Letters in Information Technology Education (LITE)
Vol 6, No 2, 2023, pp. 11–15
e-ISSN: 2654-5667

Development of Basic Electricity and Electronics Practicum Jobsheet for Students of Electric Power Installation Engineering Expertise at SMK Negeri 3 Boyolangu

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Article Info

Article history:
Received: Des 22, 2022
Revised: Jan 19, 2023
Accepted: Feb 24, 2023

Keyword:
Teaching Materials
Practicum
Job sheet
Curriculum of 2013
Electrical Engineering

ABSTRACT

This development research aims to develop printed teaching materials in the form of practicum job sheets to assist the learning process of basic electricity and electronics by the 2013 curriculum. Research and Development is a research model used to develop existing products. The development model in this study is the Sugiyono model. This development stage begins with looking for potential problems, collecting data, designing products, validating designs, product trials, design revisions, product testing, product revisions, usage trials, and product revisions, and ends with mass production. The development of this teaching material has met the criteria for proper use with the results obtained from experts with a validation expert value of 93.8%; product trial results with an average value of 90.4%, and usage trial results with an average value of 93.6%.

I. INTRODUCTION

One of the foundations of the nation's progress is education. The better quality of the nation is supported by the better quality of education organized. According to Ali, Education is a process in a nation that prepares its young generation to live and achieve life goals effectively and efficiently to contribute best to nation-building [1]. The progress of the nation and state is reflected in education so if education is of high quality, the resulting human resources are also of high quality [2].

The government's efforts to improve the quality of education in Indonesia are guided by one of the state objectives stated in the fourth paragraph of the 1945 Constitution, namely to educate the nation's life. Articles 20, 21, 28C (1), 31, and 32 of the 1945 Constitution also stipulate that the government seeks to organize education within the framework of a national education system. This latter national education system is contained in Law No. 20/2003 on the National Education System. The government is also trying to improve the quality of education through various policies such as teacher and lecturer certification, school operational support, and the establishment of national standards, which are embodied in Government Regulation No 19 of 2005 on National Education Standards. Education standards include content, process, manpower, facilities and infrastructure, management, assessment, funding, and graduation competencies. With these standards' help, education quality can be improved significantly and purposefully. If each education unit can achieve or even exceed the national education standards, it can be said that education is of high quality.

Improving the quality of education is proposed to improve the quality of human resources in Indonesia, one of which is aimed at the SMK level. SMK students are expected to be ready to become a skilled workforce. Based on data from the Ministry of Education and Culture of the Republic of Indonesia accessed in Dapodik on June 2, 2021, the number of SMKs is 14,339 out of a total of 28,398 high schools in Indonesia in the 2020/2021 academic year. Given

that the number is so large, SMKs must be managed thoughtfully. The expertise competencies at the SMK level must be mastered are productive, creative, innovative, effective, and qualified to participate in society as skilled workers. These skills are obtained through the SMK learning process through theory and practice. The learning process in the form of theory will broaden students' insights into the materials provided. However, theoretical learning will be complex for some students who cannot imagine the theory. Therefore, it is necessary to have learning in the form of practicum that can increase student skills.

Practical and technical skills can be developed with training activities in the learning process. There are still many learning processes that should be carried out practically but are still carried out theoretically and teacher-centered. This will reduce students' enthusiasm for improving their competence. For the implementation of practicum learning to run effectively, it is necessary to have a practicum implementation manual. Practical implementation instructions are needed to carry out learning activities systematically. The solution that can be used is to use practicum worksheets [3]. Using practicum worksheets in practicum can make it easier for students to do their work according to the instructions listed [4], [5].

Based on observations made at SMK Negeri 3 Boyolangu on September 15, 2020, it was found that there were already several job sheets. However, no Basic Electricity and Electronics practicum job sheets are available to facilitate students' assignments. This subject weighs 108 lesson hours in the first semester and 96 in the second semester. The Basic Electricity and Electronics syllabus has fourteen essential competencies in two semesters. The first-semester learning activities are carried out from critical competencies one to ten and, in the second semester, continued until necessary competencies fourteen.

II. EASE OF USE

This type of research is research and development (R&D) using Sugiyono's development model because it can increase the feasibility of the product by testing its effectiveness with a more structured systematic. Some stages can be illustrated as follows:

A. Potential and Problem Stage

In this first stage, researchers analyzed potential problems at SMKN 3 Boyolangu to know the existing problems and provide solutions.

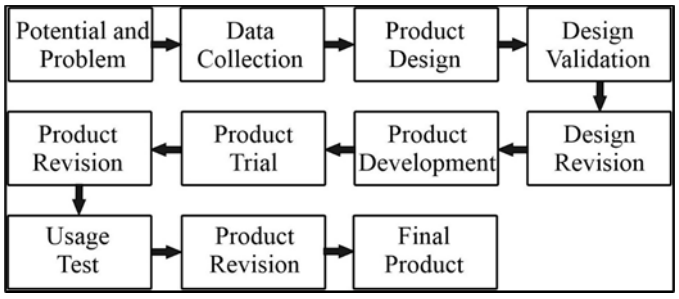

Fig. 1. Steps of sugiyono's development model

B. Data Collection Stage

Based on the information collected, researchers can plan teaching materials and focus on materials by the latest 2013 curriculum so that students can learn and understand the material according to the demands of the competencies that must be mastered.

C. Product Design Stage

At this stage, the researcher designs the product from the cover page content to suggestions more interestingly so that students are more motivated in the practicum process.

D. Design Validation Stage

After the product design was realized and validated by two supervisors, the researchers then analyzed the input from the experts. They used it as input to improve the job sheet design before it was tested.

E. Design Revision Stage

After receiving an assessment from experts in the form of input, criticism, and recommendations that can be considered as a basis for improving product design to get a good predicate so that the product can proceed to the trial stage.

1) Stage of the Development Process

At this stage, researchers improve the quality of teaching materials based on the results of design revisions that experts have validated.

F. Product Trial Stage

The products made are tested on several small-scale students to get criticism, suggestions, and comments that can be used to improve the products developed.

G. Product Revision Stage

This revision is carried out if there are still shortcomings during the trial in the small-scale group. However, if the product proves to be feasible, then the product can be tested directly on a large-scale group.

1) Usage Testing Phase

The trial in this large-scale group used a questionnaire to collect student responses in terms of material, convenience, usability, and attractiveness of the display and to find out the obstacles when using the product to find out the advantages and disadvantages of the product.

H. Final Product Stage

When the final product has been declared feasible and valid, the teacher can mass-produce it and use it as practical support for Basic Electricity and Electronics subjects for class X Electric Power Installation Engineering students at SMK Negeri 3 Boyolangu.

The test subjects in this study were 11th-grade students of Electrical Power Installation Engineering of SMK Negeri 3 Boyolangu who had taken Basic Electricity and Electronics. The types of data in this development research are quantitative data and qualitative data. Quantitative data collection instruments use

questionnaires given to experts and students, qualitative data obtained from expert opinions and suggestions during the validation process, and student responses after using the product. The data generated from expert validation was then processed and matched with Table 1 [6].

TABLE I. CRITERIA FOR VALIDATION RESULTS

No	Validation Percentages (%)	Description
A	86 – 100	Very feasible
B	71 – 85	Feasible
C	51 – 70	Inappropriate
D	1.00 - 50	Not feasible

III. RESULTS

This research and development produced printed teaching materials as practicum worksheets. The following are parts of the Basic Electricity and Electronics practicum Job sheet that has been developed.

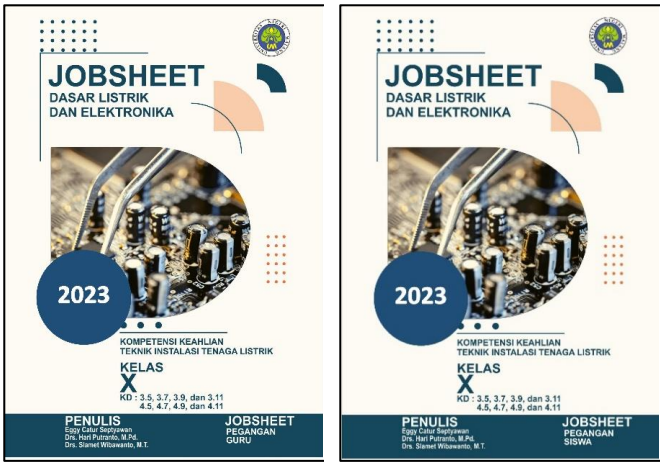

Fig. 2. Teacher and student's job sheet cover

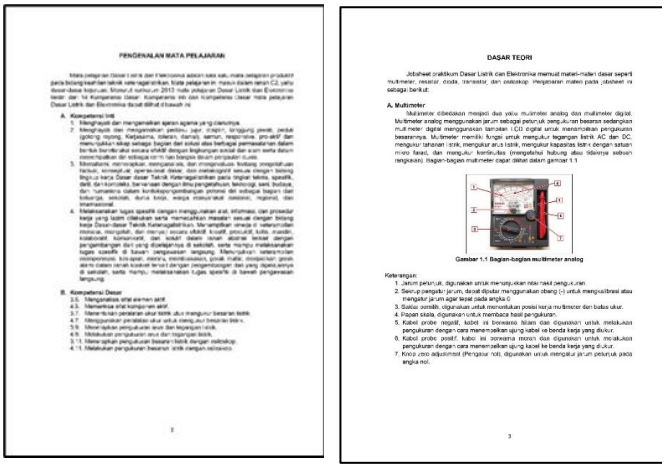

Fig. 3. Learning the content of the job sheet

Fig. 4. Jobsheet identity

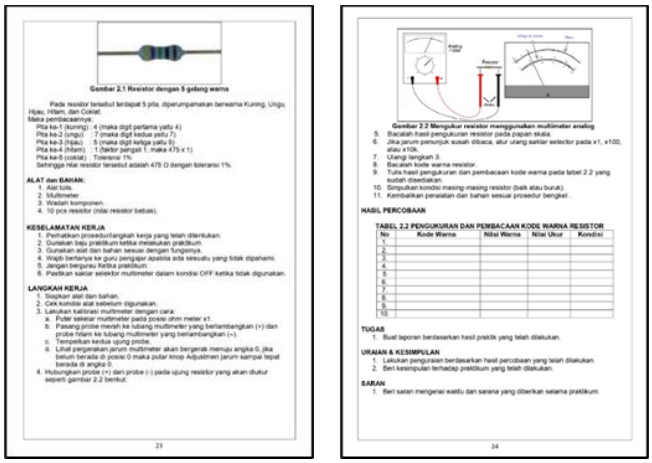

Fig. 5. Job sheet work steps

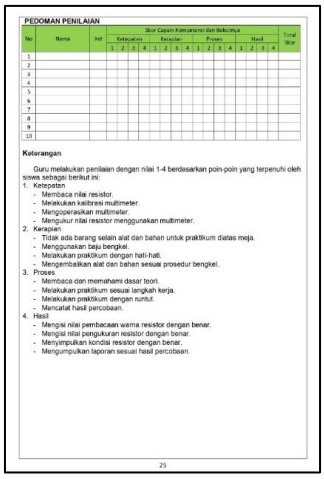

Fig. 6. Job sheet assessment guidelines

Figures 2 are found at the beginning of the job sheet, while 3, 4, and 6 are located in part II. For Figure 6, the assessment guidelines are only in the teacher's job sheet.

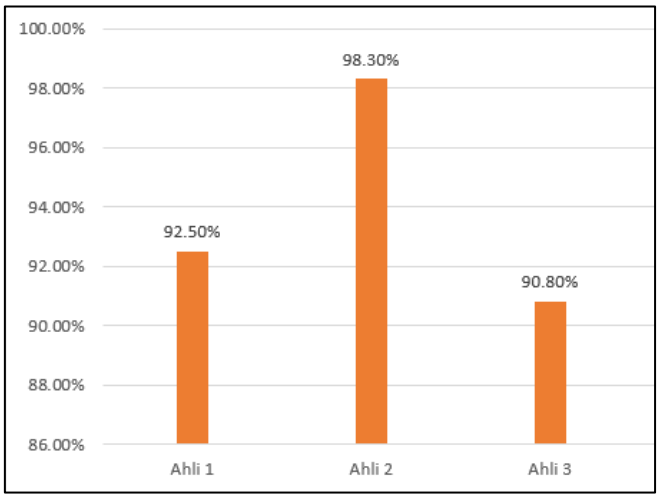

Fig. 7. Graph of design validation results

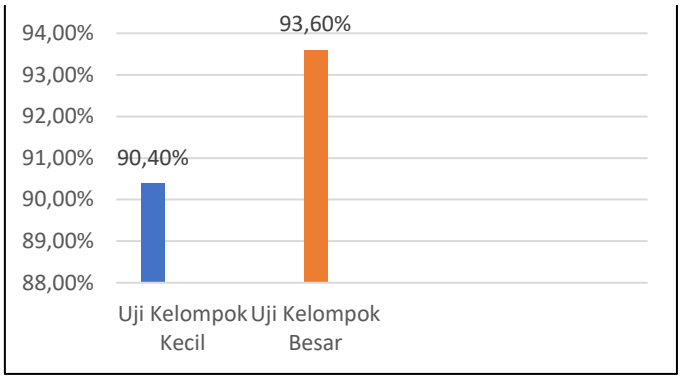

Fig. 8. Graph of trial results

Based on Figure 7, expert 1, as supervisor one, conducted design validation on February 10, 2023, and obtained a score of 92.5%. Expert 2, as supervisor 2, completed design validation on February 10, 2023, and received a value of 98.3%. Expert 3, as the teacher of the Basic Electricity and Electronics subject, conducted a design validation test on February 17 with a score of 90.8%.

Based on Figure 8, the average percentage of job sheet assessment questionnaire data from 20 student respondents in class XI competency in Electrical Power Installation Engineering expertise is 90.4%. Researchers conducted a job sheet practicum at the trial use stage from February 21, 2023 to March 2, 2023. They asked for help from XI-grade students in the competency of Electrical Power Installation Engineering expertise. The assessment results by student respondents in class XI TITL 1, TITL 2, and TITL 3 are shown in Appendix 7. The average percentage of questionnaire data from three classes of XI TITL students is 90.4%.

IV. Discussions

This development uses Sugiyono's modified Research and development (R&D) method [7]. There are three points in the research and development of the Basic Electricity and Electronics practicum job sheet: the problem formulation and research objectives. The first stage is designing the Basic Electricity and Electronics practicum job sheet. At this stage, the researcher compiled the structure of the job sheet to be developed. The Basic Electricity and Electronics practicum job sheet was prepared, referring to the essential competencies in the 2013 curriculum syllabus [8]. There are 14 crucial competencies in Basic Electricity and Electronics subjects [9]. The vital competencies used are: (a) 3.5 Analyze the properties of active elements, (b) 4.5 Check the properties of active components, (c) 3.7 Determine electrical measuring equipment to measure electrical quantities, (d) 4.7 Use measuring equipment to measure electrical quantities, (e) 3.9 Apply current and voltage measurements, (f) 4.9 Perform current and voltage measurements, (g) 3.11 Apply measurements of electrical quantities with an oscilloscope, (h) 4.11 Perform measurements of electrical quantities with an oscilloscope. This development does not use all essential competencies because only some basic competencies of Basic Electricity and Electronics subjects are practiced. The next stage is that from several critical competencies in Basic Electricity and Electronics subjects, seven titles of Basic Electricity and Electronics practicum job sheets are developed as follows: (a) Measuring resistor values with a multimeter, (b) Measuring DC voltage and current with a multimeter, (c) Creating diode characteristics with a multimeter, (d) Measuring forward bias and reverse bias on diodes, (e) Determining transistor characteristics with a multimeter, (f) Measuring DC voltage using an oscilloscope, (g) Measuring AC voltage using an oscilloscope.

After the Basic Electricity and Electronics practicum jobsheet was developed, the three experts' next step was design validation testing: expert 1, Drs. Hari Putranto, M.Pd., as the first supervisor, obtained the assessment results with a percentage of 92.5%: expert 2, Drs. Slamet Wibawanto M.T., as the second supervisor, received the assessment results with a percentage of 98.3%: expert 3, Dra. Sariyem, the Basic Electricity and Electronics teacher at SMK Negeri 3 Boyolangu, obtained a score of 90.8%. From the three experts, the assessment results show that the developed Basic Electricity and Electronics practicum job sheet is suitable for use without revision based on Table I validation result criteria.

Product trials were conducted after the design validation stage by the three experts. This trial used a random sampling technique by taking 20 class XI Expertise Competency in Electrical Power Installation Engineering students who had taken Basic Electricity and Electronics subjects [10]. The average percentage result of the assessment questionnaire data from the 20 students is 90.4%, indicating that the developed Basic Electricity and Electronics practicum job sheet is suitable for use without revision based on Table I validation result criteria. According to these results, the Basic Electricity and Electronics practicum worksheet is feasible and can be used in actual practicum activities. At the usage trial stage, researchers used class XI students of Electric Power Installation Expertise who had taken Basic Electricity and Electronics subjects. The average percentage of assessment questionnaire data from three classes of students in class XI Expertise Competency in Electrical Power Installation is 93.6%, which indicates that the developed Basic Electricity and Electronics practicum job sheet is feasible to use without revision based on Table I validation result criteria. Based on these results, the development product in a Basic Electricity and Electronics practicum worksheet is declared feasible and can be used in actual practicum activities.

V. CONCLUSION

The design of the job sheet for Basic Electricity and Electronics Competency Electric Power Installation Engineering Expertise is based on the basic competencies in the 2013 curriculum syllabus. The essential competencies are (a) 3.5 Analyse the properties of active elements, (b) 4.5 Check the properties of active components, (c) 3.7 Determine electrical measuring equipment to measure electrical quantities, (d) 4.7 Use measuring equipment to measure electrical quantities, (e) 3.9 Apply current and voltage measurements, (f) 4.9 Perform current and voltage measurements, (g) 3.11 Apply measurements of electrical quantities with an oscilloscope, (h) 4.11 Perform measurements of electrical quantities with an oscilloscope. Developing job sheets for Basic Electricity and Electronics subjects was carried out by starting to compile and write. Compilation and writing are sourced from the syllabus (K-13). The titles of the developed job sheets are (a) measuring resistor values with a multimeter, (b) measuring DC voltage and current with a multimeter, (c) making diode characteristics with a multimeter, (d) measuring forward bias and reverse bias in diodes (e) making transistor characteristics with an analog multimeter (f) measuring DC voltage using an oscilloscope (g) measuring AC voltage using an oscilloscope. The Basic Electricity and Electronics course job sheet's feasibility test consists of product and usage trials.

The product trial was conducted after the product was developed. The product trial was applied to 20 students of class XI of the Electric Power Installation Engineering Expertise Competency. The average percentage result of the product trial was 90.4%. The usage trial was conducted in three XI Electric Power Installation Engineering Expertise classes. The average percentage result of the usage trial is 93.6%.

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