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Boosting Motivation with 3D E-Modules: Discovery Learning for Vocational IT Students

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ABSTRACT

PISA (Program for International Student Assessment) scores over the past 20 years show that many Indonesian students can still not understand simple reading or basic concepts in certain subjects. Integrating technology with education focuses on eliminating the gap in recognizing and utilizing learners' abilities. Electronic modules (e-modules) are one of the alternatives that can be used to deepen understanding of the material and increase student motivation in learning. This research aims to develop a flipbook-based e-module equipped with 3D models containing discovery learning stages to increase the learning motivation of grade X students, especially in the basics of computer network engineering and telecommunications elements of technological developments in computer network engineering and telecommunications. Research and development are conducted using the Hannafin and Peck model with stages including (1) needs analysis, (2) design, and (3) development and implementation, where each stage is accompanied by evaluation and revision. This research resulted in a media validation test value of 95.50% or very feasible, and the material expert validation test resulted in a value of 97.20% or very feasible. The product trial stage was carried out at SMK Negeri 8 Malang with the results of a small group trial of 89.93% or very feasible and a large group trial of 91.72% or very feasible. Measurement of student learning motivation obtained a gain score of 0.63 or a moderate increase category, from 72.99% in the high category to 90.10% in the very high category.

I. INTRODUCTION

The regeneration of technology in the 21st century has resulted in a trend of change and the need for innovation in education. [1]. As stated by Rahayu et al., in this era, the learners faced are learners who develop in the digital era, so it can be emphasized if the 21st-century school standards for teachers and students must be related to the use of technology in learning where the main objective of 21st-century learners is to build individual learning abilities and support learners to understand concepts and develop their abilities to become lifelong, active, and independent learners. [2].

Various national and international studies reveal data that Indonesia has experienced a learning crisis due to learning loss in the last 20 years, which is reflected in the absence of a significant increase in PISA (Program for International Student Assessment) scores over the last 10-15 years. [3]. The study shows that there are still many Indonesian students who cannot understand simple reading or basic concepts in certain subjects, and the COVID-19 pandemic further exacerbates this condition.

This problem is the basis for creating a new policy, namely implementing an independent curriculum that affects the Computer Network and Telecommunications Engineering expertise program, especially the Basics of Computer Network and Telecommunications Engineering subject. Basic Computer Network and Telecommunications Engineering is a subject that must be taught in the TKJT expertise program. The scope of this subject material includes system insights and measurement methods in Computer Network Engineering and Telecommunications. [4].

Observations carried out at three vocational schools in Malang City reveal several problems related to teaching materials, learning models, and learning motivation possessed by students. In the learning process of basic computer network engineering and telecommunications subjects, teachers have not provided adequate teaching materials that students can use to understand the material and develop their abilities, with supporting data of 80.6% of students agreeing to this condition through questionnaires distributed. The subject of the basics of computer network engineering in phase E is oriented towards understanding concepts in the field of computer networks and telecommunications. As many as 63.9% of learners stated that many components must be learned, and 83.7% feel they need clearer visualization to understand these components easily. During learning, learners are allowed to be active with their material findings, and then the teacher briefly explains the material and continues with the assignment. However, 69.4% of learners still have difficulty understanding the material learned. In addition, 64.8% of learners still often feel bored, sleepy, and less focused, even though 61.1% claimed to have a fairly strong desire, enthusiasm, and motivation to learn.

Teachers can achieve effective learning motivation by paying attention to the needs of students, such as by providing diverse ways of learning. [5], providing reinforcement and the like [6], can also encourage students to be more passionate about learning [7]. Selecting and applying the right learning model will encourage the growth of pleasure, increase learning motivation and critical thinking skills, and make it easier for students to understand the subject. One of the learning models that can be applied is the discovery learning model. [8]. Simamora & Saragih stated that discovery learning is a learning model that focuses on observation and experimentation activities carried out by students in learning. [9]. Therefore, learning facilities are needed in the form of appropriate teaching materials that can support student learning activities [10].

Based on interviews conducted with teachers and students, the tendency of teaching materials or modules needed are electronic or online teaching materials; this is because students have become accustomed to accessing materials online during online learning (in the network) due to COVID-19 and the desire to access materials anywhere and anytime. The module itself is a form of teaching material that can accommodate the abilities possessed by students by utilizing their learning time more effectively so that educational goals can be achieved [11]. However, modules that are often used in learning still have content in the form of subject matter only with a simple layout display that can reduce students' reading interest and learning motivation [12], so to optimize the existence of this module, it is necessary to display the layout and content of the material with attractive visualizations that can be realized by implementing 3D-model technology [13]. Based on the problems found, it is necessary to develop teaching material that adapts to the latest technology, can strengthen basic understanding of learning materials, is by the independent curriculum, and can be accessed anywhere and anytime.

II. METHODS

This research uses the Hannafin and Peck model, which has three main stages: (1) needs assessment, (2) design, and (3) development and implementation. Each stage is accompanied by evaluation and revision to make the resulting product more optimal.

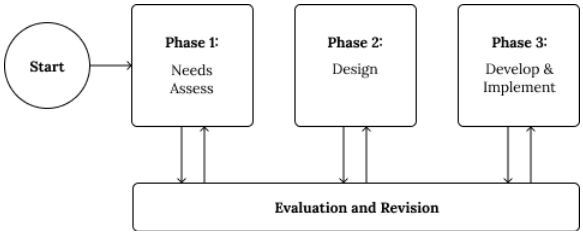

Fig. 1. Steps of the Hannafin and Peck Model

This study has subjects that consist of media experts, material experts, and students who have taken the course. A questionnaire was used, and it applied a Likert scale of 1 - 4 where the instrument used had been tested for validity and reliability first. The data generated from this data collection is quantitative and qualitative data derived from comments and suggestions.

The feasibility of the product and the results of measuring student learning motivation towards using e-modules can be calculated using the following formula.

$$Percentage(\%) = \frac{Total\ Score}{Kriterium\ Score} \times 100\% \quad (1)$$

$$Kriterium = max\ score \times \Sigma items\ \times \Sigma validator \quad (2)$$

The percentage of product feasibility obtained can be adjusted to the feasibility table as follows.

TABLE I. PRODUCT FEASIBILITY CATEGORY

Feasibility Percentage	Category
81.26% – 100.00%	Very feasible
62.51% – 81.25%	Feasible
43.76% – 62.50%	Less feasible
< 43.75%	Very unfeasible

The percentage of learning motivation that has been measured can be adjusted to the following learning motivation category table [14].

TABLE II. LEARNING MOTIVATION CATEGORY

Motivation Percentage	Category
80.00% – 100.00%	Very high
66.00% – 79.99%	High
56.00% – 65.99%	Medium
40.00% – 55.99%	Low
≤ 39.99%	Very low

The gain formula is used as follows to determine the increase in student learning motivation from before to after using the e-module.

$$G = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (3)$$

Based on the gain value obtained, a decision can then be made based on the following gain assessment qualification scale table [15].

TABLE III. GAIN SCORE CATEGORY

Gain Score	Category
G > 0.70	High
0.30 ≤ G ≤ 0.70	Medium
G < 0.30	Low

III. RESULT AND DISCUSSION

A. Needs Assessment

This stage is divided into analyzing learner characteristics, learner needs, learning needs, curriculum, objectives, and evaluation and revision.

- Learner Characteristics Analysis

  In this development research, data on learner characteristics were obtained through observations, interviews, and distributing questionnaires. Based on these data collection activities, it was found that 83.8% of learners have a strong desire to understand the material, are accustomed to finding out the material to be learned, and are actively involved during the learning process. However, 64.8% of students still often feel bored and sleepy during the learning process, which makes students lose focus and do other things when the teacher explains the material.

- Learner Needs Analysis

  Students experience problems with their learning needs because there is no adequate teaching material in modules. This resulted in 80.2% of students having difficulty understanding the material, and 56.6% of students finding it difficult to find out the subject matter. In addition, in this course subject, especially in the element of technological development in computer networks and telecommunications, many components need to be studied, so 83.7% of students stated that it would be better if there were teaching materials to visualize these components.

- Learning Needs Analysis

  Based on observations, interviews, and questionnaires, 83.8% of students are actively involved in learning and finding out the material to be taught, but this condition cannot run optimally because there is no structured follow-up related to material findings or concepts found by students. Therefore, a learning model that can optimize students' learning activities is needed.

- Curriculum Analysis

  The results of the observations, interviews, and questionnaires that were distributed show that the three schools apply an independent curriculum. Thus, vocational group subjects in class X are only centered on the Basics of the expertise program taken, one of which is the Basic of Computer Network Engineering and Telecommunications subject with the 2nd element (technological developments).

- Goal Analysis

  Based on the data obtained from the analysis of learner characteristics, learner needs, learning needs, and curriculum, the next thing to do is to determine the objectives in the form of solutions to several problems aligned with learning outcomes and objectives. Thus, it can be concluded that this development research aims to develop e-modules equipped with 3D models with discovery learning content in Basics of Computer Network Engineering and Telecommunications class X subjects with a focus on the 2nd element material to increase student learning motivation.

- Evaluation and Revision

  Evaluation and revision at this stage are used to obtain data that can maximally become the basis and support learning product development in the form of e-modules equipped with 3D models.

B. Design

- Material Elaboration

  The material in the developed e-module is the material in the 2nd element of the Basic of Computer Network Engineering and Telecommunications subject, namely technological developments in the field of computer network engineering and telecommunications with a description of the material on the development of 5G technology, microwave links, IPv6, optical fiber, and sensor systems in the field of computer network engineering and telecommunications.

- Media Content Outline

  The e-module product, which has been developed with 3D models, is a flipbook-based module that is equipped with 3D models and contains the stages of the discovery learning model with guided discovery type.

- Wireframe

  A wireframe is a basic design of a product page or application that is built where, in this wireframe, there are important elements and features of the product. [16].

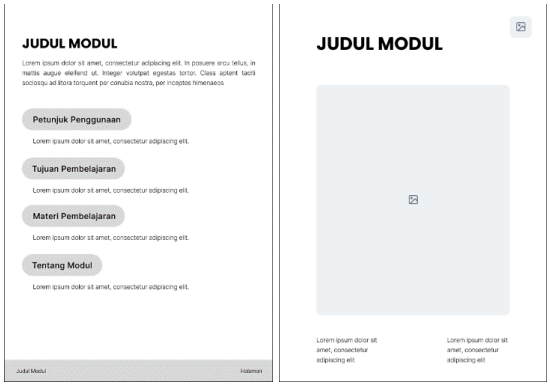

Fig. 2. Wireframe of E-Modul Cover and Menu

- Evaluation and Revision.

  After the design stage is complete, the next thing to do is evaluate material experts and media experts, and then proceed with the revision stage based on additions or input from material experts and media experts until the expected product criteria are reached.

C. Development and Implementation

- Development

  The development begins with the preparation of materials and evaluations that contain the stages of the discovery learning model, then 3D modeling is carried out, and the flipbook design is continued.

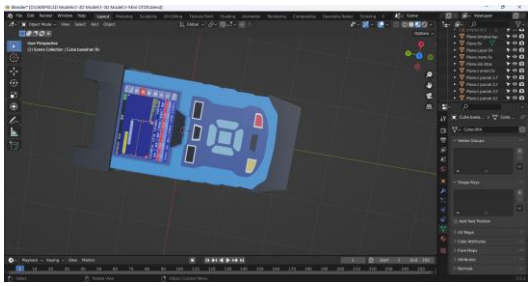

Fig. 3. 3D Modeling Using Blender

Here is a look at the flipbook developed using Canva and Heyzine.

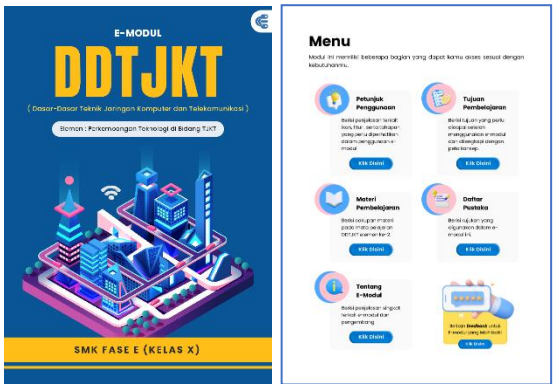

Fig. 4. Cover and Menu Page

Fig. 5. Instructions for Use and Learning Objectives Page

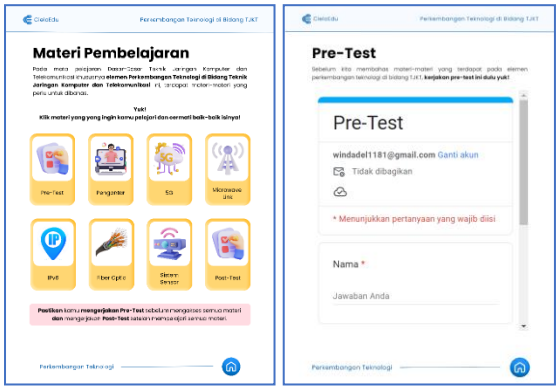

Fig. 6. Material Selection and Pre-Test Page

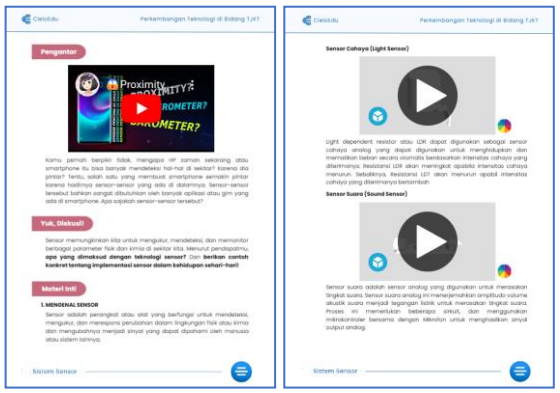

Fig. 7. Material Page

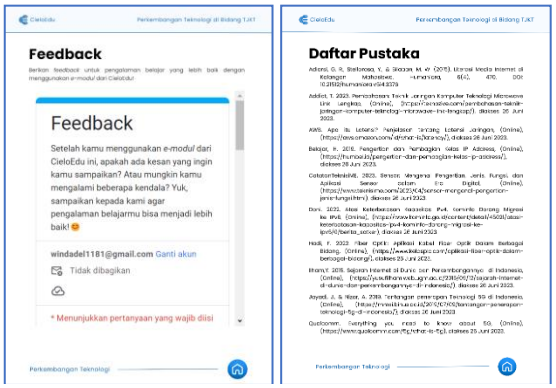

Fig. 8. Feedback and Bibliography Page

- Expert Validation

  In this study, product validation is divided into two, namely, the media validation test and the material validation test. Media validation is used to test and determine the feasibility level of learning media in the form of e-modules that have been developed. This media validation uses three aspects: usability, grammar, and language. The results of the media validation test are in the category of very feasible or very valid, with a percentage of 95.50%. Graphic aspects get a validity percentage of 95.45%, so in this aspect, the e-module with discovery learning content equipped with 3D models can be categorized as very valid. Therefore, the criteria for display design, font size and type, layout, suitability, and quality of multimedia elements can be declared very well. In line with previous studies, highly valid or practical aspects of graphics can attract the attention of students to understand better the subject matter contained in learning products [17], [18]. At this stage, revisions were also made based on comments and suggestions given by media validators.

  Material validation is used to test and determine the feasibility level of the Basic Computer Network Engineering and Telecommunications subject matter contained in the e-module that has been developed. The relevance of learning materials is very important to consider when developing learning media.[19]. In this material validation, three aspects are used: content, presentation, and language. The results of the material validation test are very feasible or very valid, with a percentage of 97.20%. The language aspect gets the highest validity percentage of 100.00%, so the e-module with discovery learning content equipped with 3D models can be categorized as very valid. Therefore, the criteria for writing, using, and selecting language can be stated to have been conveyed very well. The achievement of a very valid category in the linguistic aspect shows that the media has used the right language, and teachers can use the media. At this stage, revisions were also made based on the comments and suggestions given by the material validators before proceeding to the user trial stage.

- Implementation to Learners

  User trials in this study consisted of small-group and large-group user trials. The subjects of this user trial were grade XI students who had taken the basics of computer network engineering and telecommunications. The aspects measured in the user trial include content, presentation, language, grammar, and usability. The small group user trial with ten respondents gave results in e-modules with discovery learning content equipped with 3D models in the category of very feasible or very valid with a percentage of 89.93%. The small group trial resulted in several revisions, including access to the feedback page, video size, and access to the material selection page.

  The large group user trial with 32 respondents gave results in e-modules with discovery learning content equipped with 3D models in the category of very feasible or very valid with a percentage of 91.72%. Of the five aspects used, the presentation aspect got the highest validity percentage of 93.14%, so in this aspect, the e-module loaded with discovery learning equipped with 3D models can be categorized as very feasible. The existence of stages or learning models contained in e-modules can make learning more structured, and users also understand the material being studied [20]. In addition, interesting elements in e-modules can also make users more enthusiastic and motivated in carrying out learning activities.

- Learning Motivation

  Measurement of learning motivation was carried out before and after using the e-module. Indicators used to measure learning motivation include desire and desire to succeed, drive and needs in learning, hopes and ideals, self-confidence, interesting activities in learning, and a conducive learning environment.

  Measurement of initial learning motivation shows that the motivation possessed by students is in the high category with a percentage of 72.99%. Student learning motivation after using e-modules amounted to 90.10% in the very high category. Thus, there is an increase in the medium category with a gain value of 0.63. The hopes and aspirations indicator gets the highest gain value of 0.74, so the e-module with discovery learning content equipped with 3D models is stated to be able to increase student learning motivation in terms of hopes and aspirations. With higher hopes and ideals, students will be more motivated and try to do everything that can support the quality of their learning, such as improving their achievements by diligently doing assignments and actively participating in learning activities [21].

IV. CONCLUSIONS

Research and development of e-modules equipped with 3D models with discovery learning content in computer network engineering and telecommunications have been carried out. It can be concluded that: (1) this research produces flipbook-based e-modules that can be accessed online and multiplatform, (2) e-modules reach a very feasible category with a percentage of media validation test of 95.50%, material expert validation test of 97.20%, small group user trials of 89.93%, and large group user trials of 91.72%, and (3) e-modules can increase student learning motivation with a gain value of 0.73 or in the medium improvement category. Based on the research results, there are several suggestions, such as product utilization by the instructions for use, dissemination by teachers and students so that the product functions sustainably, and product development in terms of material or features by other researchers.

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