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Development of an *E-Module* on Occupational Safety, Occupational Health, and Environmental Protection Topics for Android-Based Information and Communication Technology Vocational Competency

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Abstract

The learning achievement in the field of safety, occupational health, and environmental protection (K3LH) material is suboptimal, even though in the industrial sector, it serves as the fundamental knowledge for establishing a healthy and safe working environment. Therefore, the objective of this research is to analyze the procedure for developing an Android-based K3LH e-module, assess the feasibility of the e-modules, evaluate their practicality, and ascertain their effectiveness by measuring student competency scores. The research methodology employs the ADDIE (Analysis, Design, Development, Implementation, Evaluation) approach model, involving 37 respondents who are 10th-grade students specializing in Information and Communication Technology Competency at SMK Ma'arif NU Paguyangan. The outcomes revealed that the e-module demonstrated a high level of feasibility, as determined through expert validation, comprehensive features, and user-friendly design. The module's practicality was also substantiated by user data, indicating a high level of practicality. Furthermore, the increased competency results indicated the effectiveness of the presented modules. In conclusion, this research establishes that the developed e-module effectively enhances student competence in HSE (Health, Safety, and Environmental) material. It offers several advantages, including comprehensive features, the inclusion of mini-games that pique student interest in module utilization, and easy accessibility, which allows for more flexible exploration of the material.

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INTRODUCTION

The advancement of information and communication technology is expected to continue expanding in response to the growing human requirements, particularly in the realm of education. The significance of educators adopting the functions of information and communication technology in a more suitable manner is of utmost importance. This is essential in order to provide the younger generation with a broader understanding and exposure to the appropriate and beneficial utilization of technology (Husain, C. 2014). In order to cater to the diverse learning styles of students, it is essential for teachers to possess a genuine interest in learning. Additionally, there is a need to create instructional materials that can effectively address challenges encountered during the learning process.

One of the educational resources that should be employed in contemporary education is the electronic module or *E-module*. E-learning modules represent a form of instruction that utilizes electronic media founded on information and communication technology (ICT). The development of E-learning modules is undertaken to fulfill the increasing demands within the realm of education and to offer students more interactive, flexible, and effective learning alternatives.

E-modules can be defined as a type of self-directed learning resource that is organized into structured learning units designed to achieve specific learning objectives. These modules are presented in electronic format, where each instructional and learning activity is interconnected through navigational links, promoting students' active engagement with the program. They also incorporate video tutorials and audio elements to enhance the overall learning experience. Consequently, E-modules have the potential to stimulate students' self-directed learning and serve as a catalyst for fostering their creativity.

The utilization of *E-modules* is indispensable when considering their advantages across all educational levels, ranging from elementary schools to colleges. Vocational high schools, or SMKs, also require innovative approaches to learning, particularly in theoretical aspects.

A Vocational High School (SMK) represents a formal educational institution offering vocational education at the secondary education level. It serves as a progression from junior high school or other equivalent forms of education, building upon the knowledge and learning outcomes that are deemed equivalent to those of junior high school (National Education System Law No. 20/2003). Vocational education is a form of secondary education designed to primarily equip students for employment in a specific field.

The Ministry of Education and Culture (MoEC) is dedicated to enhancing the caliber of graduates from secondary schools. This aligns with Presidential Instruction No. 9/2016 concerning the Revitalization of Vocational Schools, which seeks to elevate the quality and competitiveness of Indonesia's workforce.

Vocational high school (SMK) students are provided with a range of courses aimed at better preparing them for their future entry into the industrial workforce. One crucial aspect of preparing for the industrial world is acquiring knowledge about Health, Safety, and Environment (HSE). The dissemination of K3LH education to the community can commence during the school years. Educational settings like schools serve as the backdrop for various activities, encompassing both physical and psychological dimensions. Within the context of the learning process, Occupational Health and Safety (OHS) aspects assume a pivotal role, necessitating comprehensive understanding by all stakeholders, as risks to occupational health and safety can manifest themselves at any time and in any place. Schools can be likened to workplaces due to the interactions occurring among students, educators, and staff.

SMK Ma'arif NU Paguyangan is one of the Vocational High Schools located in Brebes Regency that has been granted the distinction of being a School of Excellence. However, the utilization of technology by teachers at SMK Ma'arif NU Paguyangan, particularly for theoretical subjects, has not been fully optimized.

Teachers only occasionally employ tools such as PowerPoint applications and videos from the YouTube platform. This limitation is associated with inadequate facilities and infrastructure, with only fifteen projectors available for a total of thirty-six classrooms. Consequently, teachers often rely on printed modules in the form of package books and supplementary workbook materials (LKS). Conventional teaching methods tend to render the learning process less engaging and monotonous, which is one of the factors contributing to students' decreased attentiveness and lack of seriousness when it comes to comprehending the subject matter.

The significance of students' understanding of Safety, Occupational Health, and Environment (K3LH) is underscored by the content within the foundational Information and Communication Technology (TKJ) curriculum. Therefore, there is a need to create an *E-module*, with the expectation that this application will not only serve as a tool for educators and supervisors but can also be used independently by individual users. It is anticipated that this application will facilitate independent learning, particularly in the area of K3LH teaching material, for the benefit of users or students.

METHODS

Type of Research

The ADDIE development research model is a model that encompasses five sequential phases in the development of instructional models. These phases include *Analysis, Design, Development or Production, Implementation or Delivery, and Evaluation.* The ADDIE model was formulated by Dick and Carey in 1996 for the purpose of designing learning systems (Mulyatiningsih, 2016).

Research Procedures

The research procedure refers to the steps employed to gather data aimed at addressing the research questions posed in this research. Within the context of the ADDIE development research model, the steps undertaken in this research are as follows:

1. Analysis Stage

The analysis phase conducted at SMK Ma'arif NU Paguyangan encompasses the following activities: a) assessment of the utilization of facilities and infrastructure in class X specializing in TKJ, b) evaluation of the learning process in class X TKJ, c) examination of the use of educational materials within class X TKJ. All of these analysis stages aim to identify the specific requirements within the school and to offer insights for the development of media that align with the school's needs.

2. Planning Stage

The design phase serves as a subsequent step following the analysis stage. It is conducted to formulate the requisite framework for the development process, enabling researchers to determine the appropriate course of development that aligns with educational requirements.

3. Development Stage

The development stage is a process that involves transforming design specifications into a tangible product, which in this case, is the E-module. Initially, teaching modules are created to align with learning outcomes and objectives. This involves integrating various media elements such as text, video, audio, and mini-games. The process begins with the creation of a storyboard using the PowerPoint application, which is then implemented in the Adobe Animate application to consolidate all elements, including text, sound, video, and additional mini-games for evaluation purposes. The developed media will undergo validation by three assessors, namely subject matter experts, media experts, and instructional experts. Subsequently, the E-module will be subjected to testing by module users, which includes both teachers and students.

4. Implementation

This phase involves the preparation and implementation of the developed products in the learning process to assess their impact on the quality of education, aiming for engagement, effectiveness, and innovation. Additionally, the necessary facilities and infrastructure are readied to support the product trials. The application of this learning media product takes place in class X specializing in TKJ at SMK Ma'arif NU Paguyangan.

5. Evaluation

This stage represents the final phase, which involves the evaluation of the activities undertaken by researchers to assess the quality of the developed media products. The evaluation phase serves to determine the suitability and effectiveness of the media created by the researchers. The data acquired during this stage is utilized to enhance the developed product. The outcomes of the evaluation phase will be employed to refine the product before its deployment for users. Products that have been improved will then be used by users. The next stage is the practicality of the product by conducting an evaluation in the form of *Pretest* and post *test* to determine the practicality and benefits of the product developed as well as the user's understanding when using the product in this case is the K3LH *E-module.*

Methods of Data Collection, Processing, and Analysis

The data collection technique is a critical and pivotal step in research, as the primary objective of research is data collection (Sugiyono, 2014). In this research, questionnaires are employed as the data collection method, specifically, module feasibility questionnaires, module practicality questionnaires, and module effectiveness questionnaires. These questionnaires are elucidated as follows:

1. Module Feasibility Assessment Sheet
2. Module Practicality Questionnaire
3. *Pretest* and *Posttest* Questions

The tools employed for gathering information in this development-oriented data collection process include questionnaires and interview guides. A questionnaire is a structured list of written questions that respondents are required to answer. Respondents provide their responses by selecting from pre-existing alternative options. The questionnaire was designed to assess the suitability, practicality, and effectiveness of the module created with the aim of enhancing students' knowledge in HSE-related learning. The instrument in the form of responses for material experts and media experts in the researcher's research used a questionnaire instrument with aspects and criteria adopted from the BSNP (National Education Standards Agency) questionnaire for electronic media scoring criteria, With further development by researchers tailored to the needs of the research, as a result, a feasibility test questionnaire was not subjected to testing. In this research, the practicality questionnaire was adopted from previous research that had already established its validity; thus, it did not undergo further testing. However, to assess the validity of the effectiveness questionnaire, it was initially tested on TKJ students at SMK Ma'arif NU Paguyangan.

The data analysis technique encompasses module feasibility test analysis, module practicality and effectiveness analysis, as well as value analysis. The value analysis assesses knowledge-related aspects.

RESULTS AND DISCUSSION

Implementation of Development with the ADDIE Model

The development model used in this research is the ADDIE model which consists of the stages of analysis (*analyse*), design (*design)*, *development (development*), implementation (*implementation),* and evaluation (*evaluation)*. Based on the research and development conducted, the following research results were obtained:

(1) Students express a lack of comprehension regarding the HSE material presented by the teacher in the form of printed modules during their learning sessions. (2) Students exhibit greater satisfaction and improved comprehension of the learning materials when teachers incorporate educational media into their teaching methods. (3) The examination of the teacher's challenges led to a decline in students' competency comprehension. This decline was attributed to the teacher's utilization of printed teaching materials, which were found to be less engaging and interactive. Consequently, students experienced boredom and diminished interest. (4) Students exhibit greater satisfaction and enhanced comprehension of learning materials when teachers employ engaging educational media. Furthermore, such

approaches have been shown to enhance learning outcomes and provide a valuable resource for independent research, featuring comprehensive competency content. (5) Selection of topics/materials for media content is a critical consideration. In this case, the chosen topic/material is K3LH (Occupational Safety, Health, and Environment) material, as it has not been adequately supplemented with media resources, relying primarily on textbooks.

Following preliminary observations conducted before the research, it was determined that the analysis of media requirements within schools indicated the following: (1) The K3LH material is encompassed within element V of the Merdeka Curriculum. (2) K3LH material necessitates educational media capable of providing comprehensive explanations and visual aids. (3) The desired learning media should empower students to actively engage in self-directed learning, offering flexibility for independent research, accessible anytime and anywhere without the need for external assistance. (4) There is a demand for more user-friendly and practical learning media suitable for student use. The anticipated development of this learning media is expected to address the aforementioned issues, potentially leading to improved student learning outcomes, particularly in the context of K3LH teaching materials.

Curriculum analysis is conducted to determine the selection of the HSE learning content to be developed. Subsequently, an analysis of the curriculum employed at SMK Ma'arif NU Paguyangan is performed. The curriculum in use consists of the independent curriculum for grades X-X1 and the 2013 Curriculum for grade XII.

The second phase in the ADDIE development model is the design stage. The design stage is undertaken to facilitate the creation of the learning media that is to be developed. This phase encompasses the development of product designs and the formulation of product blueprints.

At this stage, the product design of the programme to be made with *flowchart is* produced. *Flowcharting* in terms of development serves to describe the flow from one scene to another from the user's point of view, this flowchart serves to produce learning media with navigation flow that makes it easy for users to operate.

During this stage, the preparation of media content for K3LH teaching materials takes place. Content is sourced from various outlets and then processed into electronic modules. Some of the content featured in the media includes: the home menu, CP/TP (Control Panel/Tutorial Panel), developer profile, instructional material, evaluation components, user instructions, and user addition.

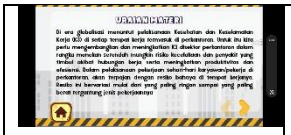
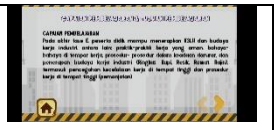
During this phase, the development of quality assessment instruments for the media is undertaken. These instruments take the form of validation checklists for material experts, media experts, teachers, and students. Additionally, competency test questions are prepared to evaluate students' learning outcomes in K3LH material.

The third phase of the ADDIE development model is the development stage. The objective of this stage is to evaluate the feasibility of the *E-module* that has been created, as a continuation of the design process conducted in the previous stage.

a) Media Creation
b) Product Validation
c) Product Revision

Revised *E-module* results based on suggestions and comments from validators

BEFORE REVISION	AFTER REVISION
	
The initial display consists solely of images/icons, lacking the button names.	The initial display already includes the description of the candy.
	
Developer profile is incomplete	Developer profile completed

 Material Description changed to CP/TP	 There are CPs and TPs
 Incomplete material references	 Reference materials have been completed
 There is no Environmental material yet	 There is already Environmental material
 No next and back buttons yet	 There is already a back and next button

The fourth stage in this ADDIE research and development model is the implementation or application phase. This phase is executed when the outcomes of the feasibility evaluation by media experts and subject matter experts meet the relevant criteria. The implementation stage involves the utilization of the K3LH *E-module* at SMK Ma'arif NU Paguyangan, involving respondents from class X TKJ 3, comprising a total of 37 students as the experimental group. This research employed a single-group pre-test and post-test design to ensure there were no leaks in terms of material or pre-test and post-test questions within the *E-module.*

The stages assessed during this phase encompass the development stage, which involves the K3LH *E-module*, validation, revision, and the enhancement of product instruments. Formative evaluation serves the purpose of ensuring that the intended objectives can be attained and allows for enhancements to be made to the K3LH *E-module*. Scoring is conducted at the conclusion of the program, or more precisely, at the end of the research, with the objective of determining the effectiveness of the developed K3LH E-module in enhancing student learning outcomes.

The purpose of this validation is to assess the validity of the research data collection instruments. The following presents an overview of the outcomes of the data instrument validation:

Upon completion of the validation test sheets by media experts 1, media experts II, media experts III, and media experts IV, calculations were performed for all components, resulting in a total score of 80.4%. According to the criteria for assessing the level of media feasibility using a Likert scale, the media featured in the K3LH *E-module* qualifies as "very feasible" for use as instructional material for students.

The results of filling out the validation test sheet on material expert I, material expert II, material expert III and material expert IV were calculated for all components obtained was 86.8%. Based on the criteria for the level of feasibility with a Likert scale, the media used in the K3LH *E-module is* included in the qualifications worthy of teaching media for students.

The outcomes of this research align with the research conducted by Rinda Resi Herdiningrum et al. (2021), which asserts that the developed e-module for fashion pattern making material is considered feasible based on the outcomes of development and data analysis. The e-module, which is based on richpeace software, has received a rating of "very feasible" from material experts, scoring (97.0), and has been similarly deemed "very feasible" by media experts, earning a score of (96.3).

Similar outcomes were reported in the research conducted by Vina Serevina (2018), which focused on the development of *E-modules* for heat and temperature material. It can be concluded that problem-based *E-modules* (PBL) have a positive impact on enhancing students' scientific process skills, as indicated by the favorable results from tests conducted by material experts, competency experts, and media experts. The value obtained from the material expert is 82.20%, and from the media expert is 75.78% and the competency expert, namely the Physics teacher, gets 94.36% while the results of the student pretest and post test get a percentage of

80.78% and 86.31%, showing that the magnitude of the increase before and after getting treatment using the *E-module* gets an increase of 0.6%.

Similarly, in a research conducted by Dea Febrista (2021), which aimed to produce an android-based interactive E-module, the following outcomes were observed: (1) Material expert validation I yielded a validation percentage of 92%, while material expert validation II achieved a validation percentage of 84%, categorizing it as "Very Valid" for use as a learning medium. (2) Media expert validation I resulted in a validation percentage of 83.07%, and media expert validation II achieved 93.84%, categorizing it as "Very Valid" for use as a learning medium.

The outcomes of students' completion of the media practicality questionnaire were subjected to calculations, resulting in an aggregate score of 77.84%. In accordance with the criteria for assessing feasibility using a Likert scale, the media incorporated within the K3LH *E-module* qualifies as "very feasible" for utilization as instructional material for students.

The outcomes presented above are in alignment with previous research conducted by Iin Rahmatul Ula (2018), which indicated that the LCDS-based E-module was rated as "Very interesting." In the small-scale trial, the average score was calculated to be 3.65%, while in the large-scale field trial, which involved 30 students, the average attractiveness score was 3.55, categorizing it as "Very interesting" and highly feasible for use. The same thing is also found in research from Yeni Kosasih (2023) which obtained results Based on data analysis, with a score = 92%, because the overall average score is in accordance with the tabulation of the level of practicality, the user's response is in the range of 75%-100%. This shows that the CLO3D digital party wear design emodule is considered very practical to improve learning outcomes.

The assessment of media effectiveness was derived from the results of both the post-test and *pre-test* conducted in a single trial. The testing method employed for evaluating effectiveness was the one-group pre-test-post-test design, which relies on the comparison of student learning outcomes in the experimental class. The N-gain value, categorized with a score of 0.78, falls within the high category.

The aforementioned results are consistent with research conducted by Satri A (2023), which involved testing the developed media using N-Gain and achieving an effectiveness rate of 76%. It can be confidently categorized as effective due to the t-value of 18.13. Similarly, outcomes in research by Fakhri Fauzi (2023) related to the application of the 5S/R work culture among students indicate a notable increase in their adherence to it by 47.59%, placing it in the medium category. The testing process involved the examination of normality and homogeneity, revealing that the obtained data did not exhibit normal variance and were indeed heterogeneous.

CONCLUSIONS

Based on the outcomes of the development research and the discussion regarding the android-based *E-module* for K3LH, the following conclusions can be drawn:

1. E-Module development utilizes the ADDIE approach which has steps (*Analysis)* Analyse the needs of the objects and subjects to be studied, *(Design)* design learning objectives, materials and e-module story boards to be developed, (*Developt)* develop the results of the media story board into the application used to create e-modules, (*Implementation*) implement by having the media and materials tested by experts and implemented on media users, (*Evaluation*) the results of the development are evaluated through the results of the questionnaire distributed.
2. The android-based K3LH *e-module* is determined to be highly feasible for utilization as a learning medium.
3. The android-based K3LH *e-module* is deemed highly feasible for use as a learning medium, as indicated by the results of the questionnaire responses evaluating its practicality. The assessment, derived from the student evaluation sheet as users of the E-module, falls under the "very feasible" category.
4. The android-based K3LH *e-module* that has been developed proves to be effective for use.

This assertion is supported by the N-Gain score test, which recorded an effectiveness rate of 78%. Consequently, it can be concluded that there is a significant and efficient improvement in learning outcomes.

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