

Analysis of Digital Literacy Technology Design for the Department of Mechanical Engineering Based on a Website at Universitas Muhammadiyah Sumatera Barat

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Abstract

This research aims to analyze the level of importance of digital literacy understanding among students of Mechanical Engineering at the University of Muhammadiyah (UM) Sumatera Barat. The digital literacy developed in this study not only facilitates access to learning references, literature, research methodologies, and testing in the field of Mechanical Engineering but also designed as a data storage place for student practical and research testing results. This research used a questionnaire as a data collection technique, which was filled out by Mechanical Engineering students at Universitas Muhammadiyah Sumatera Barat. The first questionnaire was conducted to measure the level of students' understanding of digital literacy in the field of Mechanical Engineering, and the results were used as the basis for creating a literacy website. The second questionnaire was conducted to evaluate the created literacy website. Data analysis was performed using quantitative descriptive analysis. The results showed that 57% of respondents had good understanding of digital literacy in the field of Mechanical Engineering. However, only 15% of respondents often searched for references on digital technology, and 80% of respondents faced difficulties in finding credible digital literacy sources. Moreover, most respondents expressed their interest in learning and using digital technology in research and practical work. These results served as the basis for creating a digital literacy website. The digital literacy website was evaluated, and the evaluation result showed that most respondents stated that the created literacy website was easy to use and helpful in the learning or task completion process. However, some aspects needed improvement, such as relevant and understandable content and the quality of content presentation that is more interesting for respondents. Overall, the literacy website has a high level of satisfaction in several aspects.

Keywords: Digital Literacy, Design, Website, Mechanical Engineering, Students.

1. Introduction

The purpose of developing a website-based digital literacy for the Department of Mechanical Engineering at the Universitas Muhammadiyah (UM) Sumatera Barat is to provide a reference platform for students to improve the quality of learning and enhance their competencies in keeping up with current technological advancements. The digital literacy developed in this study not only provides references for learning, literature, research methods, and testing in the field of mechanical engineering but is also designed to store data from student practical and research [1]. The purpose of storing this data is to enable students to analyze and extract useful information from the data using data mining, machine learning models, and data analysis. This can be used to increase efficiency and effectiveness in the production, testing, or research processes in the field of mechanical engineering, as well as to enhance students' understanding of digital technology advancements in this field [2]. In today's rapidly advancing digital age, skills and understanding of digital technology are increasingly essential in the field of

mechanical engineering. Digital technology has become an inseparable part of mechanical engineering, including in production processes, testing, or research. Skills in operating software and technological equipment used in mechanical engineering, such as CAD, CAE, CAD, ZW3D, MathLab, Comsol, machine simulation, data mining, and machine learning are crucial to support productivity and competency in this field [3]. However, the fact is that students often lack an understanding of how digital technology can be a valuable tool in research, which can be attributed to a lack of digital literacy among them.

The application of digital computational technology in the field of mechanical engineering can improve production process efficiency, product quality, or energy efficiency [4]. By utilizing digital technology, product design can be created faster and more accurately, machine simulation can be conducted to evaluate machine performance before being implemented in production processes [5],[6] and data analysis can be performed to improve production process efficiency. However, student knowledge is still limited to previous research conducted by their peers, resulting in a lack of innovation and courage in choosing new research topics related to digitalization in the field of mechanical engineering [7]. This can be observed in the way students choose research topics that are closely related to previous research titles with similar modifications to existing machines or tools. Students consider digitalization-based research, such as simulation, machine learning, data mining, and software engineering, to be highly complex and do not understand how to apply it in the field of mechanical engineering [8]. Based on research findings [9], digital literacy is positively correlated with knowledge, skills, and participation in the digital world. The results indicate that individuals with higher levels of digital literacy tend to have broader knowledge about digital technology and are able to use it more effectively. The impact of digital literacy shows that it has a significant influence on online participation and internet use. These findings [10] suggest that individuals with higher levels of digital literacy tend to be more active in using the internet and social media, as well as being able to utilize the potential offered by digital technology. Another study [11] indicates that digital literacy is related to an individual's ability to manage information and acquire knowledge independently. These results suggest that individuals with higher levels of digital literacy are more capable of identifying, evaluating, and critically using information, as well as being more independent in acquiring knowledge through digital media.

Based on the problems described above, a website-based digital literacy is designed to provide references, information, and to identify and explore research topics that are relevant to digital technology. This is crucial to improve the digital literacy of mechanical engineering students and to help them understand how digital technology can be used as a tool in conducting research in the field of mechanical engineering. The goal is to increase the digital literacy of mechanical engineering students, so they can be better prepared to follow the developments in digital technology and to foster their interest in conducting digital computing studies such as the use of software engineering (CAD, ZW3D, MathLab, Comsol, CAE, Master-Cam), and programming languages like Python [3],[8]. Because digital computing is becoming increasingly popular in the field of mechanical engineering in developed countries.

2. Research Methodology

The method used in this research can be seen in the research scheme or steps shown in Figure 1.

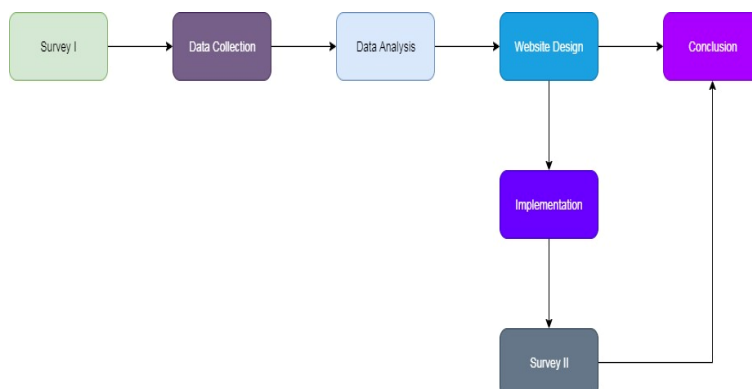


Figure 1. Research Scheme

The design of a digital literacy based website aims to improve the understanding and knowledge of mechanical engineering students at Universitas Muhammadiyah Sumatera Barat, based on the results of a field survey conducted among mechanical engineering students at Universitas Muhammadiyah Sumatera Barat. The survey revealed that the students' level of understanding of digital literacy, especially in the field of mechanical engineering, is still minimal, including their knowledge of software or applications that can facilitate their research on their final project (thesis) [5]. This is reflected in the research results of the students who always refer to the research titles created by their previous seniors. It can be seen that the students are still boxed in by modifying existing titles and lack innovation and renewal, resulting in research titles that are still limited to the same scope, while the world of mechanical engineering is rapidly advancing, with technology advancing at an unprecedented rate. The survey also proved that students are not keeping up with digital developments in the field of mechanical engineering. Students are not aware of the many benefits and conveniences of using digital literacy in the field of mechanical engineering, such as data mining, CAD, ZW3D, MathLab, Cosmol, CAE, machine learning [3],[8], which can greatly help them in analyzing tasks, laboratory work, and research. The process of creating a digital literacy based website is carried out in several stages.

2.1 Survey

A survey was conducted at the Universitas Muhammadiyah Sumatera Barat, and the population in this study was all mechanical engineering students at Universitas Muhammadiyah Sumatera Barat. The research sample was taken using purposive sampling technique, which involved selecting samples that had characteristics that were in line with the research objectives. The respondents of this research were 40 mechanical engineering students who were randomly selected from the existing population.

2.2 Data Collection Technique

The data collection technique used in this study was a survey using a questionnaire filled out by the respondents. The questionnaire was prepared by referring to the level of digital literacy understanding of students as shown in Table 1.

Table 1. First Questionnaire

No.	Question	Answer Choices
1	How often do you use digital technology to complete your assignments or research?	a. Often b. Rarely c. Never
2	How familiar are you with digital technologies such as data mining, machine learning, and simulation in the field of mechanical engineering?	a. Very familiar b. Familiar c. Not familiar
3	How often do you search for references on digital technology in the field of mechanical engineering?	a. Often b. Rarely c. Never
4	How important do you consider the application of digital technology in the field of mechanical engineering for your learning and research?	a. Very important b. Important c. Not important
5	Do you have any difficulties in finding references on digital technology in the field of mechanical engineering?	a. Yes b. No c. Not at all sure
6	Are you interested in learning more about digital technology in the field of mechanical engineering?	a. Very interested b. Interested c. Not interested
7	Are you interested in using digital technology in your future research or experimentation?	a. Very interested b. Interested c. Not interested
8	Do you have any difficulties in applying digital technology in your research or experimentation?	a. Yes b. No

- | | | |
|----|---|--|
| 9 | Are you interested in accessing digital literacy websites in the field of mechanical engineering to improve your understanding of digital technology? | c. Never tried
a. Very interested
b. Interested
c. Not interested |
| 10 | Do you need a website that provides centralized information on digital technology in mechanical engineering? | a. Very much needed
b. Needed
c. Not needed |

2.3 Data Analysis

The data analysis used in this study is quantitative descriptive. Quantitative descriptive analysis is a statistical analysis technique used to describe and summarize data using statistical methods such as frequency, percentage, mean, and median [12].

2.4 Development of Digital Literacy Website

Based on the results of the data analysis, a website was developed to improve the digital literacy of mechanical engineering students at Universitas Muhammadiyah Sumatera Barat. The development of this website was carried out by considering aspects such as ease of access, clarity of information, and so on.

2.5 Evaluation of the Digital Literacy Website

After the website development is completed, an evaluation is conducted on the website that has been created. This evaluation is carried out by asking students questions about the ease of access, clarity of information, and quality of the website that has been created.

3. Result and Discussion

3.1 Survey

The survey was conducted at the University of Muhammadiyah Sumatera Barat (UM. Sumatera Barat) and the population in this study was the mechanical engineering students of UM Sumatera Barat. The survey was conducted on mechanical engineering students with various levels of semester, aimed to determine the understanding of Universitas Muhammadiyah Sumatera Barat students regarding digital technology in the field of mechanical engineering as well as their level of needs and interest in using and learning digital technology in this field. Data were collected through the completion of questionnaires by 40 randomly selected respondents from the population. The questionnaire consisted of several questions covering the level of understanding, frequency of use, importance, and difficulties in finding references and applying digital technology in research and practical work.

3.2 Data Collection Technique

It is important to know the level of understanding of students regarding digital literacy in the field of mechanical engineering, as this information can be used to provide relevant information to meet the needs of students. A questionnaire is a tool used to measure an individual's level of understanding about a particular subject. In this case, the questionnaire was used to measure the level of understanding of students about digital literacy. By including questions related to digital literacy, students can provide answers that represent their level of understanding. These answers can then be analyzed and processed to determine the overall level of understanding of students. The data obtained from this questionnaire can be used as an evaluation material in improving students' understanding of digital literacy and to help create more effective strategies to improve digital literacy in students.

3.3 Data Analysis

Based on the analysis of the responses from 40 questionnaire respondents, it can be concluded that most of the students have a good understanding of digital technology in the field of mechanical engineering. This can be seen from the results of question number 2, in which 57% of respondents stated that they are "very familiar" or "familiar" with digital technologies such as data mining, machine learning, and simulation in the field of mechanical engineering. However, the results of question number 3 showed that most respondents rarely search for references on digital technology in the field of

mechanical engineering, with only 15% of respondents stating that they do so frequently. This result indicates that although the respondents' understanding of digital technology is quite good, they are not utilizing the available reference sources to expand their knowledge. However, the results of questions number 6 and 7 indicate that most respondents are very interested or interested in learning and using digital technology in their research and testing. This indicates that the respondents have the motivation to improve their understanding and skills in this field. Most respondents also reported having problems in finding references (question number 5) and applying digital technology (question number 8) in their research or testing. This indicates that there are still obstacles that need to be overcome so that respondents can utilize digital technology optimally in the field of mechanical engineering. Along with the high interest of respondents in learning and using digital technology, it is very important to provide adequate information access and resources to help students overcome these obstacles. The results of the UM Sumatera Barat student questionnaire responses can be seen in Figure 2.

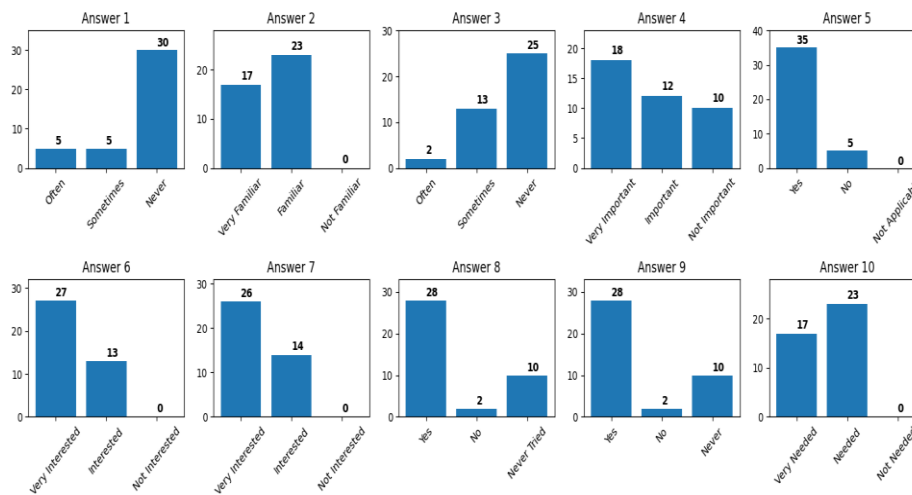


Figure 2. Graph of Student Responses to the Questionnaire

3.4 Design of Digital Literacy Website

Based on the results of this questionnaire, it can be concluded that the development of a web-based digital technology is highly important and necessary to help students understand and apply digital literacy more effectively. The questionnaire provides a strong foundation that the development of web-based digital technology will be very beneficial for students in understanding and improving their abilities in utilizing digital technology optimally. The digital literacy website for mechanical engineering is designed with several main menus as seen in Figure 3, including home, references, simulations and 3D design, machine learning, data testing, and related websites.

The design of this website is very user-friendly, so that students will not be confused in searching for relevant information according to their needs. The main information provided on this digital literacy website is divided into two main topics. The first topic is the use of software in mechanical engineering for 3D simulations such as Ansys, Solidworks, Catia, Autocad, Comsol Multiphysics, etc. [5]. This software allows mechanical engineering students at the University of Sumatra Barat to simulate and analyze virtually, test hypotheses, and evaluate the possible outcomes in the real-world application of mechanical engineering. This can provide better understanding of the operation of machines and help in creating efficient and effective machine designs. The second topic is the use of machine learning in mechanical engineering. Machine learning in mechanical engineering can be defined as a technology that utilizes computational algorithms and data to create a machine or equipment system that can learn from data and make decisions independently [13]. In mechanical engineering, machine learning is usually used to solve problems such as predicting machine failure, more efficient machine maintenance, and optimization of machine performance [14].

The application of machine learning in mechanical engineering requires sufficient and high-quality data, so an effective data collection and management system is necessary. The machine learning algorithms used must be selected according to the type of problem to be solved. There are several popular machine learning algorithms such as linear regression, k-nearest neighbors, and decision trees.

The creation of literacy about the application of machine learning in mechanical engineering is expected to help mechanical engineering students learn how machine learning can make decisions independently and how data can be used to solve problems in mechanical engineering [15].

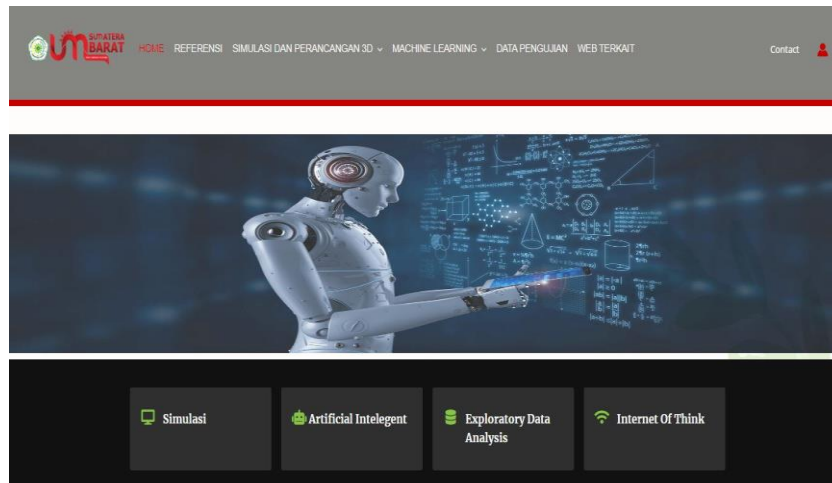


Figure 3. User Interface of Digital Literacy in Mechanical Engineering Based on the Website

Providing structured information is crucial for effective understanding and application by students. A well-structured information can facilitate the understanding process, allowing students to easily comprehend and apply the received information. This digital literacy website provides structured and clear information about virtual 3D simulation and machine learning [16]. Each topic can be divided into more specific subtopics, such as an introduction to 3D simulation techniques, machine learning techniques, and applicable applications. Furthermore, including direct application examples is very helpful in facilitating the understanding process. For instance, this digital literacy website can display examples of virtual 3D simulations in mechanical engineering, as well as examples of machine learning applications in the same field [17]. By providing structured information and direct application examples, this digital literacy website can be a useful resource for students who want to understand and apply virtual 3D simulations and machine learning in the field of mechanical engineering [18]. The general form of the information arrangement scheme for virtual 3D simulation and machine learning in this digital literacy website can be seen in Figure 4.

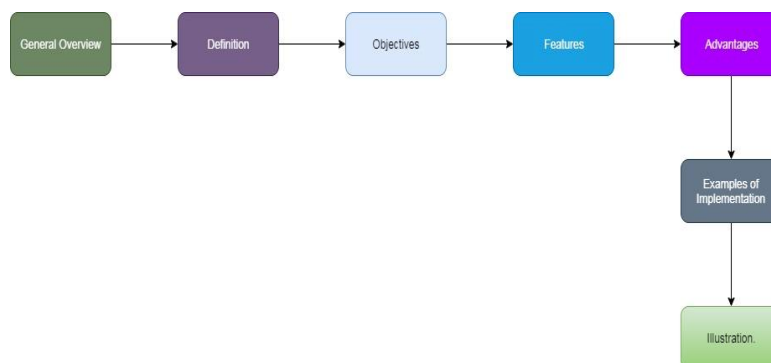


Figure 4. Website Design

Providing structured and detailed information, such as the scheme outlined above, has several advantages. First, it helps to facilitate students' understanding of the information presented because, with clear and organized points, students can easily understand the information without having to search for information from various sources. Second, it helps to maintain information consistency, as structured points ensure that the information provided is relevant to the main topic and does not shift to other topics. Third, it helps to provide fast and efficient access to information, as structured points make it easier to search for information because students can quickly and easily find the information they are looking for. The structuring of information points helps to provide a better learning experience for students, improve efficiency in conveying information, and ensure information consistency [19]. In the

section on the literacy web design, it can be seen how the results of student laboratory testing can be processed, such as in Figure 5, which shows the processing of tensile test data, students can use this literacy web to see the relationship of material in the test specimen.

Spesimen	Dimensi	Luas penampang (mm ²)	HT	Temp. HT (°C)	Holding time	Media Pendinginan	YS	TS
ST 42	Bar	63	Hardening	800	0	Air	21.86	2.72
ST 37	Bar	153	Temper	150	60	Oil	427.49	598.53
ASTM A36	Plate	400	Temper	750	120	Air	375	550

Below the table, there are input fields for: Spesimen, Dimensi, Luas penampang (mm²), HT, Temp. HT (°C), and Holding (Menit).

Figure 5. Features of Practical Testing Data

This digital information system also provides related links for students so that they can understand the sources of mechanical engineering data and learn from online communities, data scientists, and machine learning practitioners on related websites such as Kaggle, W3 School, Csi-hub, and others. The aim is to update the knowledge of students at the University of Sumatra Barat with the latest technological developments and to broaden their insights into the field they are studying. The abundance of online learning communities helps students develop their knowledge and can be used for learning purposes such as learning objectives, research, project modules, and discussion forums. For example, in the Kaggle community, students can discuss in their forums, learn, and read about current world scientific projects, and actively participate in projects on Kaggle. With these links, it is hoped that students will become more active, think critically, and be able to search for literacy that is appropriate for their academic needs.

3.5 Evaluation of Digital Literacy Website

Website evaluation is crucial in determining the success of a website and whether it meets the goals and needs of its users [20]. In this case, the UM Sumatera Barat digital literacy website can be considered successful if engineering students, who are the target users, perceive that the website meets their learning and task completion needs. To gain a deeper understanding of user satisfaction, it is necessary to conduct an evaluation using specifically designed questionnaires [21]. This evaluation aims to collect direct feedback from users, providing comprehensive insights into their satisfaction with the provided products or services. Questionnaires can provide an overview of how engineering students at UM Sumatera Barat assess the quality and accessibility of the information available on the digital literacy website. The results of the questionnaire evaluation can be utilized to improve and enhance the quality of the UM Sumatera Barat digital literacy website. This is crucial to ensure that the website meets the needs and expectations of its users, thereby assisting them in understanding the materials and studying the field of engineering [22]. Consequently, the evaluation through questionnaires is a critical and strategic step in ensuring that the UM Sumatera Barat digital literacy website not only meets the needs of engineering students but also provides optimal benefits for them [23]. This evaluation ensures that the website serves as a high-quality source of information and concretely supports the development of understanding and knowledge among students in the field of engineering. The questionnaires used to evaluate this digital literacy website can be seen in Table 2.

Based on the questionnaire results, the majority of respondents stated that finding information and navigating the digital literacy website was very easy. In addition, the website was considered very useful in helping respondents with learning and completing tasks. There were also a large number of respondents who accessed the website frequently. The results of the evaluation of the digital literacy website were compared with previous studies [9-11], which showed that digital literacy is positively

related to knowledge, skills, and participation in the digital world. The results of this evaluation are in line with previous research, which shows that digital literacy websites can provide significant benefits in improving digital literacy and knowledge of digital technology among mechanical engineering students.

Table 2. Evaluation of Digital Literacy Website Design

No	Questions	Answer
1	How easy was it for you to find the information you were looking for on this digital literacy website? a. Very easy,	a. Very easy b. Easy c. Difficult
2	How easy was it for you to navigate through the digital literacy website?	a. Very easy b. Easy c. Difficult
3	How useful was this digital literacy website in helping you learn or complete tasks?	a. Very useful b. Useful c. Not useful
4	How easy was it for you to find the information you were looking for on this digital literacy website?	a. Very easy b. Easy c. Difficult
5	How easy was it for you to navigate this digital literacy website?	a. Very easy b. Easy c. Difficult
6	How useful was this digital literacy website in helping you learn or complete tasks?	a. Very useful b. Useful c. Not useful
7	How often do you access this digital literacy website in a week?	a. Very often b. Often c. Not often
8	Did you find relevant content on the topic you were searching for on this digital literacy website?	a. Very relevant b. Relevant c. Not relevant
9	Did you find the content on this digital literacy website easy to understand and apply in the context of your learning or research?	a. Very easy b. Fairly easy c. Difficult to understand
10	Would you recommend this digital literacy website to your friends or colleagues in the field of mechanical engineering?	a. Yes, b. No, c. Not necessary

However, the evaluation results still indicate several aspects that need improvement, such as relevant content related to the topics sought by respondents. Some respondents perceive that the content on this literacy website is not always easily understood and applicable in the context of their learning or research. Improving the quality of content presentation becomes essential to capture the interest of respondents. The positive responses from the majority of respondents demonstrate that this literacy website effectively assists in enhancing their understanding of digital technology within the context of engineering [24]. Therefore, taking steps to enhance the quality of content presentation will have a positive impact in strengthening the role of this digital literacy website as a valuable source of information that provides significant benefits to users [25]. Despite some respondents feeling unfamiliar with the topics, overall, the respondents are divided into two equally-sized categories: those who would recommend this literacy website to their friends or colleagues and those who would not. Overall, the questionnaire results indicate a high level of satisfaction with the literacy website in several aspects, such as ease of finding information and navigation, as well as its usefulness in facilitating the learning process. However, there are several aspects that need improvement, such as content relevance and quality of content presentation to ensure better understanding and engagement for the respondents. From the above questions, the answers can be depicted in a graph as shown in Figure 6.

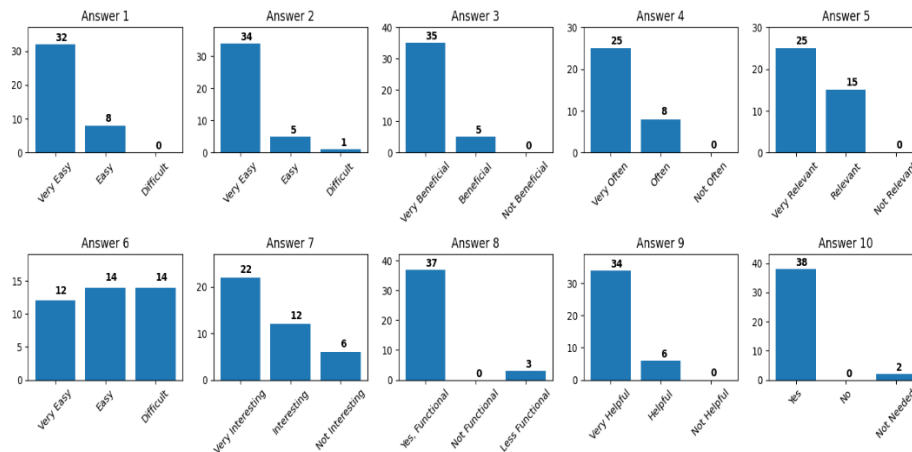


Figure 6. Graph of Questionnaire Responses After the Creation of Literacy Website

4. Conclusion

Based on the results of this study, it can be concluded that Universitas Muhammadiyah Sumatera Barat students have limited knowledge of mechanical engineering literacy and digital literacy. In addition, students also have a lack of understanding in searching for information that can support their coursework, and still rely on the laboratory work, research, and analysis done by their seniors. However, the Universitas Muhammadiyah Sumatera Barat digital literacy website has an optimal impact on Mechanical Engineering students, as it is easy to navigate and provides quality and useful information in this field. Therefore, the Universitas Muhammadiyah Sumatera Barat digital literacy website can be a useful source for improving the digital literacy of Mechanical Engineering students.

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