

Enhancing students' digital literacy: Evaluating the effectiveness of notion-based e-modules

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ABSTRACT

This study aims to investigate the effect of using Notion-based e-modules to improve students' digital literacy. The study was implemented in the odd semester of the 2023/2024 academic. This study used a quasi-experimental method with a quantitative approach. The design of the study used a pretest-posttest control group design. The data obtained were analyzed using a t-test to compare the results. The finding of study shows that the average pretest and posttest scores in the control class show a difference score of (0.52) less than the experimental class (22.00). Meanwhile the percentage of score increase obtained in the control class is (0.79%) lower than in the experimental class (33.28%). So it can be concluded that the increasing score of students' digital literacy in the experimental class higher than the control class. Based on the results of data analysis using the t-test showed a significant increase scores in posttest compared to pretest score ($t(62) = 82.76, p < 0,0001$), the control group also showed increase scores but not significantly different between the pretest and posttest scores ($t(59) = 1,95, p = 0,0571$). It can be interpreted that the experimental group showed a more significant increase compared to the control group. So, the conclusion of the study show that the use of Notion-based E-modules has a significant impact on improving students' digital literacy. Further research is recommended to expand the scope of subjects from other study programs and compare the effectiveness of Notion with other digital platforms.

Keywords: Digital literacy, e-module, notion

INTRODUCTION

Digital literacy is an essential skill in the modern era, UNESCO (2018) explains that in supporting an inclusive and sustainable global society. Digital literacy not only involves the ability to use technology, but also includes a critical understanding of information found in the digital world. Strong digital literacy also supports the development of 21st century skills, such as collaboration, creativity, and problem solving, which are urgently needed in facing global challenges. Salsabila et al., (2022) stated that it is very important to encourage people to actively participate in protecting themselves

from the increasing threats of disinformation and misinformation in the digital era.

Digital literacy includes of critical understanding, information management, and collaboration skills in digital environments (Hague & Payton, 2010). Rapid technological advances, especially in communication and information, have changed the way people work, learn, and interact, making digital literacy skills the key to success in many areas of life (Hardiansyah et al., 2024). Digital literacy will increase social awareness of how various factors can influence the way we use technology to convey certain information and meanings (Silva-

[Quiroz & Morales-Morgado, 2022](#); [Sukma et al., 2023](#))

In the digital era, digital literacy is the essential skills students must acquire to support their learning, prepare for the workforce, and more competitive society in facing global challenges ([Dewi, Utami, & Santosa, 2024](#); [Herlina, Kusumah, & Juandi, 2023](#); [Faresta, 2023](#); [Thelma et al., 2024](#)). The effectiveness of using digital media has had a positive impact on the teaching and learning process, especially in accessing information. This condition increases the risk of spreading fake news, cyberbullying, and misuse of personal data. Therefore, students need to be taught digital literacy to use technology wisely ([Murnane et al., 2012](#)).

Students with good digital skills are expected to be able to use technology effectively and responsibly to support their learning and productivity ([Bahtiar et al., 2023](#); [UNESCO, 2018](#)). However, many students in Asia only understand the basic functions of digital devices and are unable to fully use technology for complex academic activities ([Nilaphruek & Charoenporn, 2023](#)). Therefore, students need to improve digital literacy using relevant and interactive learning media.

This study examines real issues related to digital literacy among college students in Indonesia. Several studies conducted by ([Salsabila et al., 2022](#); [Fitroh et al., 2024](#); [Iskandar et al., 2024](#); [Sucipto, 2024](#)) revealed that many college students in Indonesia have low levels of digital literacy. Many students in Indonesia still tend to use digital devices for entertainment or non-academic activities. This condition reduces students' ability to use technology effectively, which negatively impacts their academic achievement. Because their ability to analyze, evaluate, and use digital information ethically is still lacking. Especially in using technology to support the learning process ([Nguyen & Habók, 2024](#)). In an era of increasing demands for the use of technology ([UNESCO, 2018](#)). Indonesian students have not been able to master critical thinking, collaboration, and

problem-solving skills in a digital context, when compared to students in countries with advanced digital education systems such as Finland or Singapore ([Wang et al., 2023](#)).

The innovation that can solve this problem is the use of Notion-based e-modules, which offer a structured and interactive approach to developing digital literacy. The notion features such as: interactive note-taking, material preparation, and digital task management. Due to the various features, Notion-based facilitates students to learn proactively, systematically, and collaboratively ([Andoro, 2023](#); [Mane et al., 2024](#); [Martha et al., 2024](#)). Several studies conducted by [Syahrin \(2023\)](#) and [Baharuddin et al. \(2022\)](#), have highlighted Notion's potential in improving learning outcomes and critical thinking skills only.

Thus, this study was conducted to fill this gap by testing the effectiveness of Notion-based e-modules not only in supporting learning outcomes and critical thinking skills like as the previous studies, but also in improving digital literacy skills. This study aims to explore the effectiveness of Notion-based e-modules to improve students' digital literacy of science education students. By integrating the notions' features into the learning process, it is expected that students can manage their digital skills, especially in completing projects and discussing complex science concepts.

This research is important considering the need for learning media that not only focus on mastering the material, but also on developing digital skills that are very essential to use during the learning process. It is hoped that the results of this study can make a significant contribution to the practice of science education and can be accepted by other educators to improve the quality of learning in the university environment. This study highlights the importance of learning media that not only focus on mastering the material but also on developing digital skills while use of technology, which is relevant to learning needs in the digital era. This shows the

need for curriculum adaptation and utilization of teaching media to create a more holistic learning approach, which is expected to improve the quality of science education. With the results of this study, the quality of science education can be improved, the use of media in the learning process is more varied, helping students develop their digital skills.

METHOD

This study used a quasi-experimental method with a quantitative approach to determine the effectiveness of the use of Notion-based e-modules in improving students' digital literacy. This study used a pretest-posttest control group design, where the research subjects were divided into two groups, namely the experimental group using Notion-based e-modules and the control group using conventional modules. The study population was students of the S1 Science Education program, with samples selected using purposive sampling techniques, involving 5th semester students who were taking the Basic Structure and Function of Plants course. Divided into 60 students in control group and 63 students in experimental group.

The intervention of this study is the use of an e-module for the Basic Structure and Function of Plants (SDFT) course which was implemented in the odd semester of the 2023/2024 academic year in the experimental class, while for the control class only use regular teaching materials. This learning activity is carried out in two stages, namely a face-to-face class and a laboratory class. The outline of this learning outcomes is analyze the structure of anatomy, morphology, and physiology process in plants. The e-module based on notion website can be access by students' gadget during face-to-face regular class, online class, and laboratory class.

The e-module has main features that consists of main reference e-book files, laboratory instructions, additional references in the form of scientific articles according to each topic, student worksheets, and a discussion

forum for reviewing activities. In addition, this e-module also has additional features such as instructions for using the e-module, music playlists, learning schedules. At the last, the e-module provides a visual references such as images, virtual laboratories, and learning videos in each topics that support learning process.

The research method design in this study is shown in the table below.

Table 1. Research method design

Subject	Pre-test	Intervention	Post-test
Group A	T ₁	O ₁	T ₃
Group B	T ₂	O ₂	T ₄

Notes:

- Group A = Experiment Group
- Group B = Control Group
- T₁, T₃ = Pre-test
- T₂, T₄ = Post-test
- O₁ = use e-modules based notion website
- O₂ = without e-modules (regular class)

The research procedure is divided into three stages below.

1. Preparation stage

- a. Compiling research instruments in the form of pretest and posttest questions, - Conducting validity and reliability tests of test instruments and questionnaires.
- b. Determining the population and sample using purposive sampling techniques.
- c. Grouping the sample into two: the experimental group (using Notion-based e-modules) and the control group (using conventional modules).

2. Implementation stage

- a. Giving an initial test to both groups to determine digital literacy skills before the intervention.
- b. The experimental group studied the material using Notion-based e-modules while the control group studied the same material using conventional modules. Learning was carried out for 8 weeks.
- c. Giving a final test to both groups to measure digital literacy skills after the intervention.

3. Data analysis stage

- a. Calculate the average and difference of pretest and posttest scores for each group.

- b. Conduct descriptive analysis of the average and difference of students' pretest and posttest scores.
- c. Analyze the difference in score improvement between the experimental and control groups using the t-test.

The research instruments included a digital literacy test in the form of a pretest and posttest. The validity and reliability of the instrument were tested first before being used. The results of the validity and reliability tests showed that there were 20 valid and reliable questions out of 30 total questions. The validity analysis including two steps, validity and reliability test.

The content validity and construct validity were carried out by three expert validators as lecturers of the Basic Structure and Function of Plants course. Then, the empirical validators were carried out using product moment correlation by use SPSS program. The validation results showed 20 valid questions with a significance value of <0.05 so that they would be used in the study. However, the reliability test instrument was determined using the Cronbach Alpha test. The results showed that the questions used were reliable with an r value of 0.689, means that the reliability of the questions was high.

The pretest was conducted before the implementation of learning to measure students' initial abilities. After that, the experimental group took part in learning using Notion-based e-modules, while the control group used conventional modules. After the intervention was completed, a posttest was conducted to measure changes in digital literacy. The research instrument was a digital literacy questionnaire with a Likert scale of 1-5, consisting of six indicators of digital literacy on Table 2.

The data obtained were analyzed using a t-test to compare the results of the pretest and posttest between the experimental and control groups (Hogg, McKean, and Craig, 2019). This analysis aims to identify significant differences between the two groups in terms of increasing

digital literacy. In addition, the data from the analysis are supplemented with descriptive analysis of the mean and difference from the pretest and posttest data. This study is expected to provide empirical evidence regarding the effectiveness of Notion-based e-modules as a learning medium in improving students' digital literacy.

Table 2. Digital literacy indicators

Indicator	Description
Creativity	The ability to think creatively and the ability to produce, build, and disseminate information creatively
Functional skills	The ability to operate digital equipment as needed
E-safety	The ability to evaluate digital information sources for their reliability and credibility
Collaborative	Maximize the potential of digital technology in collaborative activities or teamwork
Effective communication	Communicate clearly and effectively using various digital formats
The ability to search for and select information	The ability to evaluate the information was needed or relevant and reliable

(Source: Hague & Payton, 2010)

RESULTS AND DISCUSSION

The results of this study present an analysis of pretest and posttest data to measure the increase in digital literacy in science education students using the SDFT E-module learning media based on the notion website. The following are the results of the statistical analysis carried out.

Descriptive statistics

The following table presents a statistical description of the average score in pretest and posttest scores for the experimental and control groups.

Table 3. Descriptive statistic

Group	N	Average		Standard Deviation	
		Pretest	Posttest	Pretest	Posttest
A	63	65.15	65.67	8.05	8.28
B	60	65.32	87.32	7.65	8.29

Note:
 A= Experiment group
 B= Control group

Based on the data in The table 3, it shows that the average pretest and posttest scores in the control class show a difference score of (0.52) less than the experimental class (22.00). Meanwhile the percentage of score increase obtained in the control class is (0.79%) lower than in the experimental class (33.28%). So it can be concluded that the increasing score of students' digital literacy in the experimental class higher than the control class.

The normality test was conducted to ensure that the data is normally distributed. The results of the normality test show that the data is normally distributed ($p > 0.05$). A homogeneity test was conducted to ensure that the variance between groups is homogeneous. The results of the homogeneity test show that the variance of the two groups is homogeneous ($p > 0.05$). The t-test was conducted to compare the average pretest and posttest scores between the experimental group and the control group with the results of the t-test of the control group while the experimental group.

Table 4. t-test statistic analysis result

Group	Meaningful Differences	t-value	df	p value
A	22,0	82.76	62	<0.0001
B	0.52	1.94	59	0.0571

Note:

A= Experiment Group

B= Control Group

Based on the results of data analysis (Table 4) using the t-test showed a significant increase scores in posttest compared to pretest score ($t(62) = 82.76, p < 0.0001$), the control group also showed increase scores but not significantly different between the pretest and posttest scores ($t(59) = 1,95, p = 0.0571$). It can be interpreted that the experimental group showed a more significant increase compared to the control group. This result highlights the potential effectiveness of the SDFT e-module based on the notion website in improving students' digital literacy skills better than conventional learning approaches. The improvement is supported by several

advantages of e-modules based on the notion website, shown by the increase in students' digital literacy as measured using the six digital literacy indicators explained below.

Creativity

From the aspect of creativity, the use of Notion supports students to think creatively. Especially when students compile and disseminate information interactively. This condition will increase students' creativity causes of increase understanding and interaction to learning materials (Jakonen & Jauni, 2021; Sukma, Purwianingsih, & Amprasto, 2023). Notion offers a variety of design and visual styling options, such as interactive pages, customizable templates, and multimedia integration (images, videos, and audio) that help students express their ideas creatively (Delima, Budiarta, & Hasyim, 2021; Lunenburg & Lunenburg, 2014; Leow, 2014).

Functional skills

Through various features such as task management, material arrangement, and multimedia integration, students can organize their learning activities more systematically and encourages them to become experts in utilizing technology effectively. These features make learning is more effective because students active in constructing their own knowledge through exploration and interaction with relevant resources (Dagar & Yadav, 2016; Oanh & Nhung, 2022). This contributes to their readiness to face the world of work that demands mastery of digital technology (Kalyani, 2024).

E-safety

Notion also encourages students to evaluate the reliability and credibility of digital information sources, which causes students to be more critical in choosing and using valid information. This condition is in line with (Husamah et al., 2024) which emphasizes the importance of source evaluation in digital literacy as part of e-safety competency.

Notion helps students develop essential information literacy skills, including the ability to

identify reliable sources, avoid plagiarism, maintaining copyright, originality of work, secure access, and sharing information safely. This is supported by [Sharma et al. \(2024\)](#) and [Kumar et al. \(2019\)](#) research. This is relevant to [UNESCO \(2018\)](#) which emphasize that understanding cyber security and digital identity management is an important part of 21st-century competencies. So the notion website-based e-module is an effective learning media to support awareness of e-safety.

Collaborative

Furthermore, Notion supports students to maximize the potential of digital technology in collaboration or teamwork by use features to share notes, provide input, and work together on one platform ([Alfionora & Darussyamsu, 2021](#); [Haleem et al., 2022](#)). Notion's collaborative features, such as shared workspaces and real-time editing, provide opportunities for peer feedback and brainstorming. This collaborative environment fosters creative synergy, as students build on each other's ideas and feedback in group discussions ([Rakasiwi & Listyani, 2020](#)).

Effective communication

Notion helps students communicate clearly and effectively using various digital formats, collaborative notes, comments, or links between pages. This allows them to convey ideas in a more organized and transparent way, reducing the potential for miscommunication. This technology also supports the principles of effective interpersonal communication, where the delivery of messages must be clear, relevant, and in accordance with the objectives ([Markevych, Khavanska, & Filenko, 2022](#)). Which is in line with the literature highlighting the role of technology in enhancing effective communication in learning ([Alfionora & Darussyamsu, 2021](#); [Hoa, 2023](#); [Siswati & Suratno, 2024](#)).

According to research by [Ismail & Febriyanti, \(2022\)](#), the use of collaboration-

based technology can increase team effectiveness by up to 35%. So that notion-based e-modules can be a tool for building holistic and contextual communication skills.

The ability to search for and select information

Notion-based E-modules improve students' ability to search for and select relevant information needed. Students are encouraged to find additional relevant materials and filter information that best supports their understanding of learning topics independently. In the context of education, digital literacy plays an important role in supporting a more interactive and effective learning process ([Sharma & Singh, 2024](#)). [Murnane et al. \(2012\)](#) stated that the ability to find and evaluate information is a core component of digital literacy. This aspect can be significantly improved because Notion-based E-modules become important to encourage many type of references in one way access.

The role of digital literacy in science learning

Digital literacy is very important in science learning, especially in the Basic Structure and Function of Plants course because it helps students access various relevant, up-to-date, and accurate resources to support their understanding of science concepts ([Hoa, M.A, 2023](#); [Martha et al., 2024](#)). This ability also allows students to think critically, evaluate scientific claims logically, and also actively interact with simulations, virtual laboratories, and scientific data, it will help students to finish their project learning ([Dagar & Yadav, 2016](#); [Javaid et al., 2023](#); [Kalyani, 2024](#); [Sucipto, 2024](#)). In addition, digital literacy encourages collaboration and communication through digital platforms, so students can work together on projects and share their findings, just like in real-world scientific practices ([Jihan et al., 2023](#); [Syahrin, 2023](#)). Science education students are required to be able to search, evaluate, and utilize relevant information from various digital sources to find

and accurate and reliable information is essential in scientific research (Zhang & Pochuieva, 2023).

It also prepares them for future careers that require mastery of digital tools for research, analysis, and presentation (Sharma et al., 2024; Stolpe & Hallström, 2024). Digital literacy supports interactive learning with multimodal content delivery, increasing student engagement and understanding of science learning materials (Sharma, 2022; Kalyani, 2024; Sucipto, 2024).

The role of notion-based e-modules in science learning

Notion-based e-modules can accommodate science learning by utilizing its flexibility and features (Cahyani et al., 2023; Martha et al., 2024; Sharma et al., 2024). This platform allows the delivery of multimedia-rich content, such as e-book, videos, interactive simulations, interactive quiz such as padlet, and data, all of which can be presented in one module (Figure 1). So the content can be structured in the form of pages, sections, and databases, providing step-by-step guidance, it helps student understanding theoretical concepts, practical experiments, and critical thinking activities (Cahyani et al., 2023; Martha et al., 2024).

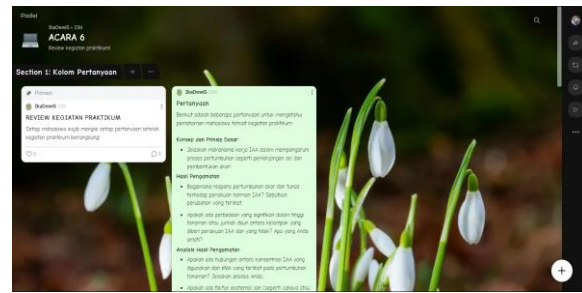


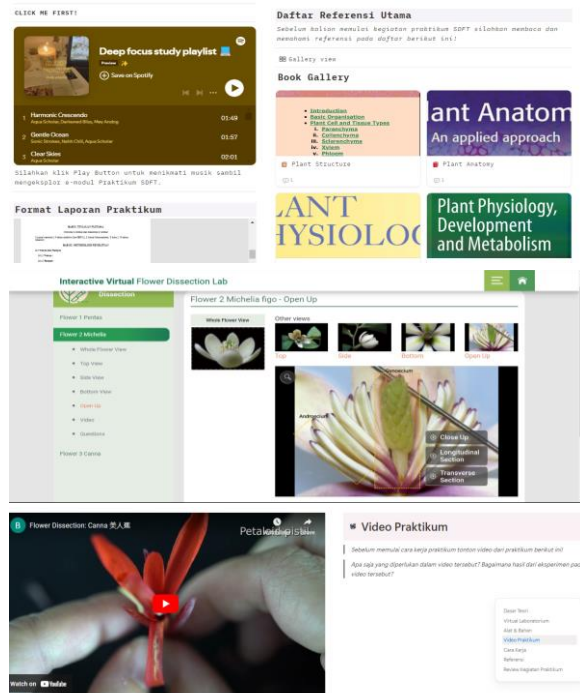
Figure 1. The Features of Notion-based e-modules

In addition, the interactive collaboration feature in Notion allows students to discuss, work in groups, and get direct feedback from teachers. With this approach, Notion-based e-modules become an effective tool for creating an engaging, interactive, and comprehensive science learning experience (Stolpe & Hallström, 2024). With this ability, students learn to adjust their communication style according to the audience and context being discussed so that they can improve their skills in communicating effectively (Nilaphruek & Charoenporn, 2023).

The description above show that this e-module effective in facilitating interactive and in-depth learning, especially in science education students. This finding is in line with previous studies showing that interactive digital learning platforms based on the notion website can improve students' digital literacy by providing a more structured and accessible learning experience (Sharma et al., 2024; Stolpe & Hallström, 2024). The results of the study show that notion-based E-modules can be an effective alternative learning media to improve digital literacy skills holistically. It is also provide insight for educators and curriculum developers about the importance of integrating interactive and collaborative digital platforms in the learning process to optimally support the development of students' digital literacy.

CONCLUSION

The results of this study concluded that the use of Notion-based E-modules significantly improved students' digital literacy. Paired t-test analysis showed a significant difference between pretest and posttest scores, indicating that



Notion-based E-modules were effective in increase students' digital literacy.

For further research, it is recommended to expand the scope of the subject by involving students from other study programs. So that the effectiveness of Notion-based E-modules can be analyzed more diverse context and find out which platform is most effective in supporting the improvement of students' digital literacy.

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