Development of E-Modules on Basic Subjects of Electricity and Electronics

Edo Ari Yurmansyah, Edidas, Ahyanuardi, Asrul Huda
Pascasarjana Fakultas Teknik Universitas Negeri Padang
yurmansyah1@gmail.com

ABSTRACT: This study aims to produce an electronic module based on a self-directed learning learning model that is Valid, Practical and Effective. So that it can help students learn independently and understand the basic theory of Electricity and Electronics. This research is a research and development (R&D) study that refers to the ADDIE instructional development model. The stages in the ADDIE development procedure are Analysis, Design, Development, Implementation and Evaluation. Research Results based on the assessment of 77% material expert validators and 82% media experts, the developed electronic modules are valid. Based on the response of 83% of teachers and 84% of students, the electronic modules developed have high practicality. The results of effectiveness are known from increasing students’ theoretical understanding and testing the effectiveness of the material tested with quite effective results with an N-Gain value of 62%.

Keywords: E-Module, Validity, Practicality, Effectiveness

INTRODUCTION
The development of communication technology that facilitates all access in all fields, especially in the field of education. Education is not far from the face-to-face activities of educators and students who are aware of infrastructure, educator competence, media and student enthusiasm. According to (Dimyati, 2013) said that learning activities are a process of observing the environment and providing good action for oneself. (Dantas, 2020) also says that activities that involve a process, income and output to produce something are called the learning process. Student learning outcomes are influenced by learning activities (Arsyad, 2016). In the implementation of the learning process according to (Ekayani, 2017) to create good results, good educators, students, material objectives, supporting sapras and evaluations are needed.
SMK is a vocational school that must have more competence and different values. The competencies in question are specific competencies that must be possessed that are different from other schools. This competency is in the form of hard skills that will be useful in life that supports work in the business world and industry. SMK
students create outputs that directly work in their fields. Basically, SMK is more concerned with vocational and is required to master the field of competence taken, therefore in SMK carry out Job Field Practice (PKL) activities in the business world and the industrial world as a form of supporting the improvement of competence from the expertise taken. Student skills are influenced by teachers, teachers play an important role in improving the quality and quality of education. The learning carried out is effective, creative and fun, so students are interested in learning so as to achieve good learning outcomes. However, there are still many obstacles in this achievement, this is stated by (saragih, 2017).

SMK in the learning process is synonymous with practice that uses a lot of the Project Base Learning model and also the teacher is used as the main figure as the driving force with the teacher-centered learning model where the teacher directly provides knowledge (Sofyan, 2010). In the transfer of knowledge effectively and efficiently, the right media is needed. According to Edgar Dale (Vienna Sanjaya, 2008) the media helps students form an experience. Students who acquire knowledge, skills and attitudes with good conditions through a person or material used are called media. The technological era of the industrial revolution 4.0 the learning process is required to use IT-related media to create effectiveness. As stated by (BNSP, 2010) that educators are required to utilize and combine various media in creating effective and efficient learning. Interesting media is certainly needed for media development as media innovation. According to (shanmugan, 2019) states that the delivery of teachers in providing learning materials should be by developing media. Good media produces good results. Modules can be used as media but are manual but if developed with technology it is called an electronic module (hashim, 2018).

Based on the results of researchers' observations at SMKN 6 Bungo in 2022 SMKN 6 Bungo has Lima Expertise competencies, namely Industrial Electronics Engineering, Multimedia, Fashion, Culinary and Beauty Management. Because the researcher teaches in the Department of Industrial Electronics Engineering and Multimedia, the researcher focuses on the problems in TEI in the subject of Basic Electricity and Electronics (DLE) because many students graduate on practical competencies but fail in theoretical learning. From the results of interviews with DLE teachers, it was explained to researchers that the use of electronic modules has not been used due to the limitations of learning media but only using print modules that can be used.

Mrs. Dinda Emilia Triyanti, S.Pd waka curriculum:
"At this time, no teacher of SMK Negeri 6 Bungo uses E-Module as a learning medium. Teachers usually only use regular modules that are downloaded on the internet or use library books only. And there are also teachers who use videos and power points in the learning process at SMK Negeri 6 Bungo". (Dinda Emilia Triyanti, S.Pd)

In addition, dinda’s mother also said:
"The need for the development of the latest media for effectiveness and efficiency in the learning process, especially for productive subjects". (Dinda Emilia Triyanti, S.Pd)

In addition to Waka curriculum, DLE Subject Teacher Mr. Harkatun Ganexa, S.Pd stated in a direct interview that students are more interested in practicum in labor than in learning theory in class and students master practicum skills more. So as to make the theoretical value of students in theory have a low value but a high practice value. The development of e-modules was also not carried out at SMK Negeri 6 Bungo as said by Mr. Harkatun Ganexa, S.Pd.

"The problem that usually occurs is that the value of practice is higher than the value of knowledge. And for the development of e-modules in the Department of Industrial Electronics Engineering has never been implemented". (Harkatun Ganexa, S.Pd)

Based on the Final Ujian value of D asar Listrik and Electronics shows a low value of material comprehension while when compared to the practicum value obtained by students is higher.

Table 1.1 Data on Final Semester Examination Results of Class X Industrial Electronics Engineering (TEI)

<table>
<thead>
<tr>
<th>NO</th>
<th>VALUE</th>
<th>STUDENT</th>
<th>COMPLETE</th>
<th>INCOMPLETE</th>
<th>AVERAGE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory</td>
<td>31</td>
<td>5</td>
<td>26</td>
<td>51.87</td>
</tr>
<tr>
<td>2</td>
<td>Practice</td>
<td>31</td>
<td>31</td>
<td>0</td>
<td>82.84</td>
</tr>
</tbody>
</table>

Based on the above problems, using the right media allows solving these problems. The use of media that utilizes technology such as modules that are used as electronic modules. So that the module is called multimedia which consists of writing, video, sound, simulation and online exam link features. According to research (Pratama, 2019) on the development of effective, valid and feasible multimedia products that have been tested.

When compared to previous research, it is much different because the media development used is online and only uses a laptop. Meanwhile, the research that the author did was biased in online and offline access, with various forms of formats such as SWF, Exe, Html. As well as exams conducted online using google forms.

Electronic modules as an active and effective medium so that students are excited about learning (admaja). The development of electronic modules that can be accessed online and offline using laptops, computers, and smartphones is a medium that is in line with the needs of students in increasing the value of theoretical material competition. So based on this, researchers conduct research on the development of E-Modules (electronic modules).
METHODS
ADIIE (Analysis-Design-Development-Implementation-Evaluation) is a model in research development. The development procedure used in this research is the development of ADIIE. According to Raiser, this model has 5 stages, namely. Analysis, Design, Development, Implementation, Evaluation

Data Analysis
Acquisition of data on validity, practicality and effectiveness. The data obtained are calculated based on the methods and theories used using the help of Microsoft Excel. As for the analysis of the data obtained: the calculation is obtained on average each validator statement based on Aiken’s coefficient V with a value of 0.77 with Valid Categories. With the values of each aspect as follows.

Table 4.7. Categories of each Material Aspect

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Shopping (Self Instructio)</td>
<td>Valid</td>
</tr>
<tr>
<td>Self Contained</td>
<td>Valid</td>
</tr>
<tr>
<td>Stand Alone</td>
<td>Valid</td>
</tr>
<tr>
<td>Adaptive</td>
<td>Valid</td>
</tr>
<tr>
<td>Friendly.Familiar (User Friendly)</td>
<td>Valid</td>
</tr>
<tr>
<td>E-Module Components</td>
<td>Valid</td>
</tr>
<tr>
<td>Self Directed Learning</td>
<td>Valid</td>
</tr>
</tbody>
</table>

For the medium the average result obtained from each validator statement is based on Aiken’s coefficient V with a value of 0.82 with Valid Category. With the values of each aspect as follows.
Table 4.9. Categories of each Aspect of Media

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving</td>
<td>Valid</td>
</tr>
<tr>
<td>Usability</td>
<td>Valid</td>
</tr>
<tr>
<td>Functions</td>
<td>Valid</td>
</tr>
<tr>
<td>Linguistics</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Data
From the results of the distribution of the questionnaire to 25 students, the Head of SMKN 6 Bungo M. Gasim S, S.T, Vice Principal of Bid School. Curriculum Dinda Emilia Triyanti, S.Pd, Head of Multimedia Expertise Program Shofian Atsatsaury Nst, S.Pd, Head of Industrial Electronics Engineering Expertise Program Lisa Andriani, S.Pd., M.Pd.T. and productive teacher of industrial electronics engineering Harkatun Ganexa, S.Pd then obtained practicality data which was then processed using Microsoft Office Excel with the calculation of the isan tract based on student responses 84% with High Category and 83% based on teacher response with High Category based on calculation resultsn Percentage interval category.

Effectiveness Test Data
Data Normality Test
This normality test was carried out on two data obtained, namely pretest data and posttest data. The normality test was performed using rocky calculations of the SPSS application which can be seen in the table below.

Table 4.13. Normality Test Results

<table>
<thead>
<tr>
<th>Tests of Normality</th>
<th>Kolmogorov-Smirnov$^a$</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td>Pre_Test</td>
<td>.142</td>
<td>31</td>
</tr>
<tr>
<td>Post_Test</td>
<td>.147</td>
<td>31</td>
</tr>
</tbody>
</table>

In the output of the Test of Normality, pretest and posttest normality tests are obtained. based on the Kolmogrov-Smirnov Test of Normality a pretest class shows a signification value of 0.114 greater than 0.05 (0.114 > 0.05) then the data is normally distributed. While the data Posttest signification value is 0.087 and greater than the signification value of 0.05 (0.087 > 0.05) then the data is declared normally distributed. While the Shapiro-Wilk Test of Normality pretest class shows a
signification value of 0.099 and greater than the signification value of 0.05 (0.099 > 0.05) then the data is declared normally distributed. While the posttest data shows a signification value of 0.055 and greater than the signification value of 0.05 (0.055 > 0.05) then the data is declared normally distributed.

**Paired Test T-Test Sample**

After the data is normally distributed, it is analyzed with parametric statistical analysis. Parametric statistical tests carried out on pretest and posttest data obtained were carried out with paired t-test samples aimed at determining whether there was an average difference in the two data obtained from the same sample. Paired Test This t-test sample is performed using the SPSS application with the output results obtained as follows:

**Paired Sampel Correlation**

In the first output a correlation or relationship is obtained between the pretest value and the posttest value. From the results of this test, a signification value of 0.00 and smaller than 0.05 (0.00 < 0.05) was obtained, so it was stated that there was a relationship between the pretest value and the posttest value. The calculation output results obtained in the table below.

Table 4.14. **Paired Sample Correlation Results**

<table>
<thead>
<tr>
<th>Pair 1 Pre_Test &amp; Post_Test</th>
<th>N</th>
<th>Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31</td>
<td>.726</td>
<td>.000</td>
</tr>
</tbody>
</table>

**Paired Sampel t-test**

At the output of this calculation, a value is obtained whether there is a difference between pretest and posttest. In the output below, a Paired Sample T-Test signification value of 0.00 is obtained. Based on the Paired Sample t-test if the value of sig.(2-tailed) < 0.05 then a significant difference between pretest and posttest learning outcomes. If sig.(2-tailed) > 0.05 then there is no difference. It is known that the value of the signification obtained is 0.00 and small from 0.05 then different pretest and posttest learning outcomes. As for the output of the calculation.
Table 4.15. *Paired Sample Correlation* Results

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Std. Error Mean</td>
<td>95% Confidence Interval of the Difference</td>
</tr>
<tr>
<td>Lower</td>
<td>Upper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1 Pre_Test - Post Test</td>
<td>29.41535</td>
<td>8.11901</td>
<td>1.45822</td>
</tr>
</tbody>
</table>

**Gain Score Effectiveness Test**

After it is known that the data on pretest and posttest learning outcomes have differences, the Gain Score is tested for the effectiveness of learning outcomes in the use of e-modules. Data processing carried out at the Gain Score effectiveness test stage is carried out by calculations using the *Microsoft Excel* application. The calculation of the average N-Gain Score of 0.62 with the Category sedang and the average percentage value of the N-Gain Score is 62% and in the effective category. Then the e-module is quite effectively used in the learning process.

**Improved Student Learning Outcomes**

From the results of the E module, there is an increase in student learning outcomes, namely students' understanding of knowledge of the theory of basic learning of electricity and electronics. The results of increasing understanding of this theory can be seen from the results of evaluations at 4 meetings using the developed e-module. At the end of each meeting, students are given evaluation questions to measure students' understanding of the material being taught.

![Figure 4.5. Graph of Improving Student Material Comprehension](image-url)

From the graphic data, there is an increase in theoretical understanding of the material tested on each student from the first meeting to the fifth meeting with the
application of the basic e-module of electricity and electronics. The average increase in theory of student learning materials.

![Graph](image)

Figure 4.6. Average Graph of Increased Comprehension of Material

**RESULTS AND DISCUSSION**

The results of the study are DLE e-module products that students use independently with the help of smartphone or computer or laptop access devices. This e-module was developed to be used in accordance with the syllabus at SMK N 6 Bungo class X Industrial Electronics Engineering Even semester. The development of e-modules in DLE subjects at SMKN 6 Bungo on the results of field observations carried out aims at the development of this e-module in order to improve theoretical understanding of the learning material with learning carried out as a provision for understanding that students will bring in practicum learning.

**E-Module Product Development**

The development of this learning e-module is designed according to the needs and problems in the research, researchers explore the problems contained in the field that include all components and look for solutions to problems that are considered to be able to solve these problems. Peneliti determines the development of learning media that are considered to be able to solve the existing land problem, namely developing the DLE e-module.

The development of this DLE e-module uses the ADDIE development method. The initial stage carried out in the development of this e-module is the analysis stage where in this stage of analysis there are stages of analysis of needs, curriculum and character. Needs analysis is aimed at looking at the initial problem and is found in
the classroom on DLE subjects. With this needs analysis, hope, alternative problem solving and fact descriptions are obtained that facilitate the selection of media to be developed. At this stage, an alternative problem solution is obtained, namely by floating the DLE module, which is considered by researchers to be biased in solving the problems found. The next stage of analysis is carried out curriculum analysis with the aim of selecting the material used. This curriculum analysis process has been adjusted to the existing curriculum at the research location which will be carried out by adjusting the subject curriculum. The syllabus of DLE subjects present in industrial electronics engineering is used in the analysis of the syllabus. Furthermore, analyze the character to find out how the character of the learners such as background, attention, motivation, abilities, and skills that students already have. After all this analysis is done then the researchers can design the E-Module. then the creation of E-Modules is expected to be able to have a good impact on the learning process.

Furthermore, in this development, researchers carry out the Design stage for material development and question exercises. The learning that will be applied is in the form of learning that utilizes teaching materials to learn independently. After the teaching material development stage is carried out, the researcher makes a preliminary design of the e-module prototype which will be used as test material for the development product.

Validation of the Eligibility of Material and Media Content
The test results in the calculation analysis with the formula Aiken's V. On the calculation analysis table 4.6. with an average of each material validation of 0.77, while in table 4.8. Validation Calculation Analysis MEDIA 0.82. With the results of each aspect as follows.

Table 4.15. Media Validation Results

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Average</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Aspects</td>
<td>0.81</td>
<td>Valid</td>
</tr>
<tr>
<td>Usage Aspects</td>
<td>0.81</td>
<td>Valid</td>
</tr>
<tr>
<td>Functions</td>
<td>0.89</td>
<td>Valid</td>
</tr>
<tr>
<td>Linguistics</td>
<td>0.80</td>
<td>Valid</td>
</tr>
</tbody>
</table>

From the table above, it can be seen that the validation aspect in the category is valid with the average calculation result of the Display aspect of 0.81, the Usage aspect with an average of 0.81, the Function aspect (Functionality) with an average calculation of 0.89 and the Linguistic aspect of the average calculation result of 0.80.
Table 4.16. Material Validation Results

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Average</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Study</td>
<td>0.79</td>
<td>Valid</td>
</tr>
<tr>
<td>Complete Learning</td>
<td>0.79</td>
<td>Valid</td>
</tr>
<tr>
<td>Stand Alone</td>
<td>0.75</td>
<td>Valid</td>
</tr>
<tr>
<td>Adatif</td>
<td>0.81</td>
<td>Valid</td>
</tr>
<tr>
<td>Friendly</td>
<td>0.75</td>
<td>Valid</td>
</tr>
<tr>
<td>Components of the e-module</td>
<td>0.73</td>
<td>Valid</td>
</tr>
<tr>
<td>Self Directed Learning Approach</td>
<td>0.78</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Of the two aspects of media validation in the category of valid. Meanwhile, in terms of aspects of learning, material content, conformity with self-directed learning models, design and language. So the electronic module developed is feasible and valid from the aspect of material content and learning media.

**E-module Product Practicality**

After the product is declared valid in terms of material and media, it is continued with trials with a *self-directed learning* model on the subject of the research conducted. The process is carried out to obtain Practicality data. The data is filled in by students and teachers to find out their assessment of the developed E-Module. Analysis of student responses 84 and 83 based on teacher responses can be seen in Table 4.3. If the results obtained from the respondents’ responses are compared with the interval of practicality calculations carried out, the electronic modules developed are in the category of high practicality. The results of the study are in accordance with Fardani’s opinion (2019) that the practicality of electronic modules is measured from testing questionnaire instruments in teachers and students. Hamid (2020) also said that media validation is seen from user responses by teachers and students.

**E-module Product Trials**

Overall students are biased towards using e modules at home and at school independently. Testing by using *One Group Pretest Posttest* comparison before and after using the application. Rachmawati (2020), stated that her research was to test the application of electronic module development with good results.

Hasil evaluation of the effectiveness of electronic modules is known by looking at improving students’ understanding of learning materials and comparing pretest and posttest results from the application of developed electronic modules. The effectiveness test results from the calculation are obtained from the differential power test which must first be carried out a condition test, namely the normality test and the
t-test difference power test (Herlina, 2019). Normality tests were performed using SPSS application-assisted calculations that produced Test of Normality pretest and posttest outputs. Based on the results of the Shapiro-Wilk Test of Normality, the pretest class showed a significance value of 0.099 and greater than 0.05 (0.099 > 0.05) then the data was declared normally distributed. Meanwhile, the posttest data shows a significance of 0.055 and greater than the value of 0.05 (0.055 > 0.05) then the data is declared normally distributed. From these results, it was concluded that the two data obtained were normally distributed and the study could be continued with parametric analysis.

After that, to determine whether there is a difference between the learning results from pretest and postest, a differential power test or T test must be carried out. Based on the type of data obtained, namely data from one sample but has 2 data variables, the T Test can be continued with the Paired Sample T-Test test because it meets the requirements in the test. Paired Test Sample T-This test is performed using the SPSS application with the results having 2 output results. In the first output a correlation or relationship is obtained between the pretest value and the posttest value. From the results of this test, a significance value of 0.00 and smaller than 0.05 (0.00 < 0.05) was obtained, so it was stated that there was a relationship between the pretest value and the posttest value. In the second output see the difference between the two values of pretest and posttest. At this output obtained the signification value of Paired Sample T-Test 0.00. Based on the basis of decision making of the Paired Sample T-Test if the value of sig. (2-tailed) < 0.05 then there is a significant difference between pretest and posttest learning outcomes. But if the value of sig. (2-tailed) > 0.05 then there was no significant difference between pretest and posttest learning outcomes. It is known that the signification value obtained is 0.00 and less than 0.05, so there is a significant difference between pretest and posttest learning outcomes.

The N-Gain Score test is viewed based on the increase in student learning outcomes by analyzing pretest and posttest calculations using the N-Gain Score formula as an effectiveness test. The calculation results obtained the average value of the N-Gain Score value of 0.62 with the medium category and the average percentage value of the N-Gain Score calculation analysis of 62%. If the results of the score gain test are compared with the table The effectiveness category is in the Category is quite effective. The use of N-Gain score calculation analysis was also used by Ulyana (2019) in her research to measure the effectiveness of understanding student material in learning using the learning media tested. The results obtained are in accordance with those obtained by Diansah, (2020) in his research to obtain the effectiveness of the use of electronic modules from the results of increasing student understanding of the material.
Application of Self Directed Learning Learning Model

Learning is applied when the learning process is carried out by teachers and students. The role of the teacher in this learning model is to explain the objectives in the initial learning before the self-directed learning model so that students can know the goals to be achieved before the learning process is carried out. In this learning, teachers must be able to create a positive and conducive environment so that students can carry out learning well. The role of teachers in monitoring the continuity of student learning in learning is important in the implementation of good learning. In the monitoring process carried out by teachers on the continuity of student learning independently, in this study teachers used Whatsapp group media to monitor independent learning students outside of school so that teachers could easily provide information and get information from students.

In the self-directed learning model, students are asked to do independent learning by utilizing DLE e-modules developed using accessing devices such as smartphones and computers and laptops. Students are asked to take advantage of all the facilities in the e-module for the continuity of learning carried out such as videos, animations, sounds, text and also images. Students are also required to be able to develop their ability to utilize other learning resources that can be used so that learning is not monotonous sourced from the developed e-modules alone. The self-evaluation feature is also used by students to measure the extent to which students are in understanding in the learning carried out.

CONCLUSION

The conclusions of this study are:

1. The DLE e-module with the resulting Self-directed Learning model is valid with a Learning media value of 82% and the content / material aspect of the e-module 77%. So the results of the study show that the validation of the DLE e-module with the Self-directed Learning model is in a valid aspect of the content of the material and learning media.

2. DLE e-module with Self directed Learning model which is produced practically based on teacher and student responses. Based on student responses, 84% with high practicality categories and 83% based on teacher responses with high practicality categories.

3. The DLE e-module with the self directed learning model is enough to increase understanding of DLE learning materials in Industrial Electronics Engineering with an n-gain score test result of 0.62 and is included in the category of quite effective and there is an increase in student understanding by 62% of the results of learning trials using e-modules. So the bias e-module is used in the learning process.
REFERENCES


Dawson, Ed’s, Educational Technology: An Encyclopedia. Copyright by ABC-Clio, Santa Barbara, CA. http://www.indian.edu


353


