Development of Industrial Electrical Installation Trainer Nuanced To Training within Industry for Students of Electrical Industrial Engineering Universitas Negeri Padang

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Abstract. This study aims to develop industrial electrical installation trainers nuanced of training within industry that is valid, practical and effective in the learning of Industrial Electrical Installation Practicum Industrial Electrical Engineering Study Program Faculty of Engineering, Universitas Negeri Padang. This trainer is expected to be able to support the learning process especially to understand the working principle and function of an electrical motor electric installation in the industry. The research method used is R & D (Research & Development) research and development methods. The product development stage includes (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) limited trial, (7) product revision testing product, (8) usage test, (9) product revision testing stage, (10) final product. The test results obtained were the media trainer for industrial electrical installations categorized as valid as a learning media after validation by the validator, amounting to 93.5% meaning that the media had fulfilled the validation aspects, namely the content and purpose components, instructional and technical to obtain very valid categories. The practicality level of the media trainer for industrial electrical installations obtained a percentage of 97.3% with a very practical category. While the effectiveness is obtained at 88.5%. Based on these stages, a valid, practical and effective media trainer for industrial electrical installation has been produced.

1. Introduction
University as formal education institutions are required to be able to keep up with technological developments so as to produce competent cognitive, psychomotor, and affective graduates. The introduction of new technology must be carried out in the lecture process so that students are able to become individuals who are ready to face the challenges of the world in the technological era. The quality of the learning process will affect student learning outcomes. One of the factors that can support the quality of student learning outcomes both in the theoretical or practical study is the availability of learning media [1]; [2].

Teaching in Industrial Electrical Installations Courses in the Industrial Electrical Engineering Study Program in the Department of Electrical Engineering FT-UNP is a practical course that leads students to know the electrical installations that develop in the industry and scientific insights related to the field of electrical installations in the industry. The course emphasizes the activities of applying a
theory in limited conditions and situations, such as in laboratories, workshops, work spaces and so on. The application of this course is widely used in Manufacturing industries. By mastering all the skills taught in each subject matter lecture, it becomes a support for graduates to be truly ready to work in the industry [3].

According to Starr, et al in [4] "Because vocational education has a close connection with the world of work or industry, practical learning and training play a key role in equipping graduates to be able to adapt to employment". Thus, they must be formed through a series of exercises or practical learning and training that are almost like the world of work. Furthermore, Nolker & Schoenfeldt in [4] states that "To teach vocational skills practices, certain strategies should be used so that students understand, both cognitively and at the same time, the basic steps of a vocational skill". The majority of formal education institutions still have not implemented the learning media needed by students in recognizing new technologies that are developing in the industry [5]. Industrial Electrical Installation Trainer is one of the potential that students can use in getting to know more about the development of installation technology in the Industry. Trainer for electrical installation of industries which are under the authority of Within Industry Training are very suitable to be applied in introducing the industry to students from an early age [6]; [7]; [8].

The trainer with the Within Industry Training authority in the practice learning process greatly guides students to learn to work gradually, sequentially and follow standard work procedures to master a work skill. In education there are two interconnected terms, namely learning and the learning process. Learning is more focused on students, what they must do in receiving lessons. According to Gagne in [5] explained that: "Learning is a process in which an organism changes its behavior as a result of experience". So after following the learning process, students are expected to gain new experiences in interaction with the environment [9]; [10].

The important thing in learning and training in vocational practice is mastering practical skills, as well as knowledge and behavior that are directly related to these skills. " One learning strategy for teaching basic vocational skills is a learning strategy within Within Industry Training. Within Industry Training Program consists of five main models: 1) work instructions, 2) work methods, 3) work relationships, 4) work safety, and 5) program development. These programs are intended to develop internal trainers and supervisors who can double their own hard work by teaching others. If each person who has a certification to provide training (the main trainer) teaches a number of Supervisors (trainers), and each supervisor then trains 10 or more colleagues, then the success of the program will double. Training programs in Within Training are known as J-Programs:

1). Job Instruction

Designed to help supervisors "train" new employees who have no expertise and are based on decades of practical experience. However, learning is used to help teachers train students who do not have expertise. Although the material underwent a slight revision over time, the basic premise remained the same as describing the work into several elements, identifying important points, and carrying out operations to achieve success. The aim is to shorten the period of "training" and improve the safety and quality of work through understanding better work on vital elements of workers.

2). Job Methods

The TWI program provides techniques aimed at helping supervisors and workers to analyse all aspects of work according to the method and to question every detail in the determination of needs, sequences, and responsibilities of each task. Questioning and evaluating will result in increased productivity and eliminating unnecessary steps and activities or waste.

3). Job Relations

This program is intended to give supervisors a method to overcome problems and to improve work relationships. Many supervisors during the war are inexperienced and lack knowledge about how to deal with problems and things that concern employees. The topics include giving feedback on employee performance, handling matters of concern to employees, rewarding great ideas or performance, communicating events or changes, and utilizing the abilities of each person.
4). Job Safety
This program is intended so that every employee can work by prioritizing occupational health and safety (K3) so as to prevent accidents or unwanted events.

5). Development Program
Program development is specifically aimed at people or individuals in each factory who want to identify specific needs or training, develop plans, get support from management, implement plans, train supervisors

Within Industry Training Strategy consists of 5 learning stages, namely preparation, demonstration, imitation, practice, and evaluation”. Description of the stages of learning in the Within Industry Training strategy as follows:

1). Preparation
Broadly speaking, the teacher's activities at this stage are preparing worksheets (Jobsheet), explaining the purpose of learning and training, explaining their importance, arousing student interest. The principal activities of the teacher in this stage are to plan, organize, and formulate the conditions of learning and training so that there are systematic activities with the strategies that will be applied.

2). Demonstration
In this stage the teacher or instructor has begun to enter the implementation phase. The teacher delivers the material using available learning media and practical training. After that, students should be given time to give feedback on what they have seen. The next step is the teacher demonstrates the real work that must be learned, explains how to work well in relation to the whole process, while taking a position in such a way that students can follow the work process from the right perspective.

3). Imitation
After the demonstration stage was carried out carefully, it was only followed by an imitation stage. In the imitation stage of students doing work activities mimicking work activities that have been demonstrated by the teacher. In conducting imitation activities, students must be organized and organized into practical learning activities so that students are truly able to understand and carry out work activities in accordance with the objectives of learning and practical training. In this stage the teacher must really pay attention to the stages of work done by students. The teacher must always monitor the student's work process. If there are things that are not appropriate, the teacher must instruct students to repeat the work and help students to do the work properly.

4). Practice
After students are able to imitate the work method well, the next step is the implementation of practical activities. At this stage students repeat the newly learned work activities until the work skills learned are completely mastered. The important thing that the teacher needs to do and pay attention to in this phase is the management of the management strategy and the organization of practical learning and training, so that students are truly able to do practical learning activities optimally.

5). Evaluation
In the TWI model learning and practical training strategy, evaluation activities are carried out at the practice stage. To evaluate learning and practical training, an instrument is used, namely Performance Assessment. The evaluation phase is the final stage that is important for every learning and training process, especially in learning and training in vocational practice. By evaluating practical learning and training, students will know their abilities clearly so that students can improve and improve the quality of their learning and training. Likewise, evaluation activities are very important for a teacher, because from the results of the evaluations carried out it can be known how far the goals have been achieved.

2. Development Methods
In writing this paper using development research methods Research and Development Sugiyono [11] states that Research and Development is a research method used to produce a particular product, and
test the effectiveness of the product. Development research in the field of education is a type of research that aims to produce products for the benefit of education / learning. In the implementation of R & D, there are several methods used, namely descriptive, evaluative and experimental methods. Descriptive research methods are used in the initial research to collect data about existing conditions. Evaluative methods are used to evaluate the process of testing the development of a product. The experimental method is used to test the efficacy of the product produced [12]; [13]; [14].

The subject of this development research is the media trainer for industrial electrical installations and the respondents are lecturers and students who take industrial electrical installation practicums with the nuance of within industry training in the Electrical Engineering Industry Sudi Program in the Department of Electrical Engineering FT-UNP. The realization of the research design was carried out by adopting the R & D research procedure scheme according to can be seen in Figure 1 below:

![Figure 1. Chart of Steps for Research Implementation](image)

The collection of data or information aims to find out the needs of the media in terms of the characteristics of the course, the characteristics of students and the results of discussions with lecturers. After the problem is known, what to do next is to collect information that can be used as material to find out the media needs in terms of the characteristics of the subject and certain product planning that is expected to overcome the problem. Activities at the information gathering stage include:

- Interview with lecturers and students
- Identifying learning media needs
- Identify weaknesses of learning media

### 3. Design Results

Industrial electrical installation trainers are designed to use Training Within Industry. Where students feel as if they are working in the industry. Within Industry Training Strategy consists of five main models 1) work instructions, 2) work methods, 3) work relationships, 4) work safety, 5) program development. These programs are intended to develop internal trainers and supervisors who can double their own hard work by teaching others. If each person who has a certification to provide training (the main trainer) teaches a number of Supervisors (trainers), and each supervisor then trains 10 or more colleagues, then the success of the program will double.

Development research conducted aims to produce products in the form of learning media. The media produced in the form of an Industri Electrical Installation trainer with the nuance of Training Within Industry developed must meet the criteria of valid, practical, and effective. The initial media trainer design in the form of images as follows:
This industrial electrical installation trainer is a set of equipment consisting of a collection of control components along with measuring instruments that have been arranged into a set of equipment so as to facilitate the learning process. This trainer will also be more effective to use because students can more easily understand and master the material that is being taught and know more about the purpose of the learning. So the ranacang industrial electrical installation trainer can support the learning of students in industrial electrical installation practicums in applying the knowledge / concepts they acquire and educate students to be able to work independently so that students can develop their skills [15]; [16].

Electrical Installation Trainer that is produced can be used by students or students in getting to know more in the development of technology Installation in the Industry, so that the trainer is designed in accordance with the concept and feasible as a learning medium both in terms of technical, function and performance as well as ergonomics aspects in use so that it can supporting industrial electrical installation practicum courses. The Industrial Electrical Installation Trainer Module Unit can be used in various types of simulations that support practice and competency testing, including:

- Manual three phase motor control
- Three sequential manual motor control
- Automatic sequential three phase motor control
- Three-phase motor control turn right-rotate shipping
- The motor control of the three phases rotates right-turn left automatically
- Three phasestar-deltamanual motor control
- Motor control of three phasestar-delta automatics

Development research is carried out with the aim of producing products in the form of valid, practical and effective learning media that can be recognized and accounted for. In the development process the media trainer has passed several stages of assessment, trial and improvement as an improvement effort. In addition, the media developed through the validation stage have become experts in their fields. As for testing the validity of learning media made based on the results of preliminary studies, the design of the development of industrial electrical installation trainers with training nuances within the industry is validated before being used in learning.
Validation is carried out by 4 validators who have competence in the field of learning media and learning materials. The purpose of validation is so that it can be said as a valid and accountable media. The activity of testing the validity of trainers for industrial electrical installations begins with media observations by validators, demonstrations, then completing the questionnaire by the validator as validation results data. Recapitulation of data from validation validation results by 4 validators in detail can be seen in table 1 below:

Table 1. Results of validation by each validator

| No | Validator                | Competency     | Percentage | Category    |
|----|--------------------------|----------------|------------|-------------|
| 1  | Dr. Hansi Effendi, M.Kom | Media Expert   | 94%        | Very valid  |
| 2  | Dr. Taali, M.T           | Media Expert   | 93.3%      | Very valid  |
| 3  | Drs. Syamsuarnis, M.Pd  | Materials Expert | 92%        | Very valid  |
| 4  | Oriza Candra, S.T., M.T | Materials Expert | 94.7%      | Very valid  |
|    | Average Validation Results |                | 93.5%      | Very valid  |

The results of validation by 4 validators on the media trainer of the Industrial Electrical Installation stated that the media trainer was very valid, which was 93.5%, meaning that the media trainer was very good to be used as a learning medium in Industrial Electrical Installation engineering subjects.

Practicality tests are carried out by distributing practicality questionnaires to respondents. As for the respondents to measure the practicality of the electrical installation media in this industry were students who took the Pratikum Electrical Industrial Installation course and the lecturers of the course. The purpose of the practicality test is to find out the respondent's response to the developed media. Terms that must be fulfilled in the practicality test include ease of use, time efficiency, easy to interpret and have equivalence.

The practical recapitulation results of the student respondents obtained an average value of practicality from the distribution of practical questionnaires was 98%. If interpreted in the category table, the 98% value is in a very practical category. While lecturers of industrial electrical installation practicum courses as media users were also asked for their opinions about the practicality of the developed media. After observing and conducting learning activities with industrial electrical installation practicum media were asked to fill out the practicality questionnaire.

The results of filling out the questionnaire filled with industrial electrical installation practicum lecturers produced the value of the practicality of home mini media installation of 96.6% in the category very practical. Based on the questionnaire dissemination, the average practicality results were 97.3%. This means that the media trainer for Industrial Electrical Installation is very practical to be used as one of the learning media because it has fulfilled the practicality requirements.

Learning effectiveness is a measure related to the success rate of a learning process. The success of the learning process is indicated by the success of students mastering the material given. Effective criteria based on classical completeness, meaning that the number of students who complete a minimum of 85%, this is a requirement of the effectiveness test. Trials conducted to see the effectiveness of the media showed that most students managed to master the lecture material. Proven at the testing phase of the use of 20 students, 18 students had a value of ≥ 85 if it was percentage then 88.5%. This means that the media is declared effective because the percentage of completeness is greater than the requirements of classical completeness.

Based on the research that has been carried out, the use of media trainers in the Industrial Electrical Installation in learning is expected to be able to bridge students between the world of education and the world of industry and to teach the information contained in the media trainer of Industrial Electrical Installation to the fullest. The results of this study should be implemented by education actors as a form of participating in supporting the culture to improve the quality of the world of education.
4. Conclusion
Development research in the field of education is to produce educational products that are valid, practical and effective to be used in learning. Research on the development of media trainers for Industrial Electrical Installation with nuances of Within Industry Training has gone through 10 stages proposed by Sugiyono. Industrial Electrical Installation Trainer is designed in accordance with the basic competencies that exist in Industrial Electrical Installation Engineering courses and Electrical Industrial Engineering Installation Practices in the Electrical Engineering Study Program of the Department of Electrical Engineering FT - UNP.

5. References

[1] Arsyad, Azhar. (2014). Media Pembelajaran. Jakarta: Rajawali Perss.
[2] Kustandi, Cecep (2011). Media Pembelajaran Manual dan Digital. Jakarta: Ghalia Indonesia.
[3] Elfizon, E., Muskhir, M., & Candra, O. (2017). Pengembangan Media Trainer Elektronika Dalam Pembelajaran Teknik Elektronika Pada Pendidikan Vokasi Teknik Elektro Fakultas Teknik Universitas Negeri Padang. Proceeding Semnasvoktek, 2, 153-160. Retrieved from http://e_proceeding.undiksha.ac.id/index.php/semnasvoktek/article/view/710
[4] Wena, Made. (2011). Strategi Pembelajaran Inovatif Kontemporer. Jakarta: PT. Bumi Aksara.
[5] Elfizon, E., Candra, O., & Muskhir, M. (2018). Penerapan Strategi Training Within Industry Sebagai Upaya Meningkatkan Motivasi Perkuliahan. INVOTEK: Jurnal Inovasi Vokasional Dan Teknologi, 18(2), 55-64. https://doi.org/https://doi.org/10.24036/invotek.v18i2.366
[6] Bukit, Masriam. (2014). Strategi dan Inovasi Pendidikan Kejuruan. Bandung: Alfabeta
[7] Elfizon, Elfizon., Syamsuarnis, Syamsuarnis and Candra, Oriza (2017) The Effect of Strategy of Training Models in Learning Electrical Installation. In: 4th International Conference on Technical and Vocation Education and Training (TVET): Technical and Vocational Education and Training for Sustainable Societies, 9-11 November 2017, Padang [7]
[8] Arisa, A,B. (2015). Pengembangan Media Trainer Motor Induksi 1 Fasa Pada Mata Pelajaran Perawatan Dan Perbaikan Motor Listrik Di Smk Negeri 5 Padang (Skripsi). Padang: UNP Perss.
[9] Sagala, Syaiful. (2003). Konsep dan Makna Pembelajaran. Bandung: CV. Alfabeta.
[10] Hanafiiah, Dkk (2012). Pemetaan Konsep Belajar. Bandung : Refika Aditama
[11] Sugiyono. (2011). Metodologi Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta.
[12] Ratumanan, Tanwey Gerson,dkk. (2003). Evaluasi Hasil Belajar Yang Relevan dengan Kurikulum Berbasis Kompetensi. Surabaya: Unesa University Press.
[13] Hosnan, (2014). Pendekatan Saintifik Dam Konstekstual Dalam Pembelajaran Abad 21. Bogor: Ghalia Indonesia
[14] Arikunto, Suharsimi. (2013). Dasar-dasar Evaluasi Pendidikan. Jakarta: Bumi Aksara.
[15] Mita Anggariyani. (2006). Pengembangan LKS Pesawat Sederhana yang disesuaikan dengan KBK untuk Kelas VII (Thesis). Surabaya : Universitas Negeri Surabaya.
[16] Wisnu Tri Nugroho. (2015). Pengembangan Trainer Kit Fleksibel untuk Mata Pelajaran Teknik Mikrokontroller dan Robotik pada Program Keahlian Teknik Audio Video di SMK Negeri 3 Yogyakarta (Skripsi) Yogyakarta : UNY.