

# Higher order thinking skills (HOTS)-oriented e-module in electric circuit

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## Higher order thinking skills (HOTS)-oriented e-module in electric circuit

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**Abstract.** This study is aimed at developing a Higher Order Thinking Skills (HOTS)-Oriented e-module in a valid, effective, and practical electric circuit topic. This HOTS-oriented e-module used the ADDIE model, which consisted of Analyse, Design, Development, Implementation, and Evaluation stages. The trial subject in this study was 13 students of Physics Education Department at Universitas Papua who enrolled in basic physics subject in the second semester of 2018-2019. The instrument used to test the validity of this HOTS-oriented e-module was evaluation sheet of the e-module validated by seven validators, which consisted of expert validators and practitioner validators. Meanwhile, effectiveness and practicality instrument for this developed e-module was the questionnaire of students' responses following the implementation of HOTS-oriented e-module learning. The data analysis for the validators' assessment was V Aiken formula, and students' responses were measured using the Rasch model. This study showed that the V Aiken value for the developed HOTS-oriented e-module was larger than 0.76 and was valid for each aspect. Rasch model on students' responses showed logit person larger than 0.00 or that the students agreed with the utilization of the HOTS-oriented e-module in learning. Therefore, it can be concluded that the HOTS-oriented e-module obtained valid, effective, and practical results for use in learning on the topic of electrical circuits.

### 1. Introduction

Electronic learning or e-learning is no longer a new thing in education. The existence of e-learning has provided an enormous impact on the shifting of education paradigm that was largely held directly in the classroom [1, 2]. Through the utilization of e-learning, students can learn anywhere anytime [3]. Development of e-learning content demands creativity of the educators to prepare learning resources for their students. One of the learning resources that could potentially be developed as the content of e-learning is an electronic module or e-module.

E-module is the development of a printed module into a digital module, which mostly adapted from the printed module [4]. The advantages of e-module compared to the printed module is its interactive nature that eases the navigation, enable the display of pictures, audio, videos, and animations as well as the practice questions which enable automatic feedback [5]. Another advantage of the e-module in the learning process is on its problem-based learning, the problems that oriented on learners, organize



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them to study, guide them to carry out individual and group investigation, develop and present their creations, and analyze and evaluate problem-solving process [6]. E-module development could be combined with the expected ability as the main objective in learning [7, 8]. Utilization of e-module in learning could develop the Higher Order Thinking Skills (HOTS) of the students [9]. In this study, a HOTS-oriented e-module was developed. HOTS is an important skill for the students, especially students of higher education institution, to prepare them for the job world [10, 11]. Students need to be actively involved in learning to develop their HOTS [12, 13]. Lecturer acts as a facilitator who facilitates learning activity and provides feedback on the students' tasks [14–16]. Learners are given opportunities to develop their thinking skills through various available learning resources

Students' HOTS can be developed through the training process within the learning activities [17], [18]. Learners can be trained through the utilization of technology, such as Computer Assisted Instruction (CAI) in learning [19, 20]. CAI is a development of information technology, that integrates contents, such as pictures, audios, or videos called multimedia technology. CAI covers the utilization of computer that directly connected with learners and teacher [21]. The models within CAI are tutorials, drills, simulations, practices, games, and problem-solving scenarios. CAI has been lately developed and has been proven effective to assist students in learning and assist teacher in teaching. This study used CAI model by utilizing the Learning Management System (LMS) of e-learning developed using Moodle application. The content of the developed e-module is combined into Moodle e-learning, thus the learning process can be systematically carried out and well-controlled.

## 2. Methods

The method used in the development of this HOTS-oriented e-module was the ADDIE model, which consisted of five stages, namely: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation as presented in Figure 1 [22].

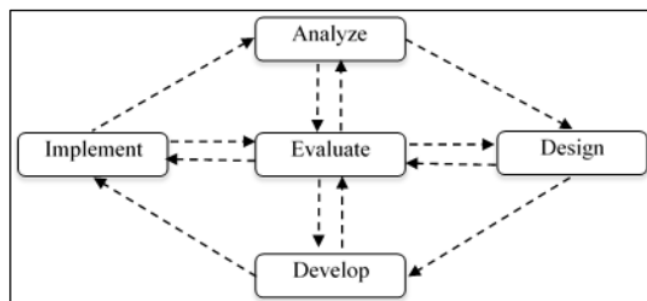


Figure 1. ADDIE Model Stages

Within the analysis stage, analysis related to the need of the system and learning accomplishment of the basic physics subject, especially in electric circuit topic based on its syllabus was carried out. In the design stage, the design of the HOTS-oriented e-module was developed as well as the system, database, and interface designs. Further, in the development stage, the follow up from what has been designed in the design stage were carried out such as, compiling the e-module content according to the syllabus and create Computer Assisted Instruction (CAI) system. In this case, the Learning Management System (LMS) used was Moodle. In this development stage, the validation test that involved seven experts and practitioners from Universitas Negeri Yogyakarta and Universitas Papua was also carried out. The validators validated the developed e-module using validation sheets on the aspects of content appropriateness, presentation aspect, language aspect, and graphic aspect [23]. The data from the validators were analyzed using V Aiken formula, and the result was compared with the V Aiken table for seven validators with four options [24, 25]. The validators' assessment items consist of four options, such as in the Likert Scale: Highly Agree, Agree, Less Agree, and Disagree. Implementation stage was carried out by inserting the content of the e-module into Moodle

application. The trial subject in this study was 13 students of Physics Education Department at Universitas Papua who enrolled in basic physics subject in the second semester of 2018-2019. Evaluation stage was the utilization of the e-learning module. In this stage, the evaluation was obtained from the students' responses regarding the implemented learning. Students' responses also used to assess the effectiveness and practicality of the developed e-module. The instrument used to assess the students' responses was an online questionnaire through the e-learning. Data analysis of students' responses used Rasch modeling through Winstep software application. The students' responses are presented in Table 1 [26], [27].

**Table 1.** Aspects and statements student responses to the e-module.

| Aspect        | Statement   | Code |
|---------------|---|------|
| Effectiveness | a. Utilization of e-module could increase students' learning spirit.              | +R1  |
|               | b. The e-module assist students to gain information on the physics topic learned. | +R2  |
|               | c. The e-module used can stimulate curiosity.                                     | +R3  |
|               | d. The e-module create an atmosphere of self-learning.                            | +R4  |
|               | e. The e-module helps develop critical analysis skill.                            | +R5  |
|               | f. The e-module assist in developing analysis skill.                              | +R6  |
|               | g. The e-module could assist in creative ability.                                 | +R7  |
| Practicality  | a. Presentation of the materials in e-module interesting.                         | +R8  |
|               | b. Text in e-module is hard to read.  | -R9  |
|               | c. Pictures, illustration, or graphic within the module are attractive.           | +R10 |
|               | d. Materials within the module were presented in sequence.                        | +R11 |

### 3. Result and Discussion

The description of this study is as follow. On the analysis stage, there was two analysis carried out, i.e., content need analysis and software need analysis. In the content need analysis, analysis of the subject such as adjustment with the syllabus was carried out. The developed materials within the e-module are basic physics materials on an electric circuit. This topic covers themes, such as the electric battery, the strength of the current, resistance of the resistor, electric power, resistor and capacitor circuit, Electromotive force, Kirchoff law, and RC circuit. The presentation of the HOTS-oriented e-module consists of the approval page, introductory page, materials, and examples of HOTS-oriented problem-solving in physics and practice tests on HOTS-oriented electric circuit.

Implementation of the e-module in basic physics subject was carried out fully online; thus, it needs integration with the currently available resource through e-learning. Utilization of Moodle e-learning supports the implementation of fully online learning [28]. Before the online learning was implemented, an orientation through a demo on how to use e-learning to introduce the e-learning media to students was carried out. Hence, they could carry out learning properly. On software need analysis, the functional and non-functional analysis was carried out, as well as the system analysis needed as an e-learning platform, Moodle. Moodle is more appropriate to be used as an e-learning platform as it has utilities and additional contents that can be easily applied [29–31]. Integration of e-module with Moodle e-learning is very effective due to the completion of its features [32]. Students are expected to utilize various e-learning facilities to develop their HOTS.

Within the design stage, the e-module design was carried out. In this stage, the development of CAI system was carried out using LMS Moodle by inserting the content of e-module into the Moodle e-learning media; thus, it can be accessed online. Moodle completeness as a learning media has made



the developed e-module can be easily accessed, and it is also equipped with supporting features such as upload feature for online assignment and discussion forum [32, 33].

In this development stage, the compilation of e-module materials, which consisted of main materials, HOTS problems, and HOTS exercises was carried out. The output of this stage is the e-module product which has been structured according to the syllabus and learning achievement as well as an evaluation sheet to measure its validation and students' responses. E-module was also validated in this stage. The validation involved seven validators, expert from Universitas Negeri Yogyakarta and practitioner from Universitas Papua. The result of this developed e-module is presented in Table 2.

**Table 2.** Results of validator assessment

| No. | Aspects and statements                                       | V Aiken | Category |
|-----|--|---------|----------|
| 1.  | Aspect of Content Feasibility                                |         |          |
|     | a. The suitability of the materials with learning objectives | 0.81    | Valid    |
|     | b. The appropriateness of the material's structure           | 0.76    | Valid    |
|     | c. The accuracy of the material content                      | 0.81    | Valid    |
|     | d. Encourage curiosity                                       | 0.81    | Valid    |
|     | e. Develop HOTS  | 0.81    | Valid    |
| 2.  | Presentation Aspect  |         |          |
|     | a. Presentation technique is attractive                      | 0.76    | Valid    |
|     | b. Support presentation of materials                         | 0.76    | Valid    |
|     | c. Can support the implementation of learning                | 0.76    | Valid    |
| 3.  | Language aspects   |         |          |
|     | a. Grammatical correctness                                   | 0.86    | Valid    |
|     | b. Spelling correctness                                      | 0.76    | Valid    |
|     | c. Term appropriateness                                      | 0.81    | Valid    |
|     | d. Punctuation correctness                                   | 0.81    | Valid    |
| 4.  | Integrity aspect   |         |          |
|     | a. Text clarity  | 0.76    | Valid    |
|     | b. Illustration clarity (picture/table)                      | 0.76    | Valid    |

The next stage in this study was the implementation of the developed e-learning module. The e-module was implemented on Physics Department students of Universitas Papua who enrolled in Basic Physics subject in the second semester of the 2018-2019 academic year. In this implementation stage, students' active involvement in learning was obvious. Their active participation was evident in their frequency to open the e-module, which was observed from the e-learning program. Independently, students were motivated to learn as the e-module can be accessed anytime anywhere [32]. Utilization of e-module in learning can increase students' independence in learning [34].

The final stage in this study was evaluation. In this stage, formative evaluation was carried out to collect the data on the effectiveness and practicality of the developed e-module. The data were intended to improve and to revise the developed e-module. The evaluation was not only limited to the design, development, and implementation of the product but also all the stages in the ADDIE model. Students' responses in using HOTS-oriented e-module were also assessed. Figure 2 shows the result of analysis from the students' responses using Rasch modeling.

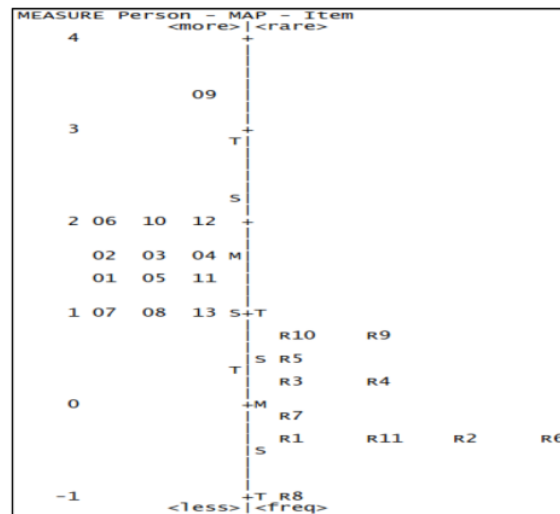


Figure 2. Students' responses in using HOTS-oriented e-module

In Figure 2, the left column is the person column, and the right column is the statement column. Items with logit value above the average logit value (+0.00 logit) imply that the respondents found it relatively easy to agree with the statement, whereas items below the average of the logit value mean that it is difficult for the respondents to agree with the statement. Based on the analysis of the person map distribution in Figure 2, it is concluded that all respondents (13 people) were above the average logit item (+0.00 logit) (100%) and that the person measure based on the measurement was +1.63 which was larger than 0.00. It shows that the students' agree with the usage of e-module in learning.

In Figure 2, there were statements with relatively low agreement compared to other items, items number R10 and R9. Statements numbers R10 and R9 were both related to the illustration display of the e-module content. This showed that the illustration quality within the e-module needed to be improved by increasing the resolution or readability of the content. Content readability of the module depends on the equipment used if it was accessed using the android phone, then the resolution level or the readability would be relatively low compared to when this e-module was accessed through a computer. Utilization of e-module in learning, in general, can increase good responses from students. Thus they will be interested and felt assisted in learning [35]. Through good responses from the learners, it is expected that their HOTS would increase.

#### 4. Conclusion

Development of HOTS-oriented e-module integrated with Moodle e-learning is one of the learning media that could be applied in learning. The result from the validators resulted that it is valid form all aspects such as content appropriateness, presentation aspect, language aspect, and graphic aspect. Students' responses to the implemented learning also showed that the students agreed with the implemented learning. Development of HOTS-oriented e-module was valid, effective, and practical; hence, appropriate to be further tested with larger test subject and its utilization can be broadened into various subjects.

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