

# Human Machine Interface Job Sheet Trainer as Student Learning Material on the Subject of Electrical Motor Installation

Tri Rijanto<sup>1</sup>, Soeryanto<sup>1</sup> and Soivan<sup>2</sup>

<sup>1</sup>Universitas Negeri Surabaya, Kampus Ketintang, Surabaya, Indonesia

<sup>2</sup>Fresh Graduate Department of Electrical Engineering Faculty of Engineering, Ketintang, Surabaya, Indonesia  
tririjanto@unesa.ac.id, [soeryanto@unesa.ac.id](mailto:soeryanto@unesa.ac.id), soivan@mhs.unesa.ac.id

**Keywords:** Job Sheet, HMI, Electrical Motor Installation

**Abstract:** Teaching material is one of the most widely used learning resources. This study aims to produce Human Machine Interface (HMI) Job Sheet Trainer to be used on the subject installation of electrical motor techniques based on: (1) the validity of the job sheet trainer Human Machine interface (HMI), (2) effectiveness in terms of student learning outcomes after using HMI job sheet trainer, and (3) practicality in terms of student and teacher response to HMI job sheet trainer. This research is a Research and Development (R&D). Subject research is 30 students of State Vocational Senior High School (SMKN 3) Surabaya class of XII TITL 1. This research used 7 steps taken from R&D reseach stage, which consist of (1) potentials and problems, (2) data collection, (3) product design, (4) product validation, (5) product product, (6) product testing, and (7) analysis and reporting. Instrument used include validation sheet, test result instrument, and student response questionnaire. The results of this research showed that the worthiness level of job sheet on aspect aspect validity as 'very worthy' with a score of 83%; aspect of practically in terms of the response of the students which is considered to be very practical with the score of 87%;and effectiveness aspects in terms of student learning. From the test using One Group Pretest-Postest and *t-test*,  $t_{count} = 49,632 > t_{table} = 2,045$  with a significance ( $\alpha$ ) 0,05, it can be concluded that there is a very significant improvement on student' study result between pretest and posttest using a job sheet so that job sheet which is said to be effective. Thus, it can be concluded that the HMI job sheet trainer HMI on the subjects of electrical motor installation at State Senior High School 3 Surabaya is considered to be feasible for used in learning activities.

## 1 INTRODUCTION

In order to improve Indonesia's human resources, the government issued Presidential Instruction Number 9 Year of 2016 on Revitalization of Senior Vocational School (SVS). Within the Roadmap of Revitalization of Senior High School, some program aspects have been confirmed for improvement of SVS to make sure that the latter has the role of the making of competent and productive human resource. Revitalization strategic issues covers alignment of curriculum (including learning innovation), availability and improvement of productive teachers and educational assistants, standardized facilities and infrastructure, strengthening and extension of collaboration with the business world (BW) and industry world (IW),

and management and organization of institution ((Kemendikbud, 2017).

Special curriculum for running the SVS education becomes a crucial issue and therefore the curriculum shall be established and aligned with the BW and IW competence demand. Curriculum as the soul of SVS education shall be regularly aligned with the related IW and BW competence demand. Without proper teaching materials it is difficult to produce graduates as expected by the industry.

Teaching material is defined as all types of materials used to help teachers/instructors in performing classroom learning and teaching activities. It can be written or non-written material (*National Center for Vocational Education*

Research). Therefore, teaching material is a set of written or non-written materials systematically organized to create a condition/environment that enables the learning participants to learn. One form of teaching materials is the job sheet.

Job sheet is a written instruction to help a worker perform his/her duties. It can also be printed sheets that contain subjects, summary and instruction for learning duties to be theoretically and practically done by students in a proper manner. It refers to the student's basic competence to be completed by students along with the information of other required supporting teaching materials (Prastowo, 2013). In other words, job sheet is used to help students perform their duties to reach a certain competence.

Electric Car Installation is one of subjects taught at SVS for Electrical Installation Engineering Competence. One of the Core Competence (CC) and Basic Competence (BC) of such competence is the ability to describe and install circuit component for Programmable Logic Control (PLC). To optimize communication between motor and PLC, Human Machine Interface (HMI) is required. Human Machine Interface (HMI) is a communication medium between the operator and system designer which serves to provide necessary information for optimum efficiency. HMI provides visualization of events or processes that are taking place at the plant so that it is easier for the operator to perform his job (Irvine, 2001). HMI is also used to indicate machine's error and machine status which allows the operator to stop and start the operation as required and monitor any some parts of the production system. To make sure that the CC-BC can be effectively transferred, related teaching material is required. It is therefore necessary to conduct a research on development of teaching material in order to obtain a valid, effective and practical job sheet.

There have been many researches on teaching materials (Martinez, 2002; Gilmore, 2007; dan Cory, 2009). The researchers suggest that (1) learning processes run smoothly and effectively in terms of transfer of knowledge, (2) teaching materials turn out to be beneficial for motivating learning participants, and (3) teaching materials trigger students' interest and conveniently introduce the technology required in the real work environment.

The research aims to develop the job sheet from the following points of view : (1) validity of HMI job sheet trainer as teaching material of Electrical Motor Installation subject, (2) effectiveness of HMI

job sheet trainer as viewed in terms of student's learning impact for the subject of Electric Motor Installation, and, (3) practicality of HMI job sheet trainer as viewed from the teacher and student's response to for the subject of Electric Motor Installation.

## 2 METHOD

The research is a research for development using steps introduced by Borg & Gall (1983) which are further adapted into seven steps. The steps include potential and problem, data collecting, product design, product validation, product revision, product testing and analysis and reporting. Detail of research steps is as illustrated in the following Figure 1.

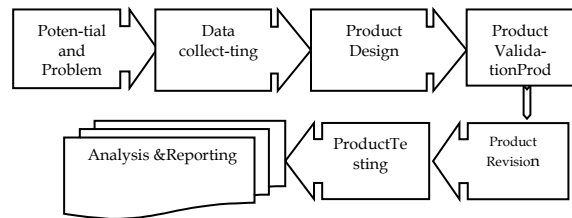


Figure 1. Steps of R&D Research

Product testing was undertaken with 30 students of 12<sup>th</sup> grade of Electrical Installation Engineering Program, even semester year of 2017/2018, State SVS 3 in Surabaya. One-group pretest-posttest design was used as can be seen in the following Figure 2.

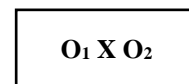


Figure 2. Testing Design

Whereas:

X = learning treatment using HMI job sheet trainer

O<sub>1</sub> = pretest prior to treatment

O<sub>2</sub> = posttest following treatment

Research instruments included (1) a validation sheet responded by the validator to reach information to be responded by on teaching material validity, (2) a questionnaire responded by both the teachers and students to get information on teaching material practicality, (3) instrument of learning result of Electrical Motor Control Set which was used *pretest and posttest* to get information on teaching material effectiveness. Data were analyzed using the descriptive analysis approach while Aiken's (1998) Index V was used to analyze

validity of validators, and *pretest* and *posttest* scores were analyzed by means of *uji-t* berbantuan SPSS 21 assisted t-test.

### 3 RESULT AND DISCUSSION

#### 3.1 Product Display

The created Job sheet required 4 (four) practice activities. The first practice was Direct Online Electrical Motor Control, the second was Forward-Reverse Electrical Motor Control Set, the third was Star-Delta Manual Electrical Motor Control Set and fourth, Automatic Star-Delta Electrical Motor Control Set.

The cover of job sheet indicates the description of the entire job sheet which contains images to describe the phenomenon related to the given materials and practice. The cover page is shown in Figure 3 below.



Figure 3. Cover or HMI job sheet trainer

Next is the sheet that contains student's identity, group, members of groups and date of practice. There are also the logo of SMK Negeri 3 Surabaya and the logo of Unesa, and title of job sheet for each practice. Identity sheet can be seen on Figure 4 below.

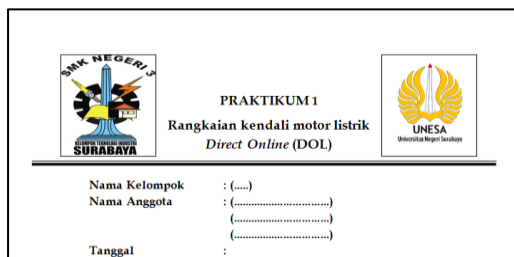


Figure 4. Identity Sheet

The following is the learning goal to be reached by the students by means of the develop job sheet. / The goals are expressed in measured operational verbs. One of the jib sheets is shown in Figure 5 below.

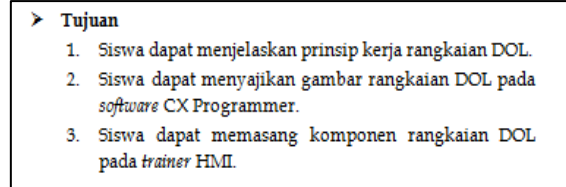


Figure 5. One of the goals expressed in job sheet.

The next sheet contains summary of materials for electrical motor control set which can help students comprehends the materials and related practice. The material only specifies important points on control and power sets. One summary of materials is presented in Figure 6 below.

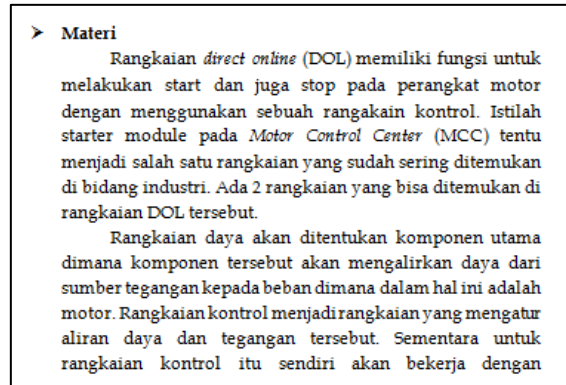


Figure 6. Summary of materials in the job sheet.

The required equipment, supplies and number therefore for such practice are presented in Figure 7, among others is the HMI trainer.

Alat dan Bahan	
Alat dan Bahan	Jumlah
Software CX Prorammer	1
Software Easybuilder	1
Kabel Penghubung	6
Trainer HMI	1

Figure 7. Required equipment and supplies

Drawings of sets are also presented on the job sheet that serve as practical guidance. One of the drawings set is presented in Figure 8 below.

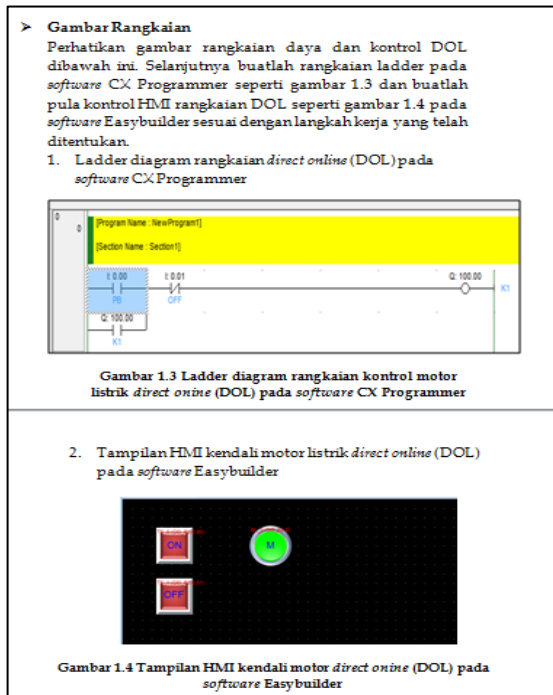


Figure 8. Drawings of Set

The Work Steps contain the exact steps to be conducted during practice, ranging from preparation of equipment and supplies up to cleaning after practice. Instruction for work steps is presented in Figure 9 below.

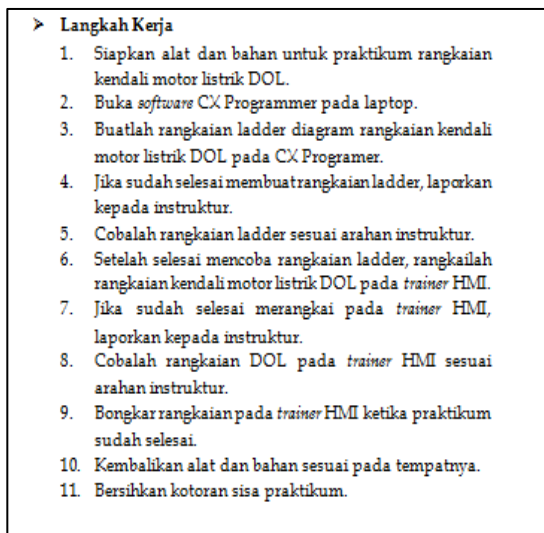


Figure 9. Work Steps

The next sheet contains practice task which specifies performance and theory comprehension. The learning participants perform the practice as

instructed. Task sheet is shown in Figure 10 as follows.

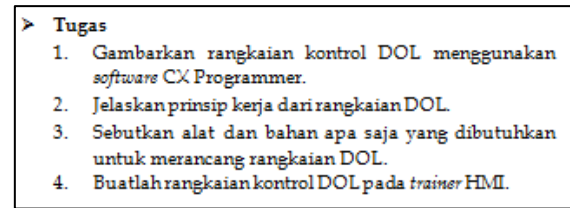


Figure 10. Task Sheet

The last sheet contains a list of reference used for compiling the job sheet. The reference can also be used by the learning participants for further knowledge enrichment. The reference list sheet is shown in Figure 11 as follows.



Figure 11. Reference Sheet

### 3.2 Product Validity

Validated HMI job sheet trainer aspects include title, identity, goal, material, equipment, work step, tasks, answer key, and writing organization. Data gathered from the three validators resulted in Aiken (1998)'s Index V as shown in Table 1. The table shows the lowest index is 0.83 while the highest is 0.92. Therefore, it can be concluded that all of the validators considered HMI job sheet trainer to be valid.

Table 1. Validated Job Sheet

No	Aspects	Aiken V Index	Criteria $\geq 0,70$
1.	Title	0,92	Valid
2.	Identity	0,92	Valid
3.	Goals	0,83	Valid
4.	Materials	0,92	Valid
5.	Equipment and Supplies	0,92	Valid
6.	Work Steps	0,92	Valid
7.	Tasks	0,92	Valid
8.	Key	0,83	Valid
9.	Writing Organization	0,92	Valid

### 3.3 Product Effectiveness

Result of analysis of t-test of testing data shows a value of  $t_h = 49.632$  with df (degree of freedom) of 29 and significance of  $\alpha = 0.05$  resulting in  $t_{tabel} = 2.045$ . There is a significant difference between pretest and posttest. In other words, application of HMI job sheet trainer can improve learning output and therefore the developed job sheet is considered to have an effective impact on learning. Summary for the t-test is shown in Table 2 as follows.

Tabl 2. Result of *paired sample test*

<i>Paired Sample Test</i>					
	N	df	Mean	t	Sig. (2-tailed)
<i>Pretest-Posttest</i>	30	29	51,333	49,632	0.000

### 3.4 Product Practicality

Product practicality is seen from the teachers and student's responses. The response dimension includes aspects of learning activities using job sheet and the related developed products. Student's response scored 87.03% which is categorized as 'very practical'. Teacher's response scored 87.5% which is also categorized as 'very practical'. This means that the developed product has the practicality for use as teaching materials.

### 3.5 Discussion

The result of research shows that the developed tool has the validity, effectiveness and practicality. This is in line with what Nieveen (2010) argues that researches for development should at least cover the aspects of validity, effectiveness, and practicality. In addition to that, the set should indicate that (1) it helps the learning process runs smoothly and effectively in term of transfer of knowledge, (2) it serves to motivate the learners, and (3) generate learner's interest in one hand and introduce the technology applied in the industry. This is well supported by the research developed by Martinez, 2002; Gilmore, 2007; dan Cory, 2009.

## 4 Conclusions

Based on the analysis result, the Human Machine Interface Job Sheet Trainer has proven to be valid, effective and practical. It means that HMI Job Sheet

Trainer is feasible. The feasibility is supported by three aspects namely, (1) validity, which is verified by three experts which resulted in Aiken's V Index of 0.89, which was larger than 0,70, and therefore was valid, (2) effectiveness as tested with *one grup pretest-posttest*, which suggested significant difference of ( $\alpha = 0.05$ ), namely  $t_h = 49.632 > t_{tabel} = 2.045$ , and therefore the developed product is effective in improving the result of study, (3) practicality as proven by a response value of 87.03% which is categorized as 'very practical', and teachers' response of 87.5% which is also considered 'very practical'. It is therefore concluded that the developed material is feasible to be used as teaching materials for Electrical Motor Installation.

Based on the result of research, some suggestion are forwarded, that (1) HMI job sheet trainer is feasible for use as teaching materials to help students in the learning process, (2) it is necessary to develop the materials in a more extensive way to allow easier teaching and learning process on Electrical Motor Installation for better alignment with the demand of the business and industry worlds.

## ACKNOWLEDGMENTS

The authors would like to thank all of the people who helped with the conduct of this research, especially Head of Electronic Engineering Study, Dean of Department of Engineering, Unesa. Principal of SMKN 3 Surabaya, and 12<sup>th</sup> grade students of Electrical Installation Engineering Program, even semester of 2017/2018, SMK Negeri 3 Surabaya who have enthusiastically been involved and motivated being the subject of the research.

## REFERENCE

- Aiken, Lewis R. (1998). *Tests and examiations: Measuring abilities and performance*. New York: John Wiley & Sons, Inc.
- Borg, W. R. dan Gall, M. D. (1983). *Education research an introduction*. New York: Longman.
- Cory, L. (2009). *Authentic materials: An Educator's Guide to Their Use in language Classroom*. USA: Ball State University.
- Erwin, N., Francis, H., Ofosu, R. A.. 2014. Developing a Human Machine Interface (HMI) for Industrial Automated System Using Siemens WinCC Flexible Advance Software. *Journal of Emerging Trends in Computing and Information Science*, 5 (2), 134-144.
- Gilmore, A. (2007). Authentic materials and authenticity in foreign language learning. *Language Teaching*, 40, 97-118.

- Kemendikbud. (2016). *Instruksi Presiden Nomor 9 tahun 2016 tentang Revitalisasi SMK*. Jakarta: Kemendikbud.
- Kemendikbud. (2017). *Panduan pendampingan revitalisasi SMK tahun 2017*. Jakarta: DirjenPSMK.
- Martinez, A.G. (2002). *Authentic materials: An overview*. Free resources for teachers and students of English, Karen's Linguistics Issues, 1-7.
- Nieveen, N., et al. (2010). *An Introduction to Educational Design Research 3<sup>th</sup> Edition*. Enschede: Netzdruk.