

Development of Digital Practicum Job sheet as Teaching Material in Electronic Engineering

Ilmiyati Rahmy Jasril^{a*}, Thamrin^b, ^{a,b}Faculty of Engineering, Universitas Negeri Padang, Jl. Prof. Dr. Hamka, Air Tawar Bar., Kec. Padang Utara, Kota Padang, Sumatera Barat 25132, Indonesia, Email: ilmiyatirahmyjasril@ft.unp.ac.id

This study aims to produce job sheets suitable for use as teaching materials in digital practicum. The method used in this research is Model Analysis, Design, Development, Implementation and Evaluation (ADDIE). The analysis phase, identified Graduates of Learning Outcomes, and sub-Outcomes of Learning from the Digital Practicum. At the design stage, the format and appearance of the job sheet are designed. The next step is the process of creating job sheets for all learning outcomes. At the Development stage, the research instrument used is content and media validation sheet that has been validated by two content and two media experts. At the Implementation stage, job sheets were tested on students. During the Evaluation stage, competency test sheets are prepared for several job and user response sheets. User response data is then processed to obtain practicality. The results show that firstly the job sheets developed were valid in terms of content and media. Secondly; the job sheets developed from user responses are very good in fostering learning interest and practical as teaching material. Based on the results of the study it was concluded that the job sheets that were developed were very suitable for use as teaching materials in digital practicum courses.

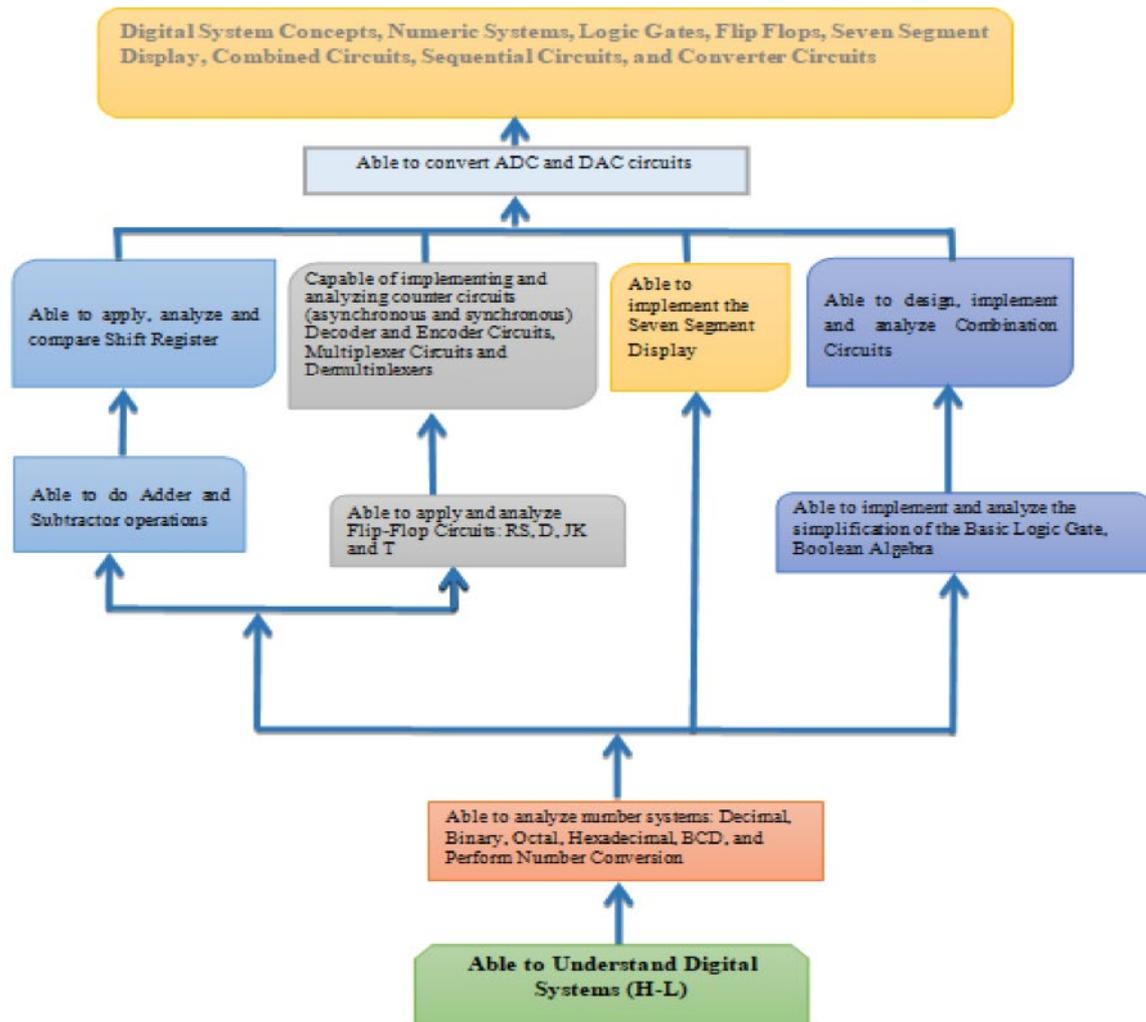
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Introduction

The use of appropriate learning methods greatly affects learning outcomes. The right method will help achieve learning objectives. Vice versa, if the method used is not appropriate, it results in ineffective learning. Digital practicum is a compulsory subject in the Electronic Engineering Education Study Program with main competencies and applying Electronic and Digital

concepts . The assessment map and the material collection are shown in Figure 1. In terms of material, this course includes having difficulty and graded understanding and is related to subsequent material. If a practicum activity is not completed or completed in accordance with the results, it will cause difficulty in the next material.

Figure 1. Map of Digital Practicum Material



Digital Practicum also incorporates courses that require a combination of skills and understanding of digital system concepts. For example, on flip-flop material, students are expected to be able to publish the diagrams provided and then assemble them into collections using the electronic components provided. Furthermore, students conduct tests and measurements to prove that the series created has worked in accordance with the theory.

Various discussions found in the implementation of learning in the odd semester of 2017/2018 initial discussion (apperception) of students are still low. This can be seen when given questions

at the beginning of lectures about the material to be practised. In general, students do not understand the agreed material and avoid the material provided by educators. Students also do not take the initiative to explore each topic studied so it is difficult to analyse the measurement data.

Practicum implementation is also less effective. More time is needed for electronic components to become a series. This diagram replaces compatibility resolution. This situation is also added to the competence of students using supporting instruments such as multimeters and oscilloscopes. Sometimes material is not finished and must be repeated at another time. This condition replaces the learning outcomes of courses not determined at the specified time.

Evaluation during 2017-2018 obtained the learning results indicated in in Table 1. There are several aspects assessed, namely the assembly of the circuit, measurement, work steps and work safety. The average student achievement varies. In the aspect of assembling electronic circuits, for example, it can still be improved, while aspects of work steps for student achievement are fairly low.

Table 1: Final Grades Semester (UAS) Digital Practicum Course

Year	Total students	Assessment			
		N ₁	N ₂	N ₃	N ₄
2017	23	70,74	63,09	59,62	53,27
2018	20	73	67,25	65.35	74,85

Source: Digital Practicum Lecturer

Information:

N₁ = Assembling Circuits

N₁ = Measurement and Measurement Results

N₃ = Work steps

N₄ = Work safety

Learning outcomes signify the representation of competencies used to shift the world of work (Wulandari & Surjono, 2013). Learning outcomes are abilities possessed by having good knowledge (cognitive), skills (psychomotor) and attitudes (affective) obtained or obtained through the teaching and learning process (Pingge, 2016). Learning outcomes are patterns of action, values, understanding, attitudes, appreciation and skills. The conclusion of all above experts above forms the discussion about the results of learning made by students after improving the learning process.

Learning outcomes are influenced through internal and external factors. Internal factors are influenced from within students (Kurniawan, Wiharna, & Permana, 2017). One of the external factors that influence learning outcomes is the school factor: teaching methods, curriculum, teacher and student relationship between school disciplines and learning media (Seputra & Wening, 2017; Rizal, et al. 2019). During practicum learning in the lab, teaching materials are used in the form of worksheets or job sheets. Job sheet is a worksheet that contains information or instructions in working on particular material or work (Suparman & Wijayanti, 2019). A job sheet is a guide or tool used by students to carry out an investigation or problem-solving activity in practicum and is useful as learning (Mindarta, et. al, 2018). Job sheets can be in the form of a set of basic activities that must be carried out by students to maximise understanding in an effort to form basic abilities in accordance with indicators of learning objectives. Job sheets are worksheets used in practical activities to facilitate students in completing certain practical activities (Widyastuti & Utami, 2018).

Several types of research related to the development of job sheets have been carried out: I Komang dan I Ketut: Research I Komang and I Ketut: this study found the presentation of interesting teaching materials and relevant learning materials (Rusmariadi, I Komang Rimpung, 2015); Triana and Indiah of this study found that the development of job sheets developed on subjects of practical work stone is suitable for use in learning practical stonework in class XI BBT SMK 1 Madiun. The implementation of the learning device in the learning process is also quite effective, as well as student response questionnaires, therefore learning outcomes are stated to be effective (Triana & Indiah, 2016); Ranu and Nurhayati. This study found that the development of a microstrip antenna job sheet based on CST Studio Suite 2011 software has been validated so it can be categorised appropriately. Student responses to all aspects contained in the learning media were stated to be appropriate. This shows that the resulting job sheet is suitable for use as a learning medium (Laksono & Nurhayati, 2016); Rini and Iga. This study found that the product-based worksheet developed is valid for use in the subject of Object-Oriented Programming (Widyastuti & Utami, 2018). The results conclude that the development of worksheets are intended to produce designs or product job sheets or worksheets as teaching materials or learning instructional media.

Based on the above facts, it is necessary to develop job sheets as teaching materials for digital practicum courses that are feasible and support the achievement of learning objectives. With the achievement of learning objectives, students are expected to have ability in accordance with what is expected after following the learning process.

Research Methods

The research consists of the Analysis, Design, Development or Production, Implementation or Delivery and Evaluation (ADDIE) model (Sari, 2017). The steps taken to achieve the research

objectives are as follows:

Analysis

At this stage, Graduate Learning Outcomes, learning outcomes, and Sub-Learning Outcomes are identified from Digital Practicum subjects. The target in this tool is all Sub CPMKs by analysing Graduates Learning Outcomes and Learning outcomes that have been set in the curriculum.

Design

This stage is designed for the format and appearance of the job sheet. Furthermore, the creation of a job sheet tailored to each learning achievement for all material that has been completed in the previous step.

Development

This stage creates the construct validation sheet and the content and validation of the practicum media. The next process is validation by the material and media validator to send the feasibility of the job sheet. Suggestions and validator responses are made material for the revision of the job sheet.

Implementation

This stage includes testing job sheets on research subjects, namely students in the odd semester of the academic year 2019/2020 in Electronics Engineering Education, Padang State University who take Digital Practicum Courses. Subsequently, a questionnaire sheet on the practicality of the product teaching material was developed for students. Student responses are then analysed to obtain practicality job sheets. At this time, the target has been to obtain the practicality data from the user.

Evaluation

This stage begins with the competency test sheets consisting of several job and user response sheets. Furthermore, giving tests to research subjects to get the effectiveness of the use of job sheets to improve learning outcomes.

Research Result

The final product of this study is a job sheet about Digital Practicum Subjects in the Department of Electronics Engineering, Faculty of Engineering, and State University of Padang. This research and development are carried out through the following validations:

Content Validation

At this stage, the job sheet is validated to find out whether the created job sheet is in accordance with the specified Learning Subjects. There are 2 experts involved in this process. The results of the validation from these two experts are shown in the following table:

Table 2: Data on Validation Result Contents

aAssessment	Content Validator 1	Content Validator 2	Average score	Score Ideal
Conformity of Material with learning outcomes	4,91	5	4.96	5
Material Accuracy	5	5	5.00	5
Cause Curiosity	4,75	5	4.88	5
Average			4.85	

The corresponding table shows that the suitability of materials with learning outcomes obtained values of 4.91 and 4.83. This means that the level of the material provided on the worksheet is compatible with CPMK. The accuracy of the material gets a value of 5 which means the material is highly accurate.

Media Validation

At this stage, whether job sheets that are made are in accordance with the rules and appealing appearance as a learning medium of practice is validated. There are two experts involved in this process. The results of the validation from the two experts are shown in the following table:

Table 3: Data on Media Validation Results

Assessment	Media Validator1	Media Validator 2	Average score	Score Ideal
Display Cover	4,83	4,67	4.75	5
Display Job sheet Contents	5	5	5.00	5
Ease of Use	4,5	4,75	4.63	5
Consistency	5,0	4,7	4.85	5
Format	5	5	5.00	5
Average			4.85	

The table above shows the two validators' evaluations on all aspects obtained excellent grades, from grades 4.5 to 5. The above assessment shows that the job sheet can be categorised as being very good as a digital practicum teaching material.

During the media validation process, there are a number of things that need to be completed as part of the revised job sheet. Those aspects which are revised and where improvements have been made can be seen in table 4 below:

Table 4: Job sheet Revision Results

1. General Job sheet instructions for students
<p>Before repair: general guideline items for using digital job sheets initially 3 items include:</p> <ol style="list-style-type: none"> 1. Read the instructions for use listed on the job sheets. 2. Check the tools and materials available before completing the practicum. 3. Follow the lecturer's instructions . <p>After repair: 2 items added.</p> <ol style="list-style-type: none"> 1. Read the instructions for use listed on the job sheets. 2. Check the tools and materials available before completing the practicum. 3. Follow the lecturer's instructions . 4. Ask the lecturer, if you have problems or difficulties when practising. 5. Gather report assignments in accordance with the format specified on the Job Sheet.
2. Work Safety job sheet for students
<p>Before repair: Work safety items initially include 5 items as follows:</p> <ol style="list-style-type: none"> 1. Students must use practical clothes (JasLab) while in the laboratory. 2. If an emergency occurs then follow the work and procedural steps. 3. Make sure the results of your circuit match the circuit drawings before connecting to the voltage source. 4. Use tools and materials in accordance with their functions. 5. Read the instructions for using the tool properly.

After repair: The initial five work safety items were increased to the following 8 items.

1. Students must use practical clothes (JasLab) while in the laboratory.
2. If an emergency occurs then follow the work and procedural steps.
3. Make sure the results of your circuit match the circuit drawings before connecting to the voltage source.
4. Use tools and materials in accordance with their functions.
5. Read the instructions for using the tool properly.
6. Do not misbehave or eat and drink during practicum.
7. Tidy up and return tools and materials according to their place.
8. Follow the rules in the laboratory.

3. The colour composition and layout need special attention for the cover of the job sheet.

Before repair: the composition and level of colour sharpness on the cover of the job sheet is still low and needs to be improved.
After repair: the composition and level of colour sharpness on the cover of the job sheet have been adjusted so that the cover appearance is more appealing.

4. Consistent numbering format

Before repair: numbering format is not consistent for each chapter.
After repair: numbering format is adjusted for each chapter.

3.1. Practicality test stage for job sheet users.

Validation of the level of practicality of the job sheet is performed on the user. At this stage, the module is tested on as many as 15 respondents. Then the questionnaire is distributed to respondents to find out whether the worksheet has met the practicality test. The results of responses can be seen in Table 5:

Table 5: Responses

Assessment	Score Achievement	Maximum Score
Appeal	4,50	5
Content	4,53	5
Language	4,59	5
Work safety	4,39	5
Consistency	4,55	5
Display (graphic)	4,59	5
Average	4.53	

The table above indicates that the average respondent consists of 4.5. This shows that the job sheet is able to foster high interest and motivation for students to understand the material presented. This is consistent with the opinions of Qomariyah & Joko, (2016); Rachmaniar & Purwadi, (2018) and Hidayat & Kustini, (2016) according to whom an effective job sheet

must present teaching materials so that students can interact more easily with the material. Regarding the material aspect, the respondents' answer is 4.5. This can be interpreted as the material presented is in accordance with achievements and learning objectives and can help students understand the concept (Bahtiar, Khumaedi, & Syamwil, 2019). Concerning language, a value of 4.6 is obtained, which means the language used in the job sheet is understood and can convey the desired message. Regarding of work safety, a value of 4.4 is obtained, which means that work safety factors have been contained quite completely on the job sheet. With regards to consistency, a value of 4.5 is obtained, meaning that the job sheet is consistent in the use of language, terms and writing format. Regarding appearance (graphic), a value of 4.6 is obtained so the overall appearance of the job sheet is very appealing. Overall the average respondent's answer on all aspects of the practical worksheet on points 4.4 to 4.6 achieved a maximum value of 5. This shows that the created job sheet can be said to be practical and feasible as a learning media (Nopitasari & Purnama, 2012); (Anggara, 2016).

Conclusions

Based on the results of the research and development carried out, it can be concluded that the developed job sheet products are feasible and can be used as teaching materials for digital practicum courses. Job sheet material validation obtained a result of 4.85 from a maximum score of 5 in the excellent category. Media validation obtained a score of 4.85 from a maximum score of 5 in the excellent category. Practicality test results from users obtained a score of 4.53 from a score of 5 with a very effective category.

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