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Development of An Interactive E-Module Based on The Independent Curriculum in Informatics Learning at Vocational Schools

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Abstract

This research aims to develop an interactive e-module based on the Independent Curriculum to support Informatics learning in class X, especially in Data Analysis materials. This research is motivated by learning problems at SMKN 1 Kwanyar, where the learning process still depends on PowerPoint media and structured digital learning resources are not available. The research method used is Research and Development (R&D) with a 4D development model (Define, Design, Develop, and Disseminate). The e-module product was validated by two experts, namely media experts and material experts, and tested on students through two stages of field tests in the form of a small group trial involving 5 students and a large group trial involving 24 students. The validation results showed an excellent level of eligibility, namely 96.67% of media experts, 92% of material experts, and an average of 91% of student responses. The findings show that the e-modules developed are valid, practical, and effective in using digital learning media. Interactive features, systematic material structure, and web-based accessibility make this e-module suitable to support independent learning and increase student engagement according to the demands of the Independent Curriculum.

Keywords: Interactive e-module, Independent Curriculum, Informatics Learning, Data Analysis, 4D Model, Digital Learning Media.

INTRODUCTION

The development of knowledge and technology today provides many changes and advantages in the field of education, especially in the teaching and learning process (Azmi et al, 2020). Advances in the field of science and technology have a great impact in various aspects of human life. Education as a crucial element in the process of individual maturation, also plays an important role in encouraging this progress (Rijal, 2020). To support these demands, Learning media is an educational tool that can be used to help the teaching and learning process, as well as foster students' motivation to learn, and everything that is used, both objects and the environment around students that can be used by students in the learning process (Motor, 2019). One form of learning media that continues to develop is interactive e-modules, which are designed systematically and allow users to interact through audio, text, video, graphics, and animations (Aeni & Widodo, 2022). The learning process is therefore required to be more innovative, interactive, and able to utilize digital technology to suit the needs of the current generation of students. One of the approaches that supports this is the use of interactive e-modules as learning media.

Learning in the subject of Informatics includes various important materials, one of which is Data Analysis which is given to students in class X. This material aims to equip students with the ability to collect, process, interpret, and present data so that they are able to apply computational and analytical thinking skills in problem solving. Because Data Analysis requires systematic steps and clear visualizations, appropriate learning media are needed to help students understand concepts in a structured way. Website-based learning can support this need because web pages provide flexible access, organized storage of materials, and easier integration of videos, images, and interactive features that match the characteristics of Data Analysis material.

Based on an interview with an Informatics teacher at SMKN 1 Kwanyar on August 20, 2025, it is known that learning still depends on PPT slides without a fixed handbook. This makes the delivery of materials, especially Data Analysis, less than optimal. Previous studies have developed web-based learning media or digital e-modules and shown positive results. Research conducted by Azkiyah et al (2022) shows that website-based learning media is very feasible and effective in improving the learning outcomes of vocational school students, with expert validation and high student response. However, the media developed has not adjusted the Merdeka Curriculum and is still limited to basic features without support for independent material updates. Moreover Pertiwi and Irfan (2021) develop web-based learning media that is proven to be valid, very practical, and effective in improving the learning outcomes of vocational school students. However, the media produced still does not meet the characteristics of the Independent Curriculum.

Based on these problems, it is necessary to develop digital learning media that is more interactive, structured, and in accordance with the needs of the Independent Curriculum. Therefore, this research developed a web-based interactive e-module designed to support students' understanding of Data Analysis material while assisting teachers in delivering the material more effectively.

METHOD

2.1 This research method uses *Research & Development* (R&D), This method aims to produce products through the process of discovering potential problems, designing and developing a product as the best solution.(Waruwu, 2024). The model used is 4D, The 4D development method is a suitable method to be applied in the development of learning tools that are structured according to the curriculum reference used.(Ma'wa et al., 2023).

2.2 Development Stage

1. First, *define*. This stage is carried out to identify learning needs through curriculum analysis, student characteristics analysis, learning objective analysis, and analysis of problems that arise in the field. Supporting data was obtained through

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interviews with Informatics class X teachers of SMKN 1 Kwanyar and the study of the Independent Curriculum document.

2. Second, *this Design* Stage is the design design stage). Furthermore, a *style guide* for *user interface* (UI) is set, which will be a reference for designers in designing and building the appearance of a website interface.
   a. *Use Case* Diagram
      The *Use Case diagram* shows the interaction of actors with the system on *the technology education* website.

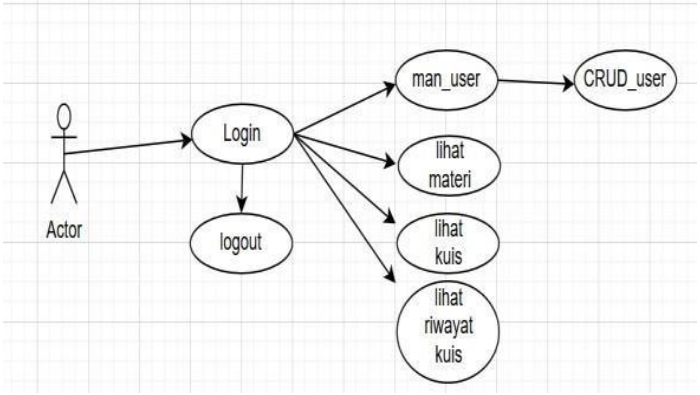


Fig 1. Use Case Admin

In the admin user, the main task of the admin is to add, *Update*, and delete *users.*

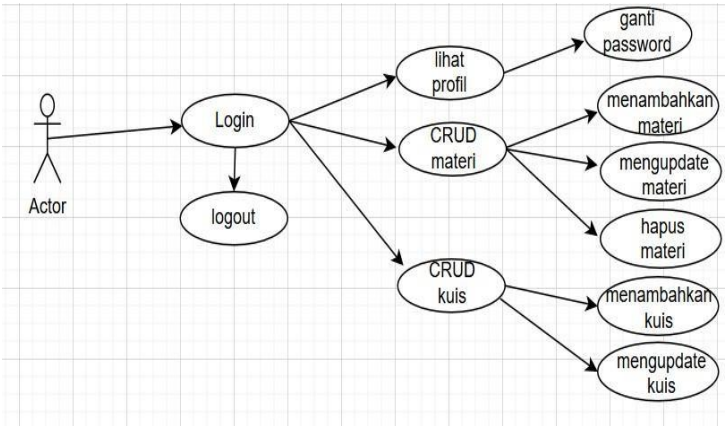


Fig 2. Of The Teacher's Use Case

In the *teacher's user*, teachers can add, *update*, and delete materials, quizzes as well as change *passwords* and profile photos.

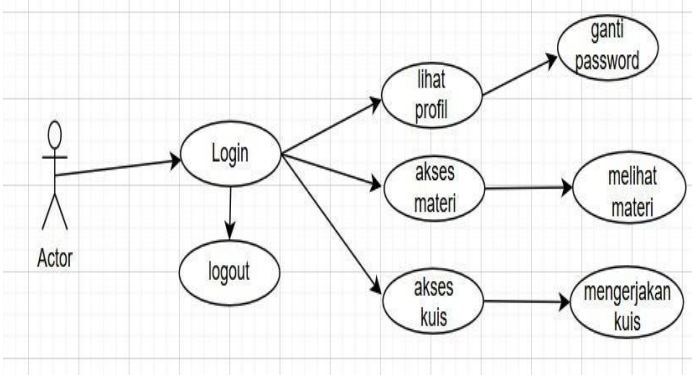


Fig 3. Use Case Students

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On student *users*, students can access materials and quizzes, besides that students can also change *passwords* and profile photos.

b. *Actifity* Diagram

Activity diagrams visualize the entire program flow, from the process of opening a *website* to closing *the website.*

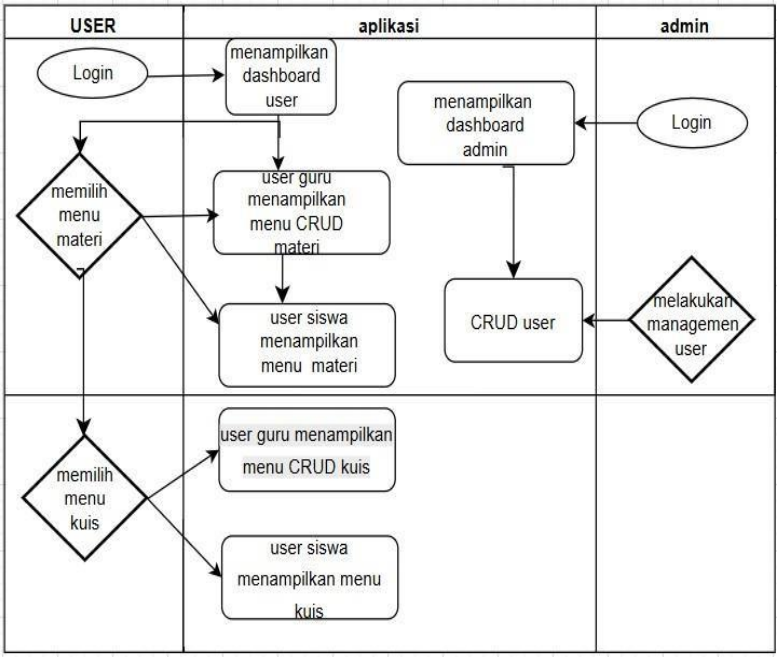


Fig 4. Activity Diagram

c. *Use Interface (UI)*

In making system design, it starts with the creation of *a user interface style guide* as a guideline for designers in designing *web interfaces.*

NO	Tampilan Rancangan	Deskripsi
1.		Tampilan perancangan desain antarmuka halaman login
2.		Tampilan rancangan desain antar muka dashboard guru

Fig 5. *Use Interface* (UI)

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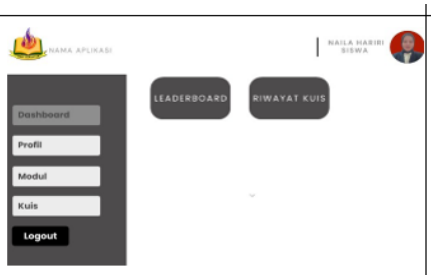
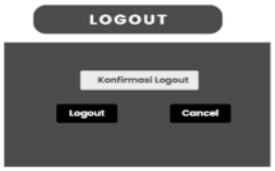
3.		rancangan desain antar muka dashboard siswa
4.		Tampilan rancangan tatap muka menu logout

Fig 6. *Use Interface* (UI)

3. Third, *Develop*. The development phase includes the implementation of the design using PHP and the Laravel framework to produce interactive website-based e-modules. After the initial product is completed, a validation process is carried out. There are 2 validators, namely 1 Media Expert and 1 Material Expert. After receiving input from experts, the researcher revised the product according to the comments given, both related to the interface display, material presentation, and interactive components. The revised product was then tested to grade X students of SMKN 1 Kwanyar in two stages, namely, small group trial (4 students) and large group trial (24 students) (Fitri *et al*, 2021). The purpose of these two stages is to find out the clarity of the material, the practicality of navigation, and the attractiveness of the e-module's appearance.
4. Fourth, *Disseminate*. This stage is carried out on a limited basis by socializing e-modules to teachers and students in the school environment. The deployment is carried out to ensure that the product can be used as a learning medium for Data Analysis materials and to allow users to provide additional feedback before the product is used more widely.

2.3 Data Collection Techniques

The data collection technique used is by conducting observational interviews, then the development of *e-modules* as a website-based learning medium *is carried out.* The results of the developed learning media will be tested through experts/experts at the expert review stage. Then the results obtained are revised and continue to test the product which aims to collect data that will be the basis in determining the level of effectiveness, efficiency, and attractiveness of the product to be produced.

2.4 Research Instruments

The Data Collection Instruments used are: 1). Media validation sheet; 2). Material validation sheet; 5). Student response questionnaire sheet. The data analysis techniques used in the development of applications in this study include qualitative data analysis and quantitative data analysis. To be able to give meaning and decision-making, the stipulations in Table 1 are used.

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Table 1. Conversion of Achievement Level Scale 5

Very Bad	1
Not Good	2
Enough	3
Good	4
Excellent	5

(Sulaksana and Mahadewi, 2022)

2.5 Data Analysis Techniques

a. Expert Validation Data Analysis

The data was analyzed using percentage calculations:

$$P = \frac{\sum X}{\sum X_i} \times 100\% \quad (1)$$

Information:

P =Presentase
$\sum X$ =Total Assessment Score
$\sum Xi$ =Highest Total Score

The results are then interpreted based on eligibility categories.

b. Student Response Analysis

Student questionnaire data was analyzed using the same percentage to determine the level of attractiveness, ease of use, and effectiveness of the e-module.

c. Product Revision Process

The revision is carried out in two stages:

1) First Stage Revision: based on the results of validation of media and material experts.
2) Revision of the second stage: based on student feedback on small group trials before use in large groups.

RESULTS AND DISCUSSION

3.1 Product Development Results

The results of the research that have been carried out are a valid, practical and effective website-based e-module learning media in learning informatics data analysis material for class X SMKN 1 Kuwanyar. The results of designing website-based e-module learning media can be seen in the following image.

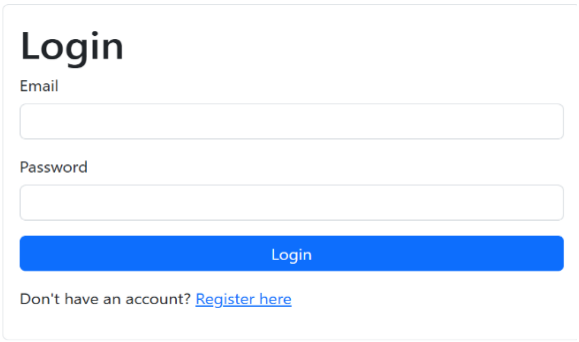


Fig 7. Login Page

In this section, students and teachers must enter the registered email and password to be directed to their respective dashboards, and if they do not have an account, they will be directed to register an account first.

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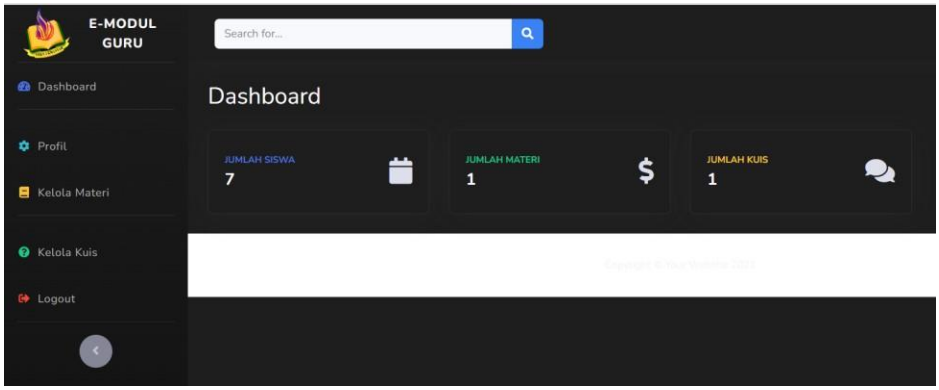


Fig 8. User Teacher Page

In this section is the teacher dashboard, where teachers can see the number of students who have logged in to this website. Teachers can also manage materials and quizzes, namely by adding or updating and deleting materials and quizzes.

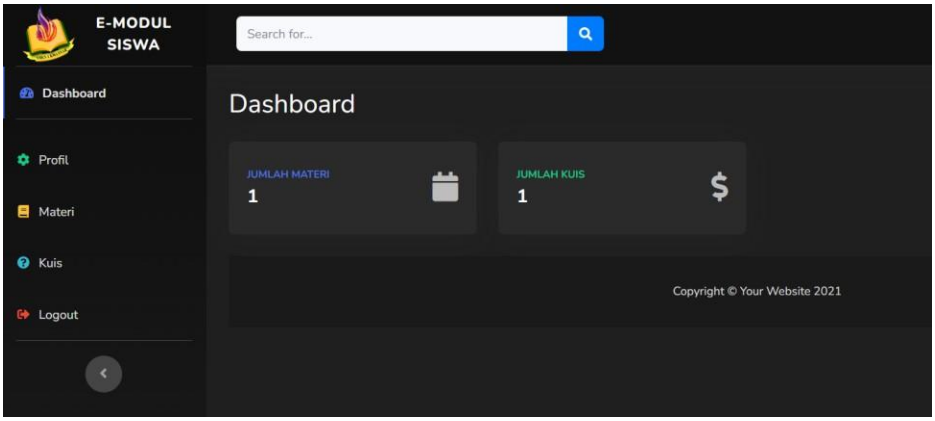


Fig 9. Student Page

In this section is the student dashboard, where students can access materials and quizzes that have been added by the teacher. Students can download existing materials, students can also take quizzes and see firsthand the quiz scores obtained.

The development of this e-module has succeeded in meeting the needs of learning that previously only relied on PowerPoint. A more interactive and neatly organized UI helps the learning process to be independent and engaging. The simple display also makes it easier to navigate for vocational school students whose characteristics require practical and easy-to-operate media.

3.2 Expert Validation Results

Validation is carried out by two validators, namely media experts and material experts. Media experts gave a feasibility percentage of 96.67%, while material experts gave a score of 92%, both of which were categorized as very good. Feedback from validators is used to revise several aspects, such as icon consistency, color contrast, and the arrangement of material points.

Expert assessments show that the e-module has met the feasibility aspects in terms of appearance, functionality, and accuracy of the material. A high percentage shows that the design and content of e-modules are in accordance with digital learning media development standards. This is also in line with the demands of the Independent Curriculum which emphasizes the use of technology as a means of learning that is flexible, independent, and adaptive.

3.1 Student Trial Results

The small group trial involved 6 students, while the large group trial involved 30 students. Student responses to the large-group trial obtained a percentage of 91% (excellent category). Students declare that:

a. Attractive e-module display
b. Easy to use navigation
c. Easy-to-understand material
d. Quizzes help understand weaknesses
e. E-Modules can be accessed at any time

The excellent response from the students showed that the e-module was able to increase student motivation and involvement in learning. Compared to previous use of PowerPoint, e-modules provide a more interactive learning experience and allow students to learn independently outside of class hours. The quiz feature also provides an opportunity for students to conduct self-evaluation.

However, there are several obstacles encountered, such as limited devices and internet networks for some students. In addition, some displays are not optimal on cellphone screens with small resolutions. This shows that the development of website-based media needs to be continuously adjusted to be compatible with various conditions of students' devices

CONCLUSIONS

Based on the results of the research and discussion, it can be concluded that the website-based interactive e-module developed using the 4D model is declared feasible, practical, and effective to be used in learning Informatics Data Analysis material for class X of SMKN 1 Kwanyar. The results of validation by media experts of 96.67% and material experts of 92% showed that the e-module had met the eligibility criteria in terms of appearance, navigation, interactivity, and accuracy of material according to the demands of the Independent Curriculum.

Trials in both small and large groups also showed excellent response, with an average percentage of 91%. Students assessed the e-module to be easy to use, engaging, and helpful in understanding the material systematically. The quiz and web-based access features provide a better self-paced learning experience than conventional media such as PowerPoint.

However, this study has several limitations, especially related to the differences in the devices used by students and the condition of the internet network that is not always stable. In addition, the display of the e-module is not fully optimal on various screen sizes of the device. Therefore, further development is suggested to improve display responsiveness as well as add more interactive learning features so that e-modules can be used more widely and sustainably.

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