research: Journal of Multidisciplinary Research and Development*, *3*(4), 39-46.

[2] Nurjanah, A. S. (2018). Kecemasan Mahasiswa Fresh Graduate Dalam Melamar Pekerjaan. *Al-Ittizaan: Jurnal Bimbingan Konseling Islam*, *1*(2), 35-38.

[3] Santosa, B., Budiastuti, P., Purnawan, P., & Sayuti, M. (2021). The Influence of Discipline, Responsibility, Cooperation, and Problem Awareness on Employability Skills. Jurnal Pendidikan Teknologi dan Kejuruan, 27(1), 81-90.

[4] Santika, E., & Mukhaiyar, R. (2020). Kebutuhan Kompetensi Keahlian Bagi Mahasiswa Prodi Pendidikan Teknik Elektro Universitas Negeri Padang. Voteteknika (Vocational Teknik Elektronika dan Informatika), 8(1), 139-145.

[5] Huzaini, Y. N., Yusro, A. C., & Purwandari, P. (2019). Pengembangan Trainer KIT Kontrol Motor Listrik Berbasis Kontaktor untuk Meningkatkan HasilBelajar Mahasiswa. *Jupiter (Jurnal Pendidikan Teknik Elektro)*, *4*(2), 30-34.

[6] Yakti, W. N. (2021). Pengembangan trainer generator 3 fasa penguat luar untuk matakuliah mesin-mesin listrik di Universitas Negeri Malang. *SKRIPSI Mahasiswa Universitas Negeri Malang*.

[7] Putra, J. S. M., Endramawan, P., & Hariwibowo, A. (2017). Pembuatan trainer instalasi motor 3 phase. *Jupiter (Jurnal Pendidikan Teknik Elektro)*, *1*(2), 81-90.

[8] Huzaini, Y. N., Yusro, A. C., & Purwandari, P. (2019). Pengembangan Trainer KIT Kontrol Motor Listrik Berbasis Kontaktor untuk Meningkatkan HasilBelajar Mahasiswa. *Jupiter (Jurnal Pendidikan Teknik Elektro)*, *4*(2), 30-34.

[9] Irvawansyah, I., & Mustafa, S. (2020). Rancang Bangun Trainer Mesin Listrik AC. *Journal Of Electrical Engineering*, *1*(2), 41-45.

[10] Yanto, D. T. P., Astrid, E., Hidayat, R., & Islami, S. (2019). Analisis Uji Kelayakan Trainer Kit Elektronika Daya: 3 Phase Half-Wave and Full-Wave Uncontrolled Rectifier. *JTEV (Jurnal Teknik Elektro dan Vokasional)*, *5*(1.1), 121-125.

[11] Hammi, T., Hamid, M. A., & Permata, E. (2020). Pengembangan trainer instalasi motor listrik untuk meningkatkan hasil belajar siswa sekolah menengah kejuruan. *TEKNO: Jurnal*

Teknologi Elektro dan Kejuruan. Malang: Universitas Negeri Malang, *30*(1), 1-10.

[12] Tegeh, I. M., Jampel, I. N., & Pudjawan, K. (2015). Pengembangan buku ajar model penelitian pengembangan dengan model ADDIE. In *Seminar Nasional Riset Inovatif IV*, vol. 208. 208-216.

[13] Suhendrik, M., & Budiono, A. P. (2014). Pengembangan Modul Ajar Teknik Merancang Berbasis Pembelajaran Kontekstual. *Jurnal Pendidikan Teknik Mesin*, *2*(03), 67-75.

[14] Rahmadiyah, I. P., & Sumbawati, M. S. (2015). Pengembangan Media Pembelajaran Trainer Elektronika Digital Untuk Mata Pelajaran Teknik Elektronika Dasar. *Jurnal Pendidikan Teknik Elektro*, *4*(1).

[15] Harahap, P., Adam, M., & Balisranislam, B. (2021). Implementasi Trainer Kit Pembangkit Listrik Tenaga Surya sebagai Pengembangan Media Pembelajaran Instalasi Listrik. *ABDI SABHA (Jurnal Pengabdian kepada Masyarakat)*, *2*(2), 198-205.

[16] Pereyras, J. (2020). Acceptability And Technical Feasibility of An Electrical Wiring Installation Trainer. *International Journal of Advanced Trends in Computer Science and Engineering*, *9*(3), 2995-2999.