Jurnal Ilmiah Pendidikan Fisika
https://ppjp.ulm.ac.id/journals/index.php/jipf/index
e-ISSN: 2549-9963 p-ISSN: 2549-9955
Vol 9 No 1 2025
DOI: https://doi.org/10.20527/jipf.v9i1.13227

Development of Guided Discovery-Based E-Module of Momentum Impulse Material to Foster Students' Digital Literacy

Sumiyati, Suyidno*, Sarah Miriam, and Qamariah
Pendidikan Fisika, Universitas Lambung Mangkurat, Banjarmasin, Indonesia
*suyidno_pfis@ulm.ac.id

Article Info

Article history:
Received: August 13, 2024
Accepted: December 19, 2024
Published: March 1, 2025

Keywords:
Digital literacy
E-module
Guided discovery

Abstract

Students' digital literacy remains very lacking. This research aims to determine the feasibility of a guided discovery-based E-Module to train students' digital literacy skills. This research is a research and development study using the ADDIE model, and a practicality test of the E-Module was carried out on 30 physics education alumni in 2017. Data collection techniques employed E-Modul validation instruments and E-Module readability questionnaires. The data analysis technique was quantitative descriptive. The results showed that (1) E-Module validation results and readability instruments in the valid category and (2) E-Module practicality seen from the student readability questionnaire has met the practical category. It is concluded that the E-Module developed on momentum impulse material is feasible to train students' digital literacy skills. This research implies that the integration of digital literacy in modules can help students prepare for the challenges of education in the digital era and encourage the development of a more interactive curriculum.

To cite this article: Sumiyati, S., Suyidno, S., Mariam.S., & Qamariah, Q. (2025). Development of guided discovery-based e-module of momentum impulse material to foster students' digital literacy. *Jurnal Ilmiah Pendidikan Fisika*, 9(1), 1-12.

INTRODUCTION

The advancement of technology in the 21st century has resulted in all fields starting to rely on technology, including education. Technological developments in education include classroom layouts that undergo major changes. This educational landscape is changed by virtual and augmented reality, learning styles (preferences) that are accommodated by flexible assignments, MOOC (massive online open course), and other online learning options. These major changes are supported by the current generation, commonly referred to as Generation Z (Gen Z). This generation of students will thrive when given a full educational experience as they enjoy challenges, group discussions, and interactive learning. In addition, they are content to use digital tools and online forums. Generation Z believes that learning can be anytime and anywhere without being limited by the classroom.

Generation Z necessitates low barriers to access to the digital world. In accordance with the characteristics of today's students, appropriate education in the 21st century must include digital literacy. Digital Literacy is the ability to use ICT or the internet to evaluate, use, build, create, and communicate content with cognitive, ethical, social, and technical or technological aspects (Kurnia, 2019; Lankshear & Knobel, 2015; Tang & Chaw, 2016). The learning process requires all elements in the education system to use the internet and communication technology, especially since the Covid-19 pandemic (Onyancha, 2023; Thanaittipath & Boonmoh, 2024; Prachagool et al., 2022; Yuvita et al., 2023). Digital literacy aims to support success in the academic field and become a professional. This is due to the fact that students are required to have skills in the digital world, adapt to

innovative learning, and adapt to a technology-based curriculum when participating in the Industrial Revolution 4.0. Thus, they are ready to face the modern world of work. In other words, students are required to remain innovative and competitive, so digitalization must be integrated into education (Fernandez-Otoya & Cabero-Almenara, 2024; Khasanah & Herina, 2020). Some competencies in digital literacy include 1) operating skills, 2) thinking skills, 3) collaboration skills, and 4) non-technical skills (Wahjusaputri & Nastiti, 2022). In addition, students' digital literacy can also be observed through 1) technical skills in accessing and using media, 2) cognitive competencies that include understanding and evaluating content and media, and 3) communication skills related to content creation, social relations, and participation (Marmoah et al., 2024). Digital literacy is also important for teachers since they are required to meet expectations related to the appropriate use of technology in supporting the classroom learning process (Rahmi et al., 2022).

The results of Amin et al. (2020) research suggest that digital literacy has been applied during the learning process, especially during online learning. Nevertheless, students still face difficulty applying it, starting from the indication of copy-and-paste in assignments, the uneven ability of students, and their indiscipline when doing assignments.

PISA results in 2018 showed that Indonesia is still at a low literacy level, with an average score of 371. Indonesia is ranked 75 out of 80 countries, with a maximum literacy score of 555 (Suyidno et al., 2022). This indicates that Indonesia's literacy ability is still below average; compared to 2015, Indonesia's literacy ability decreased from 397 to 371, meaning that there has been no improvement in literacy. According to a survey conducted by KOMINFO to see the condition of Indonesia's digital literacy in 2020, in 34 provinces, the level of digital literacy of the Indonesian population has not yet entered the "good" category. Indonesia remains at a score of 3, with the highest index score being 5. The low level of Indonesia's digital literacy is also evident from the results of the IMD World Digital Competitiveness Ranking in 2020, in which Indonesia was ranked 56th out of 63 countries. Indonesia is included in the bottom 10 countries that have low levels of digital literacy. The results of the researcher's initial study, which was conducted through distributing questionnaires, show that the integration of students' digital literacy skills was low, with an average score of 47.55. This is reinforced by Oktavia's (2021) research showing that students at SMAN 1 Kuala have a digital literacy level in the low assessment category with a percentage of 35.5%. Students still misuse technology to play games rather than open learning sites (Rahman et al., 2023).

Developing a guided discovery-based E-module on momentum impulse material to foster digital literacy skills can be an alternative to overcome the low digital literacy of students. E-Modules development is considered capable of helping students in the learning process (Misbah et al., 2021; Muhammad et al., 2021; Muzijah et al., 2020). E-Modules or electronic modules are electronic forms of printed modules that can be applied via phones or computers and are compiled using software (Dewantara et al., 2021; Kholiq, 2020;Wati et al., 2021). E-Modules can facilitate students' understanding of a material because they can visualize abstract content (Maisaroh et al., 2020). In the e-module, the material is presented systematically in the smallest part of learning to achieve certain learning objectives. The presentation is in electronic form, which includes animation, audiovisual, and navigation, which can increase user interaction when using the program. E-Modules can be accessed by everyone (Annisa et al., 2020). Learning through e-modules will stimulate students to not rely solely on the teacher as a source of information so that learning activities will be centralized on students and create interactive learning (Ismet et al., 2022). Learning using e-modules will foster digital literacy capabilities through teacher and student activities. Learning using e-modules also arouses students' curiosity about the learning process (Wahyudi, 2019). This is reinforced by the results of Pratiwi's (2022)

research that digital literacy can enhance digital literacy skills as students can obtain and share various information accurately from the digital media they use. Furthermore, e-modules help students learn physics concepts and materials, making it easier for students to interpret the material and making learning more interactive, interesting, and efficient. Impulse and momentum material related to its basic competencies is in line with this, which is its basic competency to apply the concepts of impulse and momentum, as well as the law of conservation of momentum in everyday life. The example of digital literacy in this momentum impulse material is combining material with indicators to practice digital literacy and using media as part of practicing digital literacy. In addition to the use of e-modules, the use of appropriate learning models will also affect students' concept understanding. One of the suitable learning models is guided discovery.

Guided discovery learning allows students to learn by being actively involved with concepts and principles and solve problems independently thorough investigation, according to How and Jones (Suyidno & Jamal, 2012). This guided discovery learning model helps students develop all potential and skills through scientific inquiry (Salimah et al., 2019). The guided discovery learning model achieves active learning that is suitable for use in physics learning activities because it aids students in achieving two important aspects of active learning, namely developing new knowledge and integrating new knowledge so that accurate knowledge is obtained (Hidayat et al., 2019).

Due to the aforementioned explanation, it is necessary to research the development of learning media in fostering students' digital literacy through appropriate learning methods or models. The research that has been done is related to the development of impulse-momentum e-modules based on guided discovery, which has a crucial role in improving students' digital literacy in the modern era. This approach encourages students to learn independently and hone their critical thinking skills by actively exploring physics concepts while effectively utilizing digital technology. This e-module not only facilitates the understanding of physics material but also equips students with essential skills to face the challenges in a professional world that is increasingly integrated with digital technology in the future. The difference between this e-module and other e-modules is that this e-module is developed by paying attention to the stages of guided discovery, so each phase at the stage has been facilitated in this e-module. In addition, this e-module is compiled by including several online explanations (one of which is a YouTube video), which allows students to increase their digital literacy. This research aims to develop guided discovery-based e-modules to improve students' digital literacy, which is observed through the results of e-module validation and students' digital literacy skills.

METHODS

This research employed the Research and Development method. Development research aims to produce a product and test its validity, practicality, and effectiveness (Sugiyono, 2017). This research aims to produce guided discovery-based e-modules on momentum impulse material to train students' digital literacy skills.

This research employed the ADDIE development model (Analyze, Design, Development, Implementation, and Evaluation). The ADDIE learning design model is a simple and easy procedural (Hasyim, 2016). The choice of this model was based on the consideration that the E-module obtained was expected to be feasible and meet the objectives after the stages were conducted. This research was only limited to the analysis, design, development, and evaluation stages. The stages of the ADDIE model are presented visually in Figure 1.

At the Analysis stage, researchers identified the causes of learning problems. This phase included needs analysis, analysis of student characteristics, and analysis of e-module

material characteristics. Subsequently, the design stage was conducted to prepare the components needed in the e-module. This stage designed a guided discovery-based momentum impulse e-module to train digital literacy.

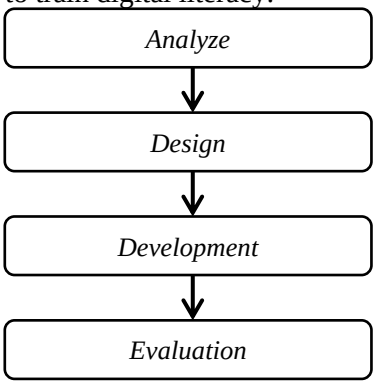


Figure 1 Adapted ADDIE development design model

At the analysis stage, researchers identified the causes of learning problems. This phase included needs analysis, analysis of student characteristics, and analysis of e-module material characteristics. Subsequently, the design stage was conducted to prepare the components needed in the e-module. This stage designed a guided discovery-based momentum impulse e-module to train digital literacy.

The e-module development stage aims to realize the design that has been designed. At this stage, the guided discovery-based momentum impulse e-module product to train students' digital literacy was developed, and it contained digital literacy developed using Flip PDF Corporate Edition.

The evaluation stage was carried out to examine whether the product developed meets expectations. This stage includes formative and summative evaluation. The e-module developed would then be revised if necessary.

The research subject is the e-module, and the object is its feasibility. The validation test subjects are one academic (lecturer) and five practitioners (physics subject teacher). The subject of the readability test is 30 people from the physics education alumni batch 2017 who have taught or are teaching in schools.

The operational definition of the characteristics that are observed in the guided discovery-based momentum impulse e-module development to train students' digital literacy is as follows:

a. The feasibility of an e-module is the quality of Its development, which is assessed based on e-module validation by experts and practitioners with an average of at least valid categories. E-Modules' feasibility is also assessed based on practicality, with a minimum practical category.
b. E-module validity is the level of validity of a medium to perform its measuring function. The validity of the developed e-module is determined based on the validation results of one academic expert and five practitioners using a validation sheet. It is expressed in the very valid, valid, quite valid, less valid, and very less valid. The e-module is declared valid if the average validator score has at least a valid category.
c. The practicality of E-Modules is an assessment of the practicality of e-modules developed to be used in terms of readability e-modules, which is declared practical if they have at least a practical category. Initial observations at SMA Negeri 4 Banjarmasin were conducted to obtain preliminary data on the characteristics of students and teaching materials to be developed. Furthermore, data on practicality was

collected through an online readability instrument through a Google Forms link. This research was conducted from February 2021 to January 2024.

d. The data analyzed included validation results from validators and responses from respondents. The data collection instruments used in this study were validation sheets and e-module readability instruments. The validation results obtained from the six validators were then calculated using the average total score on each aspect of the assessment, and the results were adjusted to the criteria listed in Table 1.

Table 1 E-module validity criteria

Interval	Category
$X > 3.4$	Very valid
$2.8 < X \leq 3.4$	Valid
$2.2 < X \leq 2.8$	Quite valid
$1.6 < X \leq 2.2$	Less valid
$X \leq 1.6$	Very less valid

(Widoyoko, 2016)

If the e-module is tested valid, the obtained data can be tested for reliability again according to the Alpha formula and then adjusted to the reliability criteria described by Arikunto (2014), as in Table 2.

Table 2 E-module reliability criteria

Coefficient Reliability	Category
$0.80 \leq r \leq 1$	Very high
$0.60 \leq r < 0.80$	High
$0.40 \leq r < 0.60$	Medium
$0.20 \leq r < 0.40$	Low
$0.00 \leq r < 0.20$	Very low

The practicality of e-module content is reviewed based on the results of e-module readability by the physics education alumni batch 2017. Practicality assessment is calculated by averaging the scores from the student readability results obtained. Then, the results are adjusted to the e-module practicality criteria, as in Table 3.

Table 3 E-module content practicality criteria

Interval	Category
$X > 3.4$	Very practical
$2.6 < X \leq 3.4$	Practical
$1.8 < X \leq 2.6$	Quite practical
$X \leq 1.8$	Less practical

(Widoyoko, 2013)

RESULTS AND DISCUSSION

The momentum impulse e-module is emphasized to support physics learning in the classroom. E-Modules are prepared based on the guided discovery model and contain digital literacy that can train students' digital literacy. The e-module that has been developed contains several components, namely the front cover, preface, table of contents, instructions for use, concept map, keywords, learning indicators, learning materials, digital literacy corner, sample questions, summary, student worksheets, learning achievement test (LAT), bibliography, glossary, and author's bio. The development of this e-module through Flip PDF Corporate Edition software is very responsive (optimal) and easily adapts to the device's screen size. The font size, images, layout, and presentation of the material remain the same even though various devices access them. All device users can access This electronic module, including a computer, iPad, iPhone, and Android, without additional software or other hardware.

The momentum impulse e-module was developed based on guided discovery, which contains guided discovery steps, namely stimulation, identifying problems, data collection, data processing, verification, and generalization. At the stimulus and data collection stages, links or QR codes are loaded, which can train digital literacy. In addition, the stimulus stage also builds new knowledge. This new knowledge facilitates students to think critically and find their own concepts to increase digital literacy (Octavia et al., 2022). The guided discovery-based momentum impulse e-module was developed to train students' digital literacy through indicators of digital literacy achievement, namely the intensity of application and utilization of digital literacy in learning activities and the number and variety of reading materials and digital-based teaching aids. In the e-module, students can open links containing impulse and momentum information to improve the first digital literacy indicator. This e-module feature allows students to access various electronic learning resources such as mp4, YouTube, articles, and quizzes. Images, videos, and quizzes present visual changes at each meeting. In addition, there are also virtual laboratory activities that use PhET. This makes the variety of digital-based teaching aids and reading sources more diverse to train the second digital literacy indicator. This is reinforced by Rohmah (2020), which states that digital literacy increases when learning using interactive media by using special features in its access. The validity test of the e-module is presented in Table 4.

Table 4 E-module validity results

Assessment Aspects	Validity		Reliability	
	Score	Category	R	Category
Software engineering	3.16	Valid		
Format	2.76	Quite valid		
Language	3.16	Valid	0.87	Very high
Content	3.46	Very Valid		
Presentation	3.35	Valid		
Usability	3.25	Valid		

According to Table 4, the validity of the e-module consists of six aspects: software engineering aspects, e-module format, language aspects, e-module content aspects, presentation aspects, and usability aspects. Thirty-five aspects of the review, when described, have valid and reliable categories.

The E-Module was developed using Comic Sans MS font with 14 font sizes and 20 or 24 for certain sub-units. Variations such as font type, size, and color are adjusted so that there is contrast between subtitles and titles. There are also some emphases on important parts of sentences with bright or soft colors. This is also reinforced by (Rizal et al., 2021), which explains that visualization on e-modules using bright colors and attractive animations can generate interest in learning. Khotimah et al. (2019) also explained that the use of teaching media, which is concerned with the use of visuals, can affect students' attention in learning, thus contributing to the acquisition of better learning scores. This e-module based on guided discovery has characteristics that allow students to find and investigate a concept in accordance with the stages of guided discovery, namely providing stimulus or motivation, identifying problems, collecting data, processing data, verification, and generalization. This E-Module has also been developed as practical teaching material that can be used anytime and anywhere, allowing it to be used independently as teaching material. This is in accordance with the statement of Widodo & Jasmadi (2008) that teaching materials must have user-friendly aspects, including supportive and clear instructions and presentation of information and the ease of users to respond and access as needed.

The e-module readability instrument has 13 statements from the e-module display aspect and the e-module material presentation aspect. The results of validating the E-Module readability instrument in each aspect have received a very valid category. The level of readability in the presentation of material can affect student motivation, interest, and understanding of learning (Zaim, 2018). Destiara (2020) suggests that the benefit of the readability test is obtaining the assessment results so that the validated product can be refined again in accordance with the respondents' suggestions and input to make it more relevant to students' needs.

Table 5 Readability instrument validity results

Assessment Aspects	Validity		Reliability	
	Score	Category	R	Category
E-Module display	3.5	Very valid	0.60	High
E-Module material presentation	3.83	Very valid		

Validated e-modules were then reviewed regarding the practicality of content based on the readability of the physics education alumni batch 2017. Table 6 shows the results of the student readability assessment of the e-module in terms of the appearance and presentation of the material.

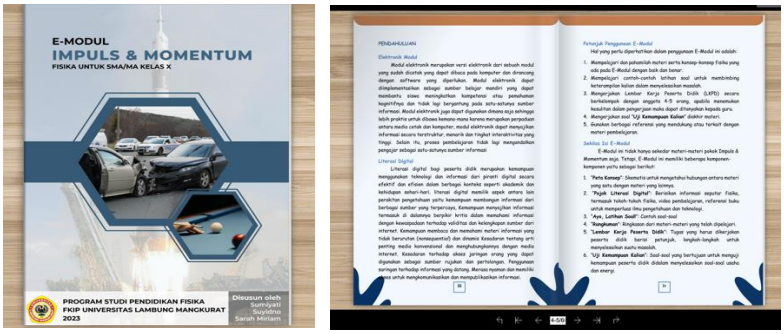
Student responses to aspects of the e-module display, namely the suitability of the e-module display, have a practical category, meaning that this aspect gets good results. This is evident from the e-module, which uses a background display with bright and soft colors, as well as the type, size, and color of the writing font used, which is easy to read and the attractive image of the material. In line with this, Dayanti et al. (2021) explain that the display design of the e-module must be attractive and facilitate students in reading and understanding the material and information presented.

Table 6 E-module readability assessment results

Aspect	Readability Assessment	Score	Category
Display	Text is easy to understand Images are clear and not blurry There is a description of the picture The images presented are interesting Images are in accordance with the material	3.37	Practical
Material Presentation	Explains concepts using illustrations of problems related to everyday life Using examples in everyday life Motivates to discuss with other friends Related to momentum impulse material The material is coherent There are no sentences that cause double meaning The symbols in this E-Module are easy to understand The terms in this E-Module are easy to understand	3.39	Practical

Student responses to the presentation aspect of the e-module material are in the practical category, meaning that this aspect gets good results. This is because the e-module is organized in Indonesian according to the rules set, making it easy for readers to understand. In addition, this E-Module is equipped with pictures and videos that can stimulate visual elements so that students are more interested in reading and increasing their understanding of the material being studied. Sriwahyuni et al. (2019) also explained that the E-Module developed through the Flip PDF Corporate Edition application presents an easy-to-

understand sentence structure and images/video that can provide more information about material that is difficult to convey through text alone. The average score of the e-module developed is in the practical category. Thus, the e-module that has been developed is practical and can be used as a teaching reference to support learning activities at school. Figure 2 shows the appearance of the e-module that has been developed.



(a) (b)

(c) (d)

Figure 2 The developed e-module. (a) Cover section, (b) Introduction section, (c) Material section, and (d) Worksheet section

Further research is needed to test the effectiveness of the E-Module in several classes or schools. This research implies that integrating digital literacy in the module can help students prepare to face educational challenges in the digital era. This step can also encourage the development of a more interactive curriculum. The limitation of this research is that the material discussed is only momentum implosion physics material. The application of e-modules in the learning process also has the potential to improve the critical thinking skills and science process skills of students (Pitorini et al., 2024; Serevina et al., 2018). The research results by Sulisetijono et al. (2023) related to AR-based e-modules proved effective in improving students' science literacy with an n-gain score of 0.7. Similar research was also conducted by Karomah et al. (2023), which showed that e-modules in the form of E-Megazines could improve students' literacy in biological materials. Other research conducted by Yoda et al. (2024) shows that e-modules positively and significantly affect students' understanding of the material taught. E-modules integrated with the appropriate learning model can stimulate good achievement in learning outcomes. The use of a discovery learning model integrated with technology-based learning media can improve students' critical thinking skills (Chusni et al., 2021; Subekti & Prahmana, 2021).

CONCLUSION

E-Modules were developed with Flip PDF Corporate Edition. The developed e-module is valid based on the results of e-module validation by academic experts and practitioners. The results showed that (1) e-module validation results and readability instruments in the valid category and (2) e-module practicality seen from student readability has met the practical category. It is concluded that the e-module developed on momentum impulse material is feasible for training students' digital literacy skills. This research implies that integrating digital literacy in the module can help students prepare for the challenges of education in the digital era and encourage the development of a more interactive curriculum.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, S and S; methodology, S and SM; formal analysis, S and Q; writing—preparation of the original draft, S, S, and Q.

REFERENCES

Amin, I. M., Mansur, R., & Sulistiono, M. (2020). Peran literasi digital dalam meningkatkan pembelajaran pendidikan agama islam di kelas XI IIS 01 SMAI Al Maarif Singosari Malang. *Jurnal Pendidikan Islam*, *5*(2), 17–23.

Annisa, S. A., Lesmono, A. D., & Yushardi, Y. (2020). Comic-based module development andro-web to improve problem solving ability in physics in high school students. *Berkala Ilmiah Pendidikan Fisika*, *8*(1), 40. https://doi.org/10.20527/bipf.v8i1.7641

Arikunto, S. (2014). *Prosedur penelitian suatu pendekatan praktik*. PT Rineka Cipta.

Chusni, M.M., Saputro, S., Rahardjo, S.B., & Suratno. (2021). Student's critical thinking skills through discovery learning model using e-learning on enviromental change subjet matter. *European Journal of Educational Research.* 10 (3), 11123-1135.

Dayanti, Z. R., Respati, R., & Gyartini, R. (2021). Pengembangan bahan ajar elektronik flipbook dalam pembelajaran seni rupa daerah siswa kelas v di sekolah dasar. *Journal of Elementary Education*, 04(05), 704–711.

Destiara, M. (2020). The practicality of teaching material biology of islamic-science based on augmented reality. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, *2*(2), 117-122.

Dewantara, D., Sofianto, E. W. N., Misbah, M., & Munawaroh, D. (2021). Physics e-module: A review and bibliometric analysis. In *Journal of Physics: Conference Series*, 2104(1), 012008. IOP Publishing.

Fernández-Otoya, F.; Cabero-Almenara, J.; Pérez-Postigo, G.; Bravo, J.; Alcázar-Holguin, M.A.; Vilca-Rodríguez, M. (2024). Digital and Information Literacy in Basic-Education Teachers: A Systematic Literature Review. *Educ. Sci. 14*, 127

Hasyim, A. (2016). *Metode penelitian dan pengembangan di sekolah*. Media Akademi.

Hidayat, R., Hakim, L., & Lia, L. (2019). Pengaruh model *guided discovery* learning berbantuan media simulasi PhET terhadap pemahaman konsep fisika siswa. *Berkala Ilmiah Pendidikan Fisika*, 7(2), 97. https://doi.org/10.20527/bipf.v7i2.5900

Ismet, Edi, R., Haryani, M. E., & Saparini. (2022). Pendampingan pembuatan E-modul untuk meningkatkan keterampilan literasi digital bagi guru MGMP IPA Kota Pagaralam. *Jurnal Pengabdian Masyarakat*, *4*(4), 1638–1646.

Khasanah, U., & Herina. (2020). Membangun karakter siswa melalui literasi digital dalam menghadapi pendidikan abad 21 (revolusi industri 4.0). *Prosiding Seminar Nasional*

Pendidikan Program Pascasarjana Universitas PGRI Palembang, 21, 999–1015.

Kholiq, A. (2020). *Development of physics digital book based augmented reality to train students' scientific literacy on global warming material*. *Berkala Ilmiah Pendidikan Fisika*, 8(1), 50. https://doi.org/10.20527/bipf.v8i1.7881

Karomah, A.S., hariyanti, E.N., Indriani, R.P., Ristanto, R.H., & Miarsyah, M. (2023). HAIBIO: Development of an a-megazine to improve biological literacy. *Journal of Science Learning*. 6(3), 272-280.

Khotimah, H., Supena, A., & Hidayat, N. (2019). Meningkatkan attensi belajar siswa kelas awal melalui media visual. *Jurnal Pendidikan Anak*, 8(1), 17–28. https://doi.org/10.21831/jpa.v8i1.22657

Kurnia, N. (2019). Litersai digital keluarga: teori dan praktik pendamping orang tua terhadap anak dalam berinternet. *Gajdah mada university press*.

Lankshear, C., & Knobel. (2015). Digital Literacy and Digital Literacies: - Policy, Pedagogy and Research Consideration for Education. *Nordic Journal of Digital Literacy*, 10 (1), 8-20.

Maisaroh, M., Mayasari, T., & Sasono, M. (2020). Pengembangan modul elektronik berbasis real life learning untuk meningkatkan kemampuan analisis siswa SMK. *Jurnal Ilmiah Pendidikan Fisika*, 4(1), 33. https://doi.org/10.20527/jipf.v4i1.1776

Marmoah, S., Poerwanti, J.I., Suharno, Gestiardi, R. (2024). The Quality Management of Education in Elementary Schools in Improving Teachers' Digital Literacy in y]the Era of Online Learning. *Pagem Journal of Education and Instruction.* 14 (1), 32-40

Misbah, M., Khairunnisa, Y., Amrita, P. D., Dewantara, D., Mahtari, S., Syahidi, K., ... & Deta, U. A. (2021). The effectiveness of introduction to nuclear physics e-module as a teaching material during covid-19 pandemic. In *Journal of Physics: Conference Series*, 1760(1), 012052. IOP Publishing.

Muhammad, N., Hamid, F., Misbah, M., & Dewantara, D. (2021). E-module on elasticity of solids topic through cooperative learning to improve learning outcomes and motivation: Validity aspects. In *Journal of Physics: Conference Series*, 2104(1), 012015. IOP Publishing.

Muzijah, R., Wati, M., & Mahtari, S. (2020). Pengembangan e-modul menggunakan aplikasi exe-learning untuk melatih literasi sains. *Jurnal Ilmiah Pendidikan Fisika*, 4(2), 89. https://doi.org/10.20527/jipf.v4i2.2056

Octavia, A., Erika, F., & Nurhadi, M. (2022). *Guided discovery learning* berbasis *indigenous knowledge* untuk melatih keterampilan berpikir. *SAP (Susunan Artikel Pendidikan)*, 6(3), 361–368.

Oktavia, R. (2021). Tingkat literasi digital siswa ditinjau dari penggunaan teknologi informasi sebagai mobile learning dalam pembelajaran biologi pada siswa mengengah atas (SMA) Kecamatan Kuala Nagan Raya. VII(2), 26–34.

Onyancha, O.B., (2023). Mapping media and information literacy skills during and after covid-19, with special reference to online education, and commerce and trade. *Journal of Media Literacy Education*. 15 (3), 93-109.

Pitorini, D.E., Suciati, & Harlita. (2024). Students' critical thinking skills using an e-module based on problem-based learning combined with socratic dialouge. *Journal of LEarning for Development.* 11(1), 52-65.

Prachagool, V., Nuangchalerm, P., & Yawongsa, P. (2022). Digital literacy of pre-service teachner in the period time of covid-19 pancemic. *Journal of Education Issues.* 8(2), 347-358.

Pratiwi, M. K. (2022). Pengembangan e-modul berbasis qr-code untuk melatihkan kemampuan literasi digital siswa pada materi perubahan lingkungan. *Bioedu*, *11*(2), 457–468.

Rahman, F., Suyidno, S., Miriam, S., & Husain, S. (2023). *Developing learners' digital literacy through guided discovery learning on the matter of work and energy*. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *13*(1), 233–244. https://doi.org/10.26740/jpps.v13n1.p233-244

Rahmi, U., Azrul., & Mahande, R.D. (2022). The prototype of blenden learning's support system to improve the pre-service teacher's digital literacy. *Journal of Educators Online.* 19 (3), 16.

Rizal, A. F., Purwaningrum, J. P., & Rahayu, R. (2021). Pengembangan E-modul berbasis etnomatematika untuk menumbuhkan kemampuan komunikasi matematis dan minat belajar siswa. *Koordinat Jurnal MIPA*, 2(2), 1–14. https://doi.org/10.24239/koordinat.v2i2.26

Rohmah, F. N., & Bukhori, I. (2020). Pengembangan media pembelajaran interaktif mata pelajaran korespodensi berbasis android menggunakan articulate storyline 3. *Jurnal Ecoducation*, 2(2), 171.

Salimah, N., Arifuddin, M., & Annur, S. (2019). Pengembangan bahan ajar model penemuan terbimbing untuk melatih keterampilan proses sains peserta didik. *Jurnal Ilmiah Pendidikan Fisika*, 3(3), 104. https://doi.org/10.20527/jipf.v3i3.1040

Serevina, V., Sunaryo, Raihanati, Astra, I.M., & Sari, I.J. (2018). Development of e-module based on problem based learning (pbl) on heat and temperature to improve student's science process skill. *The Turkish Online Journal of Educational Technology*. 17 (3), 26-36.

Sriwahyuni, I., Risdianto, E., & Johan, H. (2019). Pengembangan bahan ajar elektronik menggunakan Flip PDF professional pada materi alat-alat optik di SMA. *2*(3), 145–152.

Subekti, M.A.S., & Prahmana, R.C.I. (2021). Developing interactive electronic student worksheet through discovery learning and critical thinking skills during pandemic era. *Mathematics Teaching Research Journal*. 13 (2), 137-176.

Sugiyono, S. (2017). *Metode penelitian pendidikan*. Alfabeta.

Sulisetijono, S., Sunarmi, S., & Rochmah, A.N. (2023). The effectiveness of ar e-module of flower structure material on biology students' science literacy. *Jurnal Pendidikan Biologi Indonesia*. 9(2), 217-224.

Suyidno, S., & Jamal, M. A. (2012). *Strategi belajar mengajar*. P3AI UNLAM.

Suyidno, S., Fitriyani, F., Miriam, S., Mahtari, S., & Siswanto, J. (2022). *STEM-Problem based learning*: pembelajaran inovatif untuk meningkatkan literasi sains siswa di era industri 4.0. *Jurnal Penelitian Pembelajaran Fisika*, *13*(2), 163–170. https://doi.org/10.26877/jp2f.v13i2.11402

Tang, C. M., & Chaw, L. Y. (2016). Digital literacy: A prerequisite for effective learning in a blended learning enviroment. *The Electronic Journal of e-Learning.* 14 (1), 54-65.

Thanaittipath, N., And Boonmoh., A. (2024). Thai secondary efl teachers' use of digital literacy tools in post-covid-19 teaching. *International Journal of Education & Literacy Studies.* 12 (3), 197-207.

Wahjusaputri, S., & Nastiti, T. I. (2022). Digital literasi competency indicator for indonesia high vocational education needs. *Journal of Education and Learning.* 16 (1), 85-91.

Wahyudi, D. (2019). *Development of e-modules in learning math high*. *Jurnal Pendidikan Matematika*, *02*(02), 1–10.

Wati, M., Apriani, R., Misbah, M., Miriam, S., & Mahtari, S. (2021). Pengembangan e-modul suhu dan kalor bermuatan kearifan lokal melalui aplikasi sigil. *Jurnal Inovasi dan Pembelajaran Fisika*, *8*(1), 112-121.

Widodo, C. S., & Jasmadi, J. (2008). *Panduan menyusun bahan ajar berbasi kompetensi* (E. M. Komputindo (ed.)).

Widoyoko, E. P. (2016). *Penilaian hasil pembelajaran di sekolah*. Pustaka Pelajar.

Wiyani, N. A. (2013). *Desain pembelajaran pendidikan*. Ar-Ruzz Media.
Yoda, I.K., Kasih, I., & Ira, T. (2024). Developing an e-module to improve the seventh-grade student's bump pass skills in voleyball. *Journal of Education and E-Learning Research*, 11 (1), 17-25
Yuvita, Y., Husain, A., Sulistyawati, A.E., Meiristiani, N., Fatimah, E., Sunmud, S., (2024). Assessing the digital literacy competence of pre-service english teacher in indonesia and thailand. *Journal of Education and Learning*. 17 (4), 604-612.
Zaim, M. (2018). Keterbacaan teks non-sastra pada buku bahasa indonesia kelas x kurikulum 2013 dengan formula fry. *Stilistika: Jurnal Pendidikan Bahasa Dan Sastra*, *11*(1), 66. https://doi.org/10.30651/st.v11i1.1933

AUTHOR PROFILES

Sumiyati
sumiy586@gmail.com
Physics education Universitas Lambung Mangkurat

Suyidno
suyidno_pfis@ulm.ac.id
Physics learning model, physics learning media, STEM
Universitas Lambung Mangkurat
Google scholar: 6-IYIlAAAAAJ&hl
Sinta ID: 6020039
Orchid: https://orcid.org/0000-0002-3080-4267
Scopus links: 57200990818

Sarah Mariam
sarah_pfis@ulm.ac.id
physics learning model, physics learning media
Universitas Lambung Mangkurat
Google scholar: tzAVZYEAAAAJ
Sinta ID: 6057267
Orchid: https://orcid.org/0000-0003-2125-8222
Scopus links: 57217176641

Qamariah
qamariah@ulm.ac.id
physics learning, mobile learning, learning media
Universitas Lambung Mangkurat
Google scholar: iqvzHTUAAAAJ
Sinta ID: 6725371
Orchid: https://orcid.org/0000-0003-2955-3162
Scopus links: 57195477559