

Research Article

Interactive Learning Media to Introduce Working Principle of Hybrid Machines Using Digital Platforms

Citra Dewi Megawati^{1*}, Bima Romadhon Parada Dian Palevi²¹Creative and Digital Industry Department, Universitas Brawijaya, Malang, Indonesia²Electrical Engineering, National Institute of Technology (ITN) Malang, Malang, Indonesia**Abstract.**

Since the COVID-19 pandemic, education shifted to application-based and online lectures. In observations made until after the pandemic ended, the use of digital platforms in teaching and learning activities continued in a combined face-to-face and virtual mode. In engineering technology-based learning models, the use of digital platforms was often used. For example, in presenting PowerPoint presentation materials and similar applications. Students were able to absorb lecture material well as long as they didn't go through boring lectures. Engineering lectures in classrooms and online classes based on presentation platforms were often viewed as boring. Due to this, teachers need to deliver lectures face-to-face in class and deliver material available in books and lectures. Online, the material presented was less attractive to students and was ignored. This study aimed to introduce interactive learning media in the form of a digital platform which contains material about hybrid engines, working principles and components and provides examples of their application in modern vehicle technology. The interactive learning media was used to support the material in lectures so that when attending lectures in class and practicing the material, students could follow them well and optimize learning outcomes. Interactive learning media was made as attractive as possible, informative, and easy to reach because it was accompanied by pictures and videos and had the advantage of being low-cost. The research method used was Research and Development conducted through direct observation of student behavior, then conducting interviews with relevant lecturers and distributing questionnaires to students to obtain valid results. The research continued with the development of a digital platform-based interactive learning media. The final results of the study stated that students and teachers agreed that digital platform-based learning media can be used as media support in teaching techniques. The resulting digital platform-based interactive learning media can be operated online on a laptop or smartphone. It is hoped that the results of this research can help the teaching and learning process in lecture techniques, especially material regarding hybrid engines.

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Dewi Megawati; email:
citramegawati@ub.ac.id**Published:** 22 March 2024Publishing services provided by
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1. Introduction

Since the Covid 19 pandemic, the trend in education, which initially used classroom lectures, has shifted to application-based and online lectures [1]. This condition can be seen from the development of digital platforms such as online meetings and online classrooms, and many similar applications offered by developers due to the very high need for technology to support learning and teaching activities [2]. This shift in trend has caused a shift in the education ecosystem, which was originally based on face-to-face lectures in the classroom, to network-based lectures in a virtual model [3]. In observations made until after the pandemic ended, the use of digital platforms in learning and teaching activities was still used even though in a combined face-to-face and virtual mode [4,5]. Maybe some people think that the use of digital platforms has never been done before the Covid 19 pandemic. In fact, the use of digital platforms in lectures has been used even in the last few decades [6], although in a fairly small portion. In the technology engineering-based engineering lecture model, the use of digital platforms is often used, for example the presentation of presentation materials based on power point presentations and similar applications [7–11]. Basically, students are able to absorb lecture material well, provided that it is not through a boring lecture material. Technical lectures in class and online classes based on presentation platforms are one of the boring types of lectures [12–16]. But this is one of the root causes of the problem, some teachers are required to deliver face-to-face lectures in class and deliver material available in books and lecture syllabus [17]. Indirectly, the material presented is not interesting for students and tends to be ignored. The learning model that is considered attractive by students is practice-based learning, ironically in this case it needs to be supported by the delivery of material first (in face-to-face or online classes in presentation media) before students are ready to do work directly (practice). The challenge that needs to be taken in this research is to combine the delivery of material to fit the syllabus, but it needs to be supported by students' interest in presentation media as obtained during field practice. An interactive media-based digital platform in this research is presented. This platform displays lecture material presentations, but in an attractive format accompanied by pictures, videos, and descriptions of the working principles of the tool. This platform has support features that provide opportunities for students to learn interactively and maximize the learning experience as in field practice [6,12,18–20].

2. Materials and Methods

This study uses the method of R & D (Research and Development). The research process was carried out by means of direct observation studies regarding student behavior and was supported by interviews with teachers and distributing questionnaires to students. Interactive media developed using the Adobe Illustrator application in making illustrations of hybrid machine components and the Figma application in making prototypes of digital platform-based learning media applications. Research and Development (R&D) is a method for developing products and testing the effectiveness of products developed. Furthermore, this paper aims to explore the R&D method as a design model in educational research and offer several alternative design models for educational products.

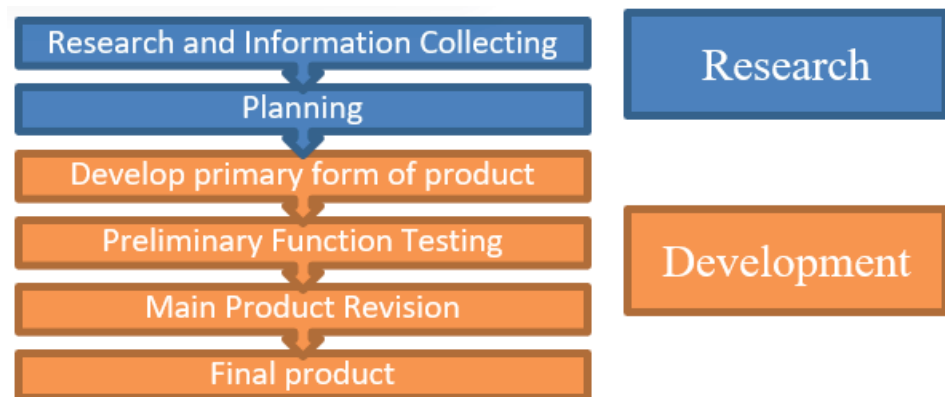


Figure 1: Research methods.

In this study, seven research processes were used as shown in Fig. 1. and were divided into two categories, namely Research and Development. The following is an explanation of the process of the research method used:

- i. Research and information collecting (research and data collection through surveys), included in this step are literature studies related to the problems studied, and preparation for formulating a research framework. is research and data collection including several things, namely needs measurement, literature study, research on a small scale and considerations in terms of value.
 - a. Observational Study of Student Behavior: Observational study of student behavior was carried out on several students at universities in Malang who have engineering courses with hybrid engine material. Observational studies show that on average students feel bored and less interested in the media used in the teaching and learning process.

- b. Interview: Direct data collection with a question-and-answer process between the researcher and the teacher regarding the hybrid machine material which produces data that the teacher finds difficult to provide an explanation of the material.
 - ii. Questionnaire: The process of collecting questionnaire data is carried out by distributing questionnaires online by filling out the Google form provided.
 - iii. Planning, included in this step is formulating skills and expertise related to the problem, determining the objectives to be achieved at each stage. Planning is done by creating a moodboard and brainstorming process on the concept of a digital platform-based learning media application.
 - a. Brainstorming is a thought process based on the results of data collection that has been done.
 - b. Moodboard is an image that is used for reference design that aims to inspire application design.
 - iv. Develop a preliminary form of product (development of the initial form of the product), namely developing the initial form of the product to be produced. Included in this step is the preparation of supporting components, preparing guidelines and manuals. In this research the product design process starts from:
 - a. A flowchart is a set of workflows for an application.
 - b. Low fidelity wireframe is an application concept framework that is realized in a simple visual. This wireframe process is carried out in the Figma application.
 - c. High fidelity wireframe or mockup is the process of perfecting low-fidelity wireframe visuals into a more complex visual by adding details of the design such as colors, button shapes, fonts used etc.
 - d. Prototype is the development of a mockup or high fidelity by connecting between pages so that they can be accessed and used.
 - v. Preliminary function testing (initial function testing), namely conducting initial field trials on a limited scale and in the form of testing the function of the application system. The initial trial process carried out in this study was testing the functions and systems of the application.
 - vi. Main product revision, namely making improvements to the initial product produced based on the results of the initial trial.

- vii. Final product revision, namely making final improvements to the model developed to produce the final product.

3. Results and Discussion

The results of the design in this study produced four visuals as follows:

1. Research and Information feel a little difficult and have spent a long time explaining to students which results in students feeling bored. The final data collection was carried out by distributing questionnaires to students by asking questions about how the media was wanted and what form the media was in.
2. After the Research and Information process is carried out, it is continued with the planning process, the process is formed into 2, namely the brainstorming process and the moodboard. The following is the result of the moodboard that has been prepared :
3. Moodboard: The moodboard of the digital hybrid machine platform is a design reference display that is used as a reference in designing applications. This moodboard uses the concept of orange color which will be replaced with blue so that the application design is more friendly to the eyes of the audience. The moodboard uses buttons, icons and graphics that are simple and easy to understand for Engineering students. See Fig. 2. below.

Develop a preliminary form of product in this study as follows:

3.1. Flowchart

The next process after the moodboard has been selected, the next process is the preparation of a flowchart which is the workflow of the digital hybrid machine platform. The flowchart shows this application. There are 5 main menus and several advanced menus. The following is a description of the flowchart (Fig. 3):

1. Starting from the Opening then
2. The home menu is the home page display.
3. Menu About Hybrid Engine
4. Hybrid Engine introduction, Story and Development of hybrid engines

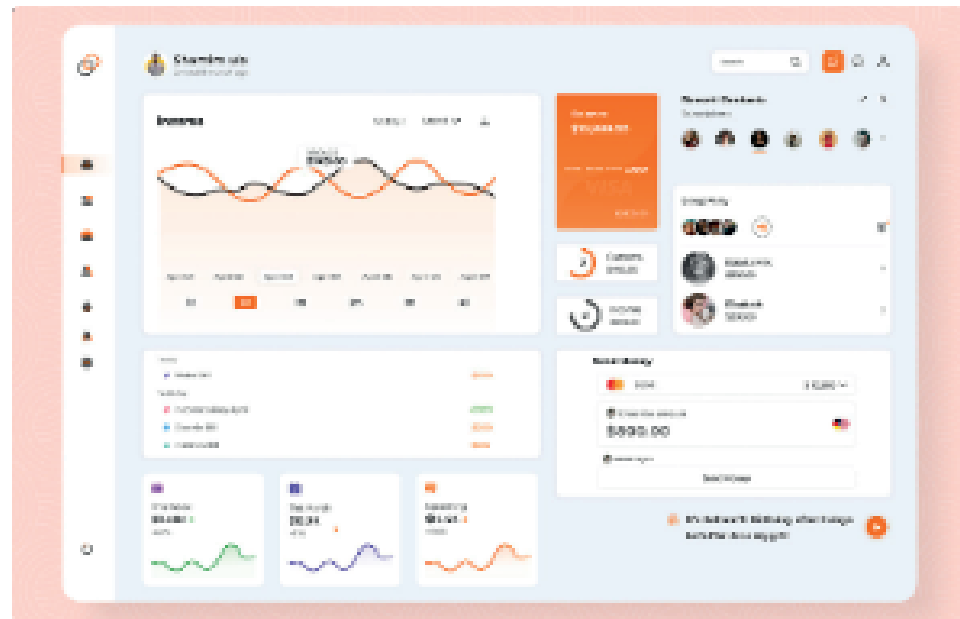


Figure 2: Moodboard platform digital hybrid machine.

5. System requirements hybrid engine
6. System requirements hybrid engine video Introduction and Description introduction Component Hybrid engine
7. Working principle of hybrid electric vehicle
8. Working principle of hybrid electric vehicle and Hybrid engine application
9. Advantages and Disadvantages of hybrid engine
10. Disadvantages of hybrid engine and Advantages of hybrid engines
11. Application or implementation
12. Hybrid car videos and Hybrid motorcycle, Other

3.2. Low fidelity wireframe

Low fidelity wireframe is a rough outline display of the application display based on the flowchart following the display of the low fidelity wireframe:

Fig. 4. (left) shows a wireframe view of the definition hybrid engine with its branching menu and feedback display. The following display starts from the opening display, then the main menu display and the About Hybrid Engine menu display and consists of the next 3 menus and a feedback menu after reading the material. Fig. 4. (right) is a display

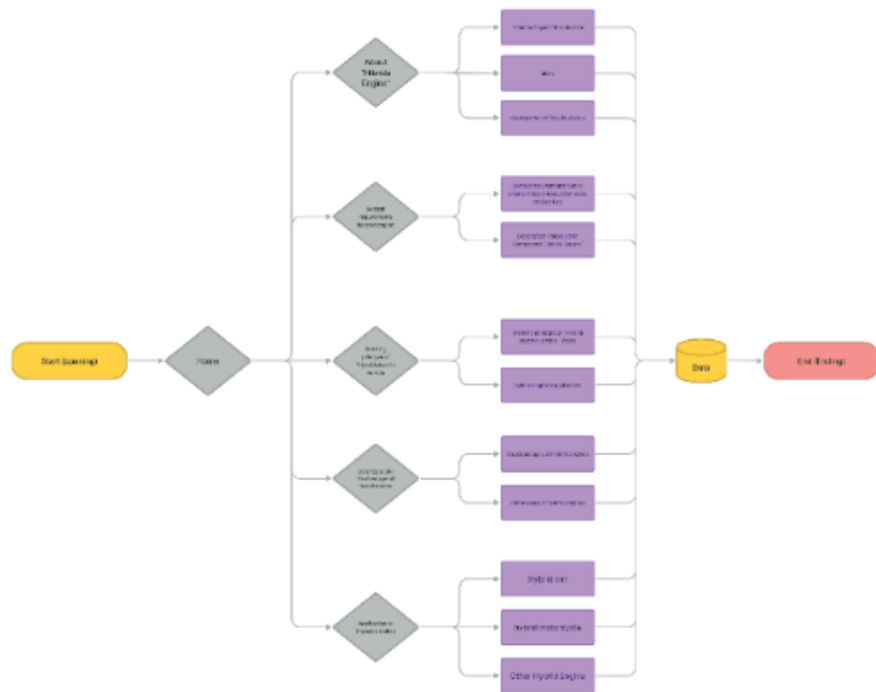


Figure 3: Flowchart platform digital hybrid machine.

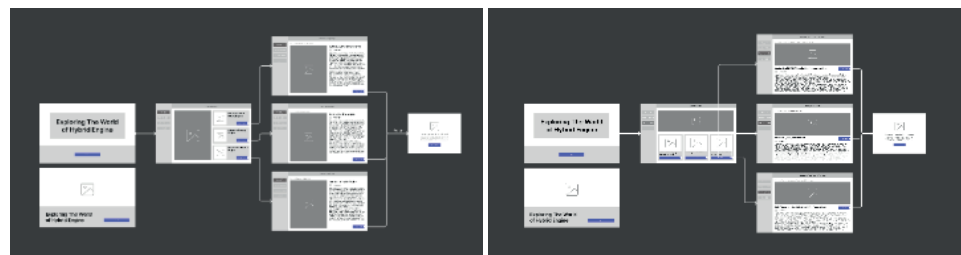


Figure 4: About hybrid engine (left) and working principle of hybrid electric vehicle (right).

of the Working principle of hybrid electric vehicle menu which consists of 3 advanced menu branches.

Fig. 5. (left) is an image of the previous menu display discussing the advantages and disadvantages of the hybrid engine. In this menu there are 5 views of the next menu. Fig. 5. (right) is a picture of the wireframe display of the system requirements hybrid engine menu, there are 5 additional menus in the form of each menu for each component display of the hybrid engine.

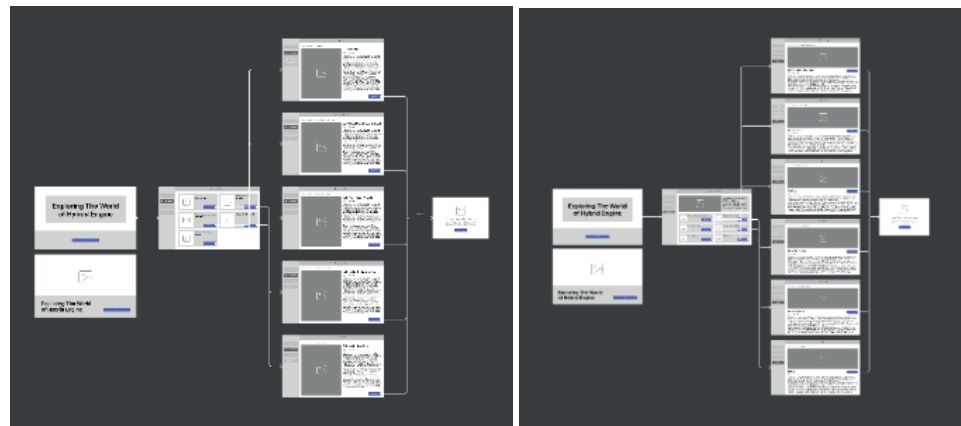


Figure 5: Advantages and disadvantages of hybrid engines (left) and system requirements hybrid engine (right).

3.3. High fidelity wireframe (Mockup)

A high-fidelity wireframe or mockup is a display Fig. 6. is a view of the opening in the digital hybrid engine platform. The opening display uses a slide show with motion photos from the hybrid engine. In this opening view, there are 3 images of machines running in motion with photo changes. Fig. 7. shows the display of the main menu which consists of an introduction to the hybrid engine, 4 main menus, 3 advanced menus and 2 videos containing the application of hybrid engines to hybrid vehicles. Fig. 8. is a screenshot of the menu for the introduction of the hybrid engine, the history of the hybrid engine and the pop-up display for greetings after reading or studying the hybrid engine. Fig. 9. is a display image of a series of hybrid machines which are divided into several and illustration of the shape of the components in the hybrid engine, namely there are 6 components starting from the Internal Combustion Engine, Electric motor, Generator, Power Split Device, Power Control Unit, Battery.

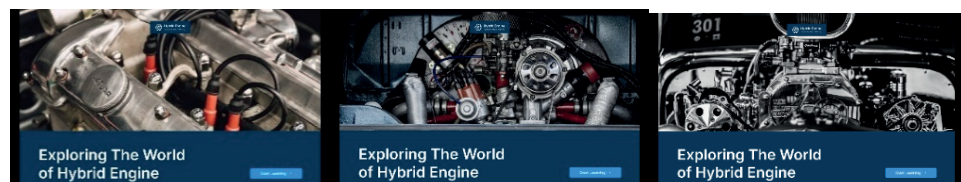


Figure 6: Opening view of the digital hybrid engine platform.

4. Conclusion

The conclusion of this study is to provide appropriate media to support the teaching and learning process in engineering lectures, especially hybrid machine materials. Research

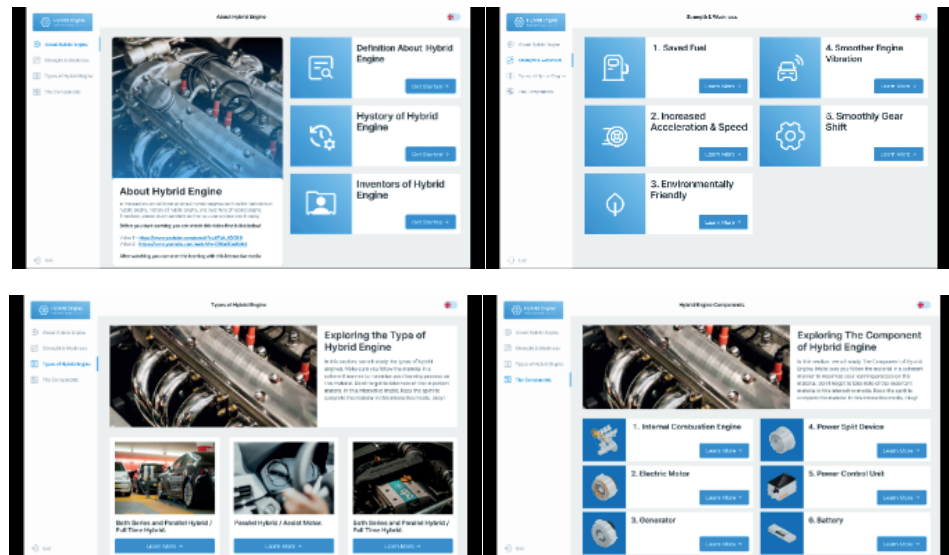


Figure 7: Display of the main menu of the digital hybrid engine platform.

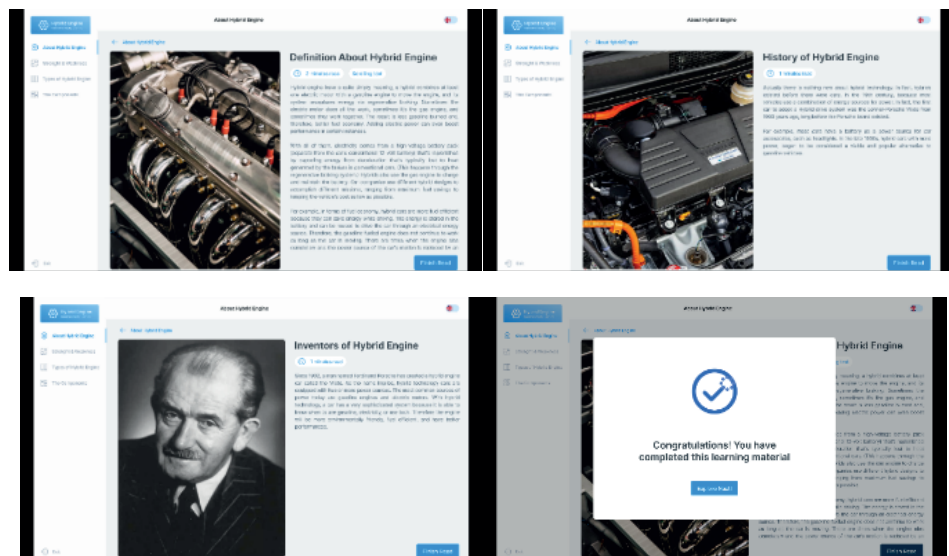


Figure 8: Menu display of two digital hybrid engine platforms.

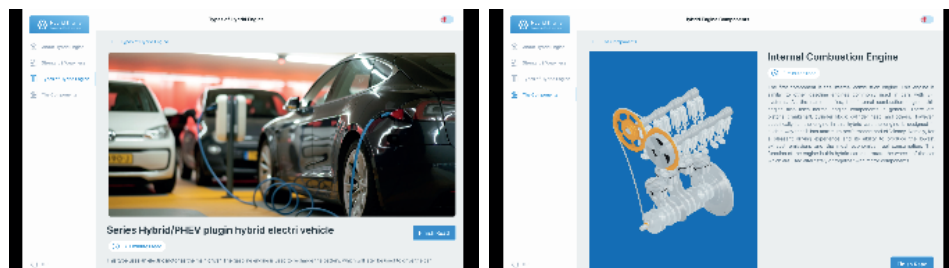


Figure 9: Another menu is displayed on the digital hybrid engine platform.

shows that it is felt that the teaching and learning process takes a very long time to explain the material and has an impact on students who feel bored and are less

interested in hybrid machine material, therefore researchers provide solutions in the form of digital platform-based interactive learning media that are in accordance with the wishes of students based on the results. questionnaires that have been distributed. The digital platform developed in this research can be run online on Mozilla Firefox, Google Chrome and the like, on desktop and mobile devices. This platform displays illustrations of machine components that resemble the original visualization, photos, videos, and detailed image descriptions, which include material on the introduction of hybrid engines, history of hybrid engines, machine components, working principles, and their advantages and disadvantages. Another advantage of this digital platform is that it has dual language features, namely English and Indonesian. The hope of this research is that the media can be used as supporting media for engineering lectures, especially in hybrid engine material.

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Author Signed.

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