

Interactive Learning Module Development Design for Electronic and Digital Engineering at Aviation Polytechnic

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ABSTRACT

Education is the gateway for anyone for accept knowledge in frame increase source Power man to be of better quality. To realize these goals, a lecturer/educator must have the skills to choose, use methods and carry out new innovations in creating an effective and efficient learning environment for students. R & D (*Research & Development*) research is research that is oriented to research, design, produce, test, the validity of the resulting product in the form of an interactive teaching module to improve understanding of the concept of electronic and digital engineering material with a development model developed by M. Alessi and Stanley R. Trollip, which consists of the stages of Planning, Design, and Development. Data collection techniques used in this study are questionnaires, tests, interviews and observations. Techniques analysis data for eligibility media use analysis data descriptive, where the analysis is carried out using the Score stages results evaluation questionnaire Which obtained from for expert (media and material), in the form of quantitative data that is changed into categories with a linkert scale. The results of the study are that the entire interactive teaching module device can be accessed via the link <https://online.fliphtml5.com/emxux/sjxl/>. The results of the assessment two expert material to fourth aspect obtained average score 3.15 Which qualitatively categorized Very Worthy ($X \geq 3.0$) and the results of the assessment by two media experts obtained a value of 3.28 the result in category very feasible ($X \geq 3.0$).

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I. Introduction

Education must genuinely serve as a foundation so that technology can be used effectively by lecturers/educators as education providers, because education is the gateway for everyone. Accepting knowledge in the frame increases the source's power and makes it of better quality (Haryanto, 2015).

According to Government Regulation Number 19 of 2005, Article 19 paragraph 1, educators are expected to use methods and media that actively involve students and create an atmosphere that is fun, interesting, and interactive, adjusted to the stage of thinking development, characteristics, and learning conditions of students. This condition is also essential in learning electronic and digital engineering.

To realise these goals, a lecturer/educator must have the skills to choose, use methods and carry out innovations in creating an effective and efficient learning environment for students. The value of aligning the higher education curriculum with the demands of the ever-changing industry (Yunus Karyanto, Rina Asmaul, Zain Fuadi Muhammad Roziqi Fath, Ahmad Junaidi, 2023). Learning

methods that influence process learning in class become good, and students will be more enthusiastic. The choice of learning methods will affect the media educators will use.

According to Sudjana, N. & Rivai (2002), using learning media can stimulate students' thinking processes from concrete to abstract. Using media in process learning can engage students' attention and help them learn, so they better understand the material being studied and learning becomes more meaningful.

Students without enough space or opportunity to discover the concepts of electronic and digital engineering materials that they will study independently experience low motivation to learn. Students become passive, bored, and struggle to understand the lessons. This condition is shown in the learning outcomes of students who receive an average score of 75.5 for the Alpha class and 75 for the Bravo class, where students only receive a passing grade of 75.

Therefore, lecturers/educators and students need an interactive teaching module that complements the Good by providing material, example questions, and exercise

questions, especially for abstract and visual material, making it easier for students to understand the concepts presented.

Module: The teaching currently used is not yet packaged in an interactive and complete form, so it cannot stimulate the students' thinking process. For this reason, a teaching module is needed to explain the material in more detail, visualise the abstract material, train students to think creatively, and solve problems. The Wrong One module teaches, which can help students and lecturers/educators overcome the issue that the module learning is not interactive.

Module learning interactive is a type of media Study that combines text material with other supporting media, such as images and videos, and facilitates navigation using barcodes. Interactive learning modules that will be developed in the study are packed digitally or in *flip books* equipped with barcode media containing additional explanatory videos from the explanations contained in *the book text*.

II. Method

The type of research that will be used is R & D (Research & Development) research, namely research that is oriented to research, design, produce, test, and validity of the resulting product in the form of an interactive teaching module to improve understanding of the concept of electronic and digital engineering material with a development model developed by M. Alessi and Stanley R. Trollip, which consists of the stages of Planning, Design, and Development with the following details:

A. Planning Stage

1) Define the Scope.

At this stage, the objectives of the interactive teaching module program are defined, the material to be covered is determined, and the target achievements are determined.

2) Identify Learner Characteristics

This stage identifies the characteristics of product users targeted for developing interactive teaching modules using interview techniques with lecturers/educators and students. The target (user) of the interactive teaching module product in this study is the electronic and digital engineering material of the Aviation Polytechnic.

3) Produce A Planning Document.

Before developing a product, it is best to create a planning document containing materials, images, test scripts, and product displays, which are presented in an interactive teaching module.

4) Determine and Collect Resources.

At this stage, it includes all materials used to support or assist in the product development. Three types of module sources are used in this development: (1) Everything relevant to the material presented. (2) Everything relevant to the development and learning process. (3). Everything

relevant to the delivery techniques presented in the interactive teaching module, in digital form/flipbooks, was used. The sources used are based on the syllabus and supplemented with other references per the learning objectives achieved.

5) Conduct Initial Brainstorming.

Brainstorming is carried out with supervisors and lecturers/educators on material related to interactive teaching modules on electronic and digital engineering material that will be developed to increase insight.

Design Stage

6) Develop Initial Content Ideas.

At this stage, the researcher designs the interactive teaching module's initial content, such as its theme, types of colours and text sizes, navigation buttons, images, and videos.

7) Conduct tasks and Concept Analysis.

At this stage, task analysis aims to determine the sequence of materials using concept maps to make them easy for students to learn. Concept analysis focuses on organising materials so that they are easy to see.

8) Prepare, Create Flowcharts, and storyboard.

The final stage in the design is to create a flowchart, which is used as a guideline for developing interactive teaching modules from the aspects of appearance, navigation, layout, and the material presented to achieve learning objectives.

B. Development Stage

1) Prepare the Text

Prepare the text of the material presented in the interactive teaching module. The text of this material is adjusted to the syllabus and Learning Implementation Plan (RPP).

2) Produce Video

The interactive teaching module will include a video explaining the material and a discussion of questions. The video presented is a brief explanation of the material.

3) Assemble the Pieces

At this stage, all content is combined into one file in the form of text, images, and videos.

4) Prepare Support Materials

The developed teaching modules contain interactive, easy-to-use media content in text, images, and videos.

5) Make a program

At this stage, the elements that have been combined are then published in the form of flip books, resulting in an interactive teaching module.

6) Test and Revision

At the testing and revision stage, there are the following steps: (1) Do an Alpha Test; (2) Make Revision; (3) Do a Beta Test; and (4) Make Final Revision. In the alpha test, validation will be carried out by media experts

and material experts. At the same time, the beta test was carried out on 24 students of electronic and digital engineering materials.

The data collection techniques used in this study were questionnaires, tests, interviews and observations, with a grid. Questionnaire For Expert The media consists of 3 aspects, namely the Appearance aspect (10 indicators and 16 items), the Usage aspect (6 indicators and six items) and the Utilization aspect (2 indicators with four items), while the Questionnaire Grid For Expert The material consists of 4 aspects, namely: the introduction aspect (3 indicators and four items), the content aspect (3 indicators and six items), the learning aspect (10 indicators and 13 items), and the task aspect (1 indicator and two items).

Technique analysis data for eligibility media use analysis data descriptive, where the analysis is carried out using the Score stages results evaluation questionnaire Which obtained from for expert (media And material), in the form of quantitative data that is changed into categories with a questionnaire assessment linkert scale, namely a score of 1 with very poor criteria, a score of 2 with poor criteria, a score of 3 with good criteria and a score of 4 with excellent criteria, then calculated according to the interactive teaching module assessment criteria table by the media expert team and the material expert team as follows:

Table 1. Criteria Assessment of Granting Score

Score	Range Score	Category
4	$X \geq 3.0$	SL (Very Worthy)
3	$3.0 > X \geq 2.5$	L (Worthy)
2	$2.5 > X \geq 2.0$	KL (Less Eligible)
1	$X < 2.0$	SKL (Very less Worthy)

III. Results and Discussion

A. Interactive Module product development process

The process in this development stage includes the development of content contained in interactive teaching modules consisting of text, images, assignments, and videos so that they are easy to read on a computer/laptop or in digital form. The components of interactive teaching modules are the same as those of modules: cover page, module identity, foreword, table of contents, description, final learning objectives, instructions for using interactive teaching modules, concept maps, learning activities, and assignments. The use of technology to support learning is designed not only to focus on introducing technology, but also as an effective method to maximise the use of technology in the learning process. (Jenita Jenita, Fatmawati Sabur, Anugerah Tatema Harefa, Ela Pebriani, Hanafiah Hanafiah 2023).

Concept maps are provided so that students have an overview of the scope of the material presented. Meanwhile, the table of contents in this interactive teaching module is given to make it easier for students.

Access the page at his wish. Reusable learning modules (RLM) highlight the importance of document navigation and readability, which significantly affect user satisfaction (Theresa, Pesl, Murphrey., Audra, W., Richburg., Holli, R., Leggette., Jean, A 2023), as follows map draft and list Contents can see on picture following.

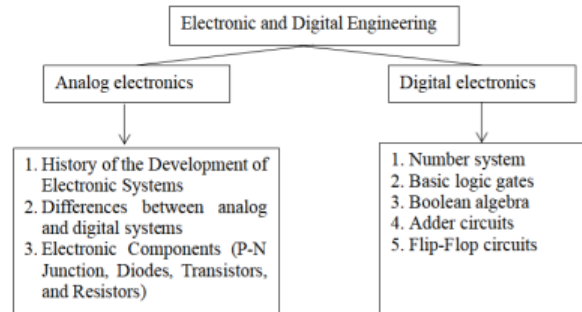


Fig. 1. Concept map view

Fig. 2. Table of contents view

The material is served in text, image, and video forms in the description material. The contents are developed by applying multimedia design principles (Mayer 2009), the principle of nine events of instruction (Gagne 1977) and module design instructions. The material is presented using simple, clear language to make it easy for students to understand. The text presentation is complemented using colour, bold, and italics to emphasise material keywords such as sub-chapter titles. The font size and typeface in this interactive teaching module are Times New Roman with a font size of 12 pt for content text in the module. The module teaches an interactive approach that can be seen in Figure 3.

4. Diode dengan bias maju (forward bias)

Diode dengan tegangan bias maju adalah kondisi dimana terminal Anoda diberi tegangan positif atau tegangan lebih besar dibanding dengan terminal Katoda. Tegangan pada Katoda bisa netral (0 Volt) atau tegangan negatif.

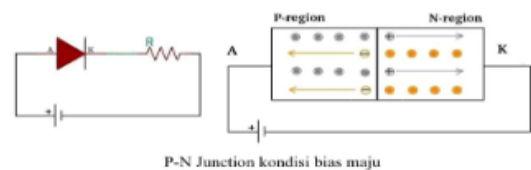


Fig. 3. Appearance Text in the module Teach Interactive

B. Product Trial Results

Based on the development model (Alessi, SM, & Trollip, 2001), product trial activities are shared into two stages: test alpha and test beta. Two media experts and two material experts tested alpha. In contrast, the beta test consists of two stages: beta test 1, conducted by six Airport Technology study program students, and beta test 2, performed by 24 students. The next step is to carry out the stage test, which is done by two expert materials and expert media, aiming to assess the level of product feasibility and make revisions if there are criticisms and suggestions from the two experts.

1) Alpha Test Results

Test alpha was conducted by a two-person expert, who is an expert in material and an expert in media. The test was performed using a questionnaire validated by a validated instrument. Each validation result from two materials and two media experts is explained below.

2) Results Validation Expert Material

Two material experts validated the material on the interactive teaching module product. Both material experts are lecturers from the Engineering study program at the Makassar Aviation Polytechnic. This material expert validation aims to measure the accuracy and quality of the material presented in the interactive teaching module product, namely, electronic and digital engineering material related to analogue and digital systems. In addition, this material expert validation aims to obtain a feasible product from each aspect. The material expert assessment questionnaire generally consists of 4 aspects: introduction, content, learning, and task/exercise. Assessment results of the two expert materials for the fourth aspect are presented in the following table:

Table 2. Results Evaluation Expert Material for Fourth Aspect

Aspect	Subject Matter Expert		Amount	Average Score
	I	II		
	Introduction	3.25		
Contents	3.0	3.0	6.0	3.0
Learning	3.0	3.5	6.5	3.2
Assignment/Exercise	3.0	3.0	6.0	3.0
Amount Overall			25.3	
Average Score Overall				3.15
Category				Very Worthy

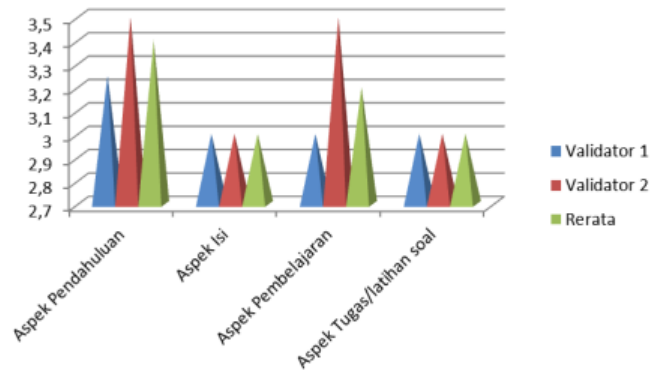


Fig. 4. Bar Chart of Material Expert Assessment Results

Figure 4 shows the results of assessing the four aspects by two material experts. Thus, the product module taught is interactive and worthy of use in the trial field with suggested revisions. Two expert materialists' assessment results for the fourth aspect obtained an average score of 3,15, which was qualitatively categorised as Very Worthy ($X \geq 3.0$).

3) Media Expert Validation Results

two media experts carried out a teaching module media assessment process. The second validator was chosen as a validator media because both are understanding of learning media. The assessment of these two media experts aims to measure the appropriateness of the media module to teach interactive before being used for testing in the field. Evaluation media expert. This consists of three aspects: appearance, use, and utilisation. The following are the results of the assessment of the two media experts on the three aspects presented in the following table:

Table 3. Results Evaluation Expert Media To Third Aspect.

Aspect	Media Expert		Amount	Average Score
	I	II		
Appearance	3.38	3.50	6.88	3.44
Use	3.17	3.17	6.33	3.17
Utilization	3.25	3.25	6.50	3.25
Amount Overall			19.71	
Average Score Overall				3.28
Category				Very Worthy

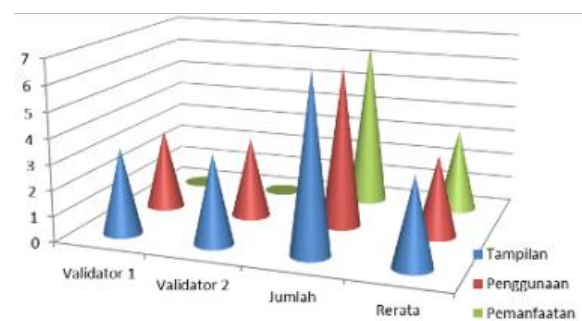


Fig. 5. Diagram Stem Results Evaluation Expert Media

The results evaluation of three aspects by two expert media in general visuals are shown in Figure 5. Based on

the diagram above, the assessment results by two media experts on the interactive teaching module product show that the display aspect, consisting of 16 indicators, has... average score most tall 3.44. In contrast, the usage aspect, composed of 6 indicators, has the lowest average score, namely 3.17, but after averaging, the overall value obtained was 3.28, resulting in a very feasible category ($X \geq 3.0$).

C. Interactive Teaching Module Revision

Revisions to interactive teaching module products were made based on input and suggestions from material and media experts.

a) Expert Revision Material

Input and suggestions from two material experts regarding the product being developed, namely:

- Video links can be added as barcodes to reduce student boredom while studying and allow them to use their smartphones.
- There are too many assignments/exercises which need to be reduced. Some questions related to content and language need to be improved.

b) Revision Expert Media

Revisions to the interactive teaching module product are based on comments and suggestions from two media experts. The video must be cited as a source. If the video is made by the developer himself, include his name at the beginning of the video. The previous interactive teaching module product did not have a developer name or source.

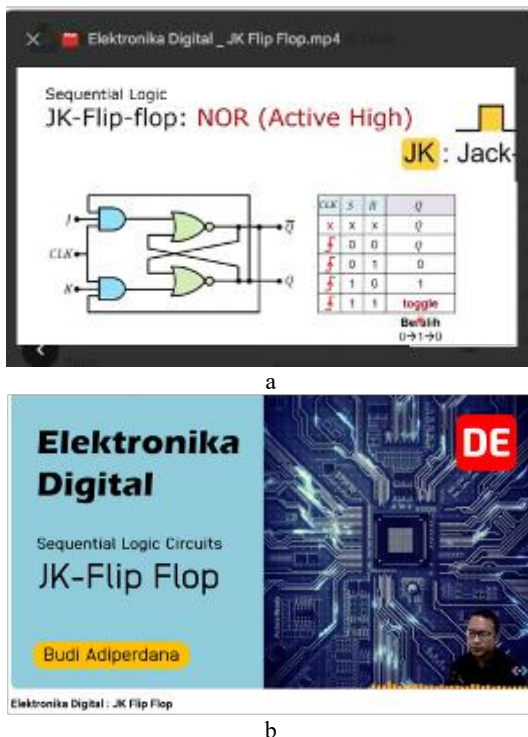


Fig. 6. Media Expert Revision Results

Overall, developing interactive teaching module products follows the steps of the Alessi, SM & Trollip model through three stages: planning, design, and development. The final product produced is an interactive teaching module in the form of flipbooks that can be read on a computer/laptop screen with a Windows operating system or a smartphone. Interactive modules improve literacy and increase learning motivation among students, leading to a more engaging educational experience (Siti, Nadia, Adnan, Al, Omar, Lilia, Ellany, 2022). The interactive teaching module device can be used by clicking the link: <https://online.fliphtml5.com/emxux/sjxl/>.

Product modules teach interactive Which developed tested alpha by two expert materials and two expert media Which control his field. Based on the results evaluation expert material obtained an average score as high as 3,15, with category very worthy, so that the material that served in the product module, teach interactive stated as worthy used with revisions according to the suggestions given. Furthermore, the product validation process by two media experts, the product assessment results obtained an average score of 3.28, with an outstanding category. Worthy, so that product module teaches interactive stated worthy used by the revisions suggested by media experts. This finding aligns with (A., Asnidar., Safriana, Safriana, Saifuddin, Muhammad, Jalil, Halimatus, Sakdiah, Syarifah, Rita 2024). Interactive e-modules have significantly improved students' scientific literacy, with studies reporting high N-gain scores and positive feedback from students and teachers.

Product feasibility of teaching modules interactive can be achieved because meets the assessment criteria for interactive teaching module products consisting of material accuracy, learner control, material by curriculum, material up to date, use discussion Which clear, can raise student motivation, students can participate in it, provide instructions for use (Heinich, R. Molenda, M., Russel, JD, & Idino 1996). In addition, interactive teaching module products apply multimedia criteria according to Alessi & Trollip, namely the breadth of material, sequence of material, clarity of language used, suitability of material with objective Study, existence of instruction Study, conclusion and interface and glossary. Furthermore, the criteria evaluation module Interactive teaching is based on (Romiszowski 1986), namely that the material is validated by expert material, supported by media which appropriate, examples, and exercise questions or assignments according to the study's intention. Level difficulty questions customised to ability student. In addition to being based on the assessment criteria, interactive teaching module products also apply module characteristics, namely 1) self-instruction, 2) self-contained, 3) stand alone, 4) Adaptive, 5) user friendly, and seven principles of multimedia design (Mayer 2009) for presenting materials in the form of animation and video. These principles are the principle of multimedia, the principle of time proximity, the principle of coherence, the principle of

modality, the principle of redundancy, and the principle of individual differences.

IV. Conclusion

Interactive teaching modules on electronics and digital engineering subjects are produced digitally, packaged in flipbooks, and equipped with video links and barcodes as additional material. It can be used as an electronic and digital engineering learning support. The interactive teaching module product produced is equipped with text, image and video content. Exercise questions/assignments serve as each activity's learning in the form of a question essay, which aims to measure students' understanding of the material studied. The interactive teaching module device can be used by clicking on the link <https://online.fliphtml5.com/emxux/sjxl/>. The module teaches interactive, developed and rated as a worthy learning resource for electronics and digital engineering learning.

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