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Development of an E-Module Based on Authentic Learning in the Context of Wetlands for Archimedes' Principle Material

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ABSTRACT

Physics is often considered an abstract subject, posing challenges for students to fully comprehend its concepts. The integration of advancing technology as a learning medium can facilitate students' understanding, particularly when combined with authentic learning approaches that present concrete situations. This allows students to observe, analyze, perform, and even experience concepts firsthand. An e-module based on authentic learning within the context of wetlands can serve as an effective learning medium. This study aims to develop a valid and practical e-module based on authentic learning in the context of wetlands for teaching Archimedes' principle. The validity of the e-module was assessed through expert validation involving three specialists, while practicality and readability were evaluated using student response questionnaires. The research follows the Research and Development (R&D) methodology using the ADDIE model, which consists of five stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The study was conducted in the Physics Education program at Lambung Mangkurat University (ULM) in Banjarmasin. The validation results indicated that the material expert assessment achieved a score of 100%, the language expert assessment scored 93.75%, and the media expert assessment scored 91.67%, with an overall average validation score of 95.14%. The readability test yielded an average score of 91.38%, while student response assessments resulted in an average score of 93.89%. Based on these findings, it can be concluded that the developed e-module is highly feasible, valid, fully readable, and practical for use in learning.

Keywords : Authentic Learning; Archimedes; Development; E-Module; Wetlands.

I. INTRODUCTION

Physics education students play a crucial role in shaping future generations with strong scientific literacy. Therefore, it is essential for them to master physics concepts comprehensively and effectively convey these concepts. However, learning physics especially for physics education, students often presents challenges in understanding abstract and complex concepts [1], [2], [3], [4]. Initial observations in the Basic Physics 1 course, particularly on the topic of Archimedes' Principle, revealed that students found the material difficult to comprehend. One of the factors contributing to this difficulty is the learning module, which is still in PDF format, lacking interactivity and not incorporating authentic learning principles.

The learning module currently in use has not yet been integrated with video examples or student worksheets that could help learners develop a deeper understanding of the material. This condition results in a lack of relevant and contextual teaching materials, making it difficult for students to connect theoretical concepts with real-world applications. Existing e-modules are often too general and fail to emphasize key aspects of authentic learning, such as incorporating real-life situations or relevant contexts. Without more specific development in e-modules, students may not experience optimal learning opportunities to understand and apply concepts in broader and more practical contexts [5], [6]. As a result, the potential benefits of authentic learning approaches cannot be fully realized, and students miss opportunities to develop more applicable and in-depth skills. Interviews with lecturers of the Basic Physics 1 course further revealed that students' problem-solving

abilities remain inadequate and require further training, particularly in the topic of Archimedes' Principle (static fluids). Students tend to rely on memorizing equations, leading to difficulties in solving problems that differ from the examples provided.

One approach to addressing this issue is the development of an innovative and interactive e-module based on authentic learning in the context of wetlands. Given that students predominantly reside in wetland areas, they may find it easier to understand Archimedes' law if the learning process is designed to reflect real-life conditions. Previous studies have shown that authentic learning significantly enhances students' problem-solving abilities. For instance, a study found that implementing authentic assessment can improve students' honesty in the learning process [7]. Additionally, another study demonstrated that problem-based learning, a component of authentic learning, helps students develop problem-solving skills and critical thinking abilities [8]. By engaging students in real-world situations that require solving complex problems, authentic learning not only enhances technical skills but also prepares them for the challenges of the professional world [9].

The use of instructional media or learning modules significantly influences students' ability to comprehend a subject [10]. With technological advancements, various innovations in learning media continue to emerge. Electronic modules, with their advantages in presenting material visually, interactively, and flexibly, have the potential to be an effective solution for enhancing the quality of physics learning [11], [12], [13].

Electronic modules have shown significant advancements in the field of education. With their ability to integrate text, images, animations, videos, and simulations, electronic modules can provide a richer and more engaging learning experience for students. A flipbook is a digital medium that mimics a printed book, featuring animated page-turning effects, thus offering an interactive experience for students. Flipbook-based e-modules can create a more engaging and dynamic learning environment [14], [15].

The development of an electronic module tailored to the needs of physics education students is expected to serve as an effective learning tool. As a form of digital learning media, electronic modules hold great potential for overcoming challenges in physics education. Therefore, this study aims to develop an e-module based on authentic learning in the context of wetlands for Archimedes' Principle, ensuring its validity and practicality for effective use.

II. METHOD

The research method employed in this study is the Research and Development (R&D) approach using the ADDIE model [16], which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This method enables the assessment of validity, practicality, and readability. The research methodology is illustrated in Figure 1 below.

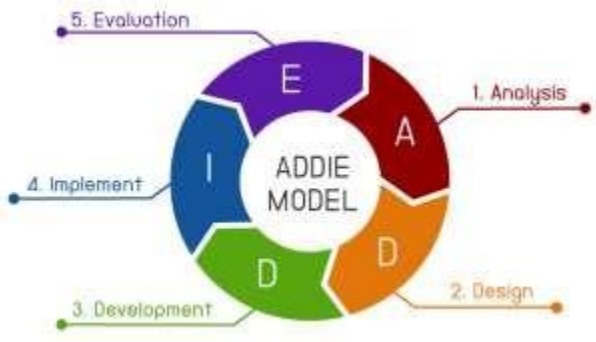


Fig. 1. ADDIE Model

In this study, several assessment rubrics were used to validate the e-module, including evaluations by subject Content experts, media experts, and language experts. The validation rubric framework is presented in Table 1 below.

Table 1. Validation Rubric Framework

Experts Validation	Aspect	Number of Question	Amount Questions
Media	Screen Design Layout	1, 2, 3, 4, 5, 6	6
	Ease of Use	7, 8, 9, 10	4

	Graphics Quality	11, 12, 13, 14, 15	5
Language	Grammar and Language Feasibility	1,2,3,4	4
	Use of Terms, Symbols and Icon	5,6	2
	Suitability for Student Development	7,8	2
Content	Content Feasibility	1, 2, 3, 4, 5	5
	Presentation	6,7,8,9	4

The validation results are then converted into percentages using the following Equation (1) below [17].

$$Score\ Percentage\ = \frac{\sum Score\ 0btained}{\sum Maximum\ Score} x\ 100\% \quad (1)$$

Table 2 presents the feasibility interpretation of the validated e-module. This interpretation categorizes the validation percentage into different feasibility levels to determine the module's quality and usability.

Table 2. Interpretation E-Module Validity

Percentage (%)	Interpretation
75-100	Very Feasible
50-74,99	Feasible
25-49,99	Not Feasible
0-24 ,99	Highly Not Feasible

(Source: Ref[18])

To determine the readability percentage of the e-module, a readability questionnaire was administered to 20 students from the Physics Education program at ULM. The rubric framework for the readability questionnaire is presented in Table 3 below.

Table 3. Readability Rubric Framework

Aspect	Number of Question	Amount Questions
Content	1, 2, 3	3
Media	4, 7, 8, 9	4
Language	5, 6, 10	3

The readability test results will be accumulated and calculated using the following Equation (1), Thus, the percentage of student responses can be categorized based on the criteria range presented in the table 4 below.

Table 4. Interpretation E-Module Readability

Percentage (%)	Readability Interpretation
0	None
1-25	A Small Portion
26-49	Almost Half
50	Half
52-75	Most
76-99	Almost All
100	All

(Source: Ref[19])

This study involved 12 students from the Physics Education program at ULM to assess student responses and the effectiveness of the e-module. To evaluate student responses, a response questionnaire consisting of 13 items was administered. The rubric framework for the student response questionnaire is presented in Table 5 below.

Table 5. Student Response Rubric Framework

Aspect	Number of Question	Amount Questions
Interest and Attention	1, 2, 4, 10, 12	5
Learning Assistance	3, 9, 11, 13	4
Ease of Use	5, 6, 7, 8	4

The response results will be accumulated and calculated using Equation (1), Thus, the percentage of student responses can be categorized based on the following criteria range presented in Table 6.

Table 6. Interpretation Student Response

Percentage (%)	Interpretation
76-100	Very High
51-75	High
26-50	Moderate
0-25	Low

(Source: Ref[20])

III. RESULTS AND DISCUSSION

The e-module developed in this study is an authentic learning in the context of wetland for the Archimedes' Principle topic. It is designed to be valid and practical for use in physics learning.

In this study, an initial analysis phase was conducted to identify issues related to the learning process in the Physics Education program. Based on preliminary observations and interviews with both lecturers and students, one of the teaching materials used for the Archimedes' Principle topic is still in the form of a PDF module. However, this module does not incorporate authentic learning with a wetland-based theme, making it challenging for students to fully grasp the concepts of Archimedes' Principle. The lack of contextual and interactive elements in the current module contributes to students' difficulties in understanding and applying the concepts in real-world situations. Figure 2 illustrates the PDF module that has been used by lecturers in teaching this topic.

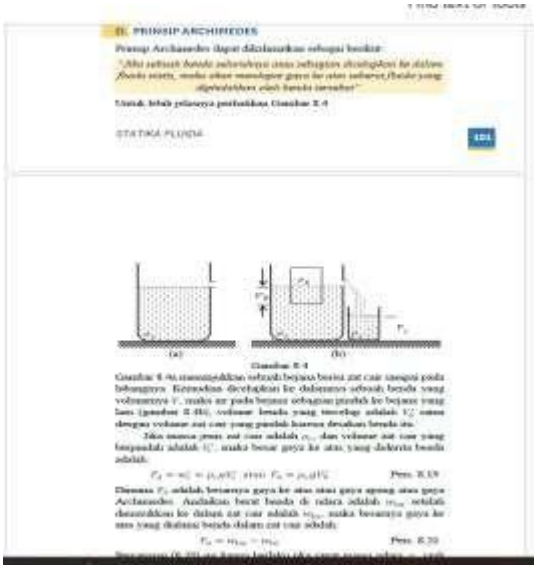


Fig. 2. PDF Module

The next step is the design phase, where the e-module is developed. At this stage, a draft of the e-module was created using Canva, consisting of 52 pages that include a cover page, table of contents, Problem-Based Learning (PBL) components, Course Learning Outcomes (CLO), user guidelines, learning materials, evaluation sections, feedback sections, references, glossary, and a back cover. The design created using Canva is illustrated in Figure 3 below. Additionally, during this phase, a validation instrument was developed to evaluate the

feasibility of the e-module. This instrument consists of expert validation questionnaires involving content experts (for material validation), media experts (for multimedia and interactivity validation), and language experts (for clarity and readability validation). Furthermore, student readability and response questionnaires were also designed to assess how well students can comprehend and engage with the e-module. These evaluation tools ensure that the developed e-module is valid and practical for use.

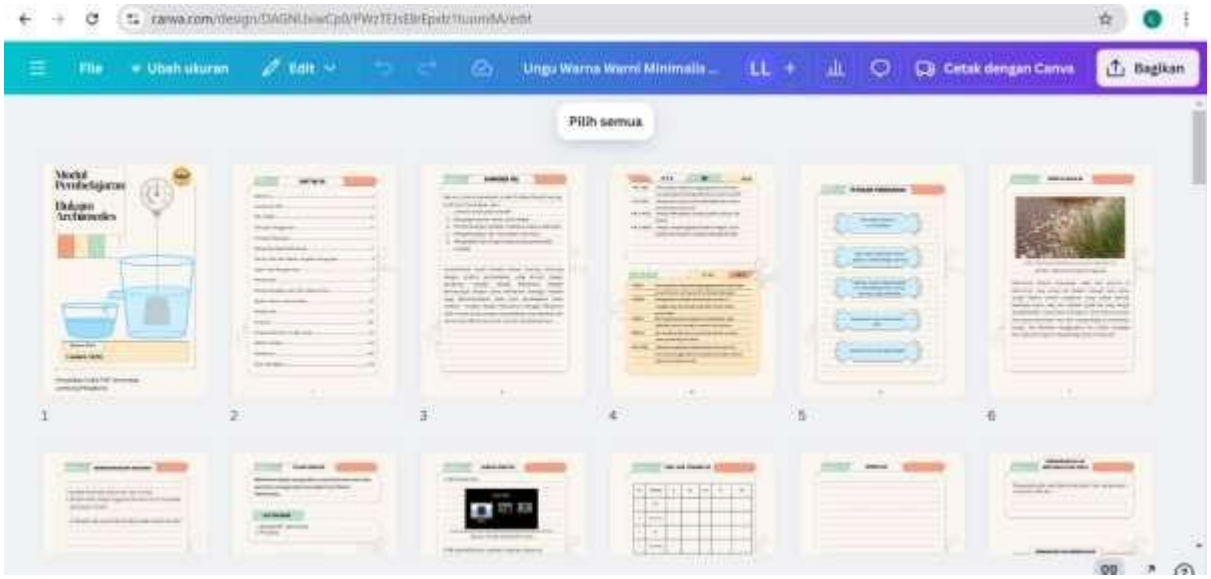


Fig. 3. E-Module Design Using Canva

The next step is development phase. The e-module, which was initially designed using Canva, was then converted and further developed into a flipbook format. Additional elements, such as YouTube links and links to student worksheets, were incorporated using the Flip PDF Professional application. Figure 4 illustrates the Flip PDF Professional application used.

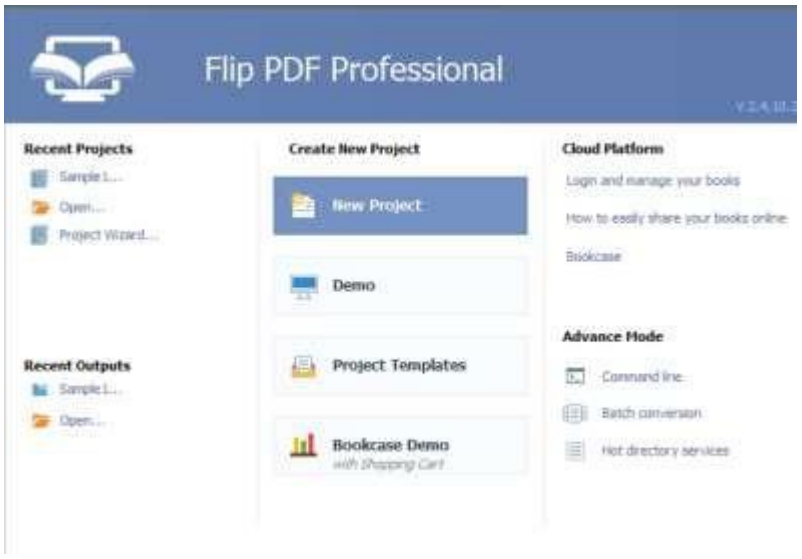
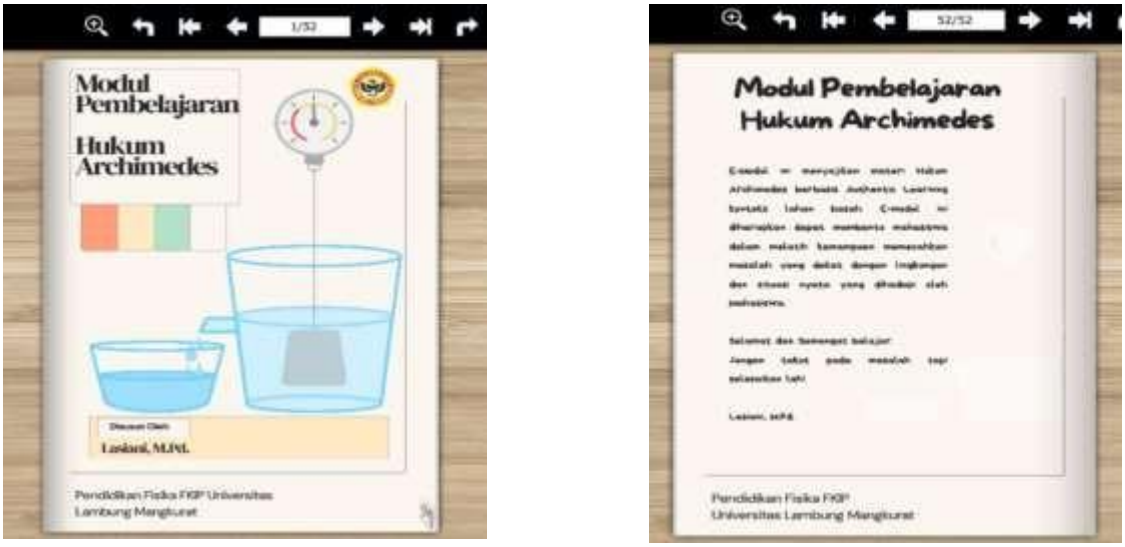


Fig. 4. Flip PDF Professional application

This enhancement aimed to create a more interactive and engaging learning experience. To ensure the feasibility and quality of the e-module, it was validated by three experts specializing in content, media, and language. Following the validation process, the module was revised based on the experts' feedback to improve its quality and effectiveness. After the revision process was completed, the e-module was implemented through a

limited trial with a small group of students to assess its usability and practicality in an actual learning environment. The front and back covers of the developed e-module can be seen in Figures 5a and 5b below.



(a) (b)

Fig. 5. (a) E-Module Front Covers (b) E-Module Back Cover

Next steps are implementation and evaluation. The validated e-module was implemented for Physics Education students at ULM for trial testing. The researcher distributed a student response questionnaire to 12 students and a readability test questionnaire to 20 students. The feedback provided by the students was carefully considered as a basis for revising and improving the e-module to enhance its quality and effectiveness. At the evaluation phase, the feasibility of the product was assessed, and efforts were made to enhance its quality. This stage involved analyzing feedback and recommendations from media experts, content experts, and language experts, as well as results from the readability test and student response questionnaire collected during the small-group trial**.**

The validation results indicate that the content expert validation achieved a percentage of 100%, the media expert validation achieved 91.67%, and the language expert validation achieved 93.75%. The detailed validation results can be seen in Figure 6 below.

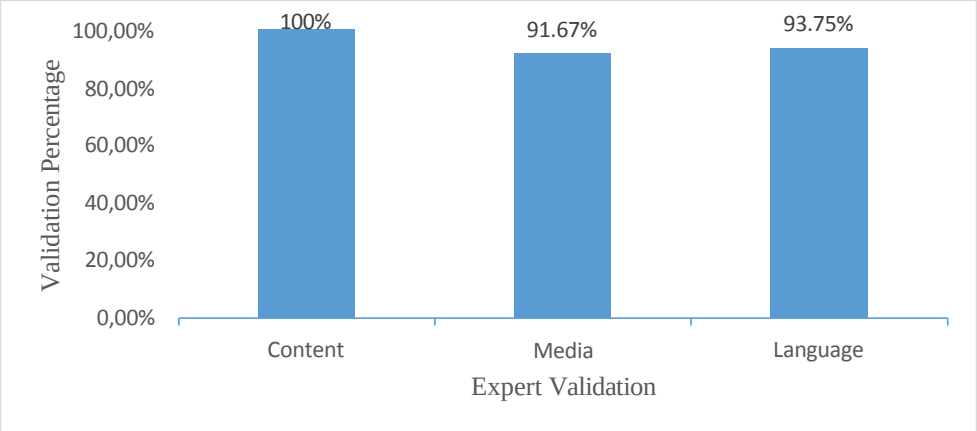


Fig. 6. Expert Validation Percentage

Based on the validation results shown in Figure 5, the average percentage of validation results from the content expert, media expert, and language expert is 95.14%. Referring to Table 2, it can be concluded that the developed e-module falls into the highly feasible category for implementation and use. In addition to providing scores on the validation instrument, the validators also offered comments and suggestions for improving the e-module. The content expert suggested enhancing the evaluation section with concept comprehension questions, considering that research indicates a high prevalence of misconceptions on this topic. This recommendation

aligns with previous studies that highlight frequent misconceptions in fluid mechanics [21], [22], [23]. The media expert recommended improving the logo, correcting some typographical errors, and revising the notation of mathematical equations. Meanwhile, the language expert advised ensuring consistency in terminology and formatting throughout the e-module. Based on these comments and suggestions, the e-module was revised and prepared for implementation to assess its readability and student responses.

The next stage is conducting a readability test of the e-module using a readability questionnaire involving 20 students. The results of the readability test can be seen in Figure 7 below.

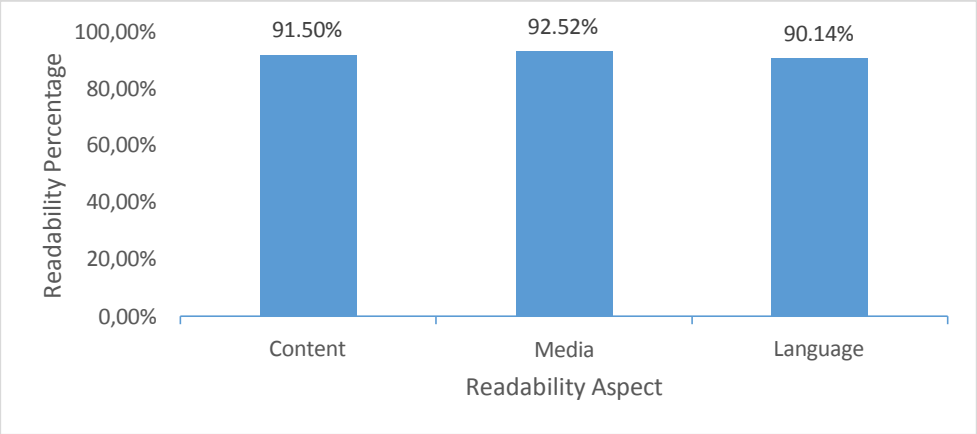


Fig. 7. Readability Percentage

The average percentage from the three aspects of the readability test reached 91.38%, indicating that the e-module falls into the "fully readable" category. Conducting a readability test is crucial in module development to ensure that the content is comprehensible and aligns with the users' literacy levels [24].

After completing the readability test phase, the product was then tested on a small group of 12 students. A response questionnaire was administered to assess students' perceptions of the developed module. The results of the student response questionnaire can be seen in Figure 8 below.

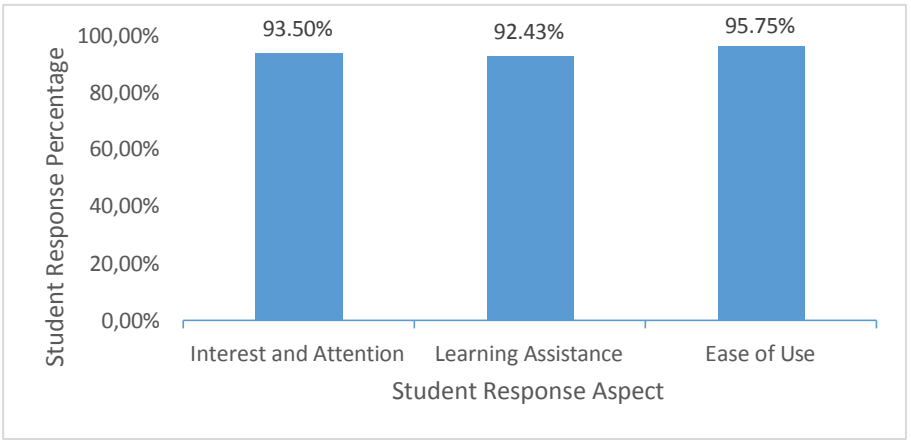


Fig. 8. Student Response Percentage

The results of the student response questionnaire, with an average percentage of 93.89%, indicate that the e-module falls into the "very high" category. In addition to providing numerical ratings, students also included comments and suggestions in their responses. Several students mentioned that the developed e-module helped them better understand Archimedes' law. Others expressed their enjoyment in using the e-module, as it presented various challenges to solve. They also found the e-module highly engaging due to its sound effects, videos, and colorful design.

IV. CONCLUSION

Based on the development results of the wetland-context authentic learning-based e-module for Archimedes' law, it can be concluded that the e-module is valid and practical for use. The validity test obtained

an average percentage of 95.14% from three experts, placing it in the "highly feasible" category. The readability test resulted in an average percentage of 91.38%, classified as "fully readable." The student response questionnaire achieved an average percentage of 93.89%, falling into the "very high" category.

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REFERENCES

[1] D. Gousopoulos, E. Kapotis, and G. Kalkanis, "Students' difficulties in understanding the basic principles of Relativity after standard instruction," *Eser. Conf. Sci. Educ. Res. Engag. Learn. a Sustain. Futur.*, pp. 169–175, 2015.

[2] J. C. Hayes and D. J. M. Kraemer, "Grounded understanding of abstract concepts: The case of STEM learning," *Cogn. Res. Princ. Implic.*, vol. 2, no. 1, 2017, doi: 10.1186/s41235-016-0046-z.

[3] D. Wangchuk, D. Wangdi, S. Tshomo, and J. Zangmo, "Exploring Students' Perceived Difficulties of Learning Physics," *Educ. Innov. Pract.*, vol. 6, no. May, 2023, doi: 10.17102/eip.6.2023.03.

[4] T. Bouchée, L. de Putter - Smits, M. Thurlings, and B. Pepin, "Towards a better understanding of conceptual difficulties in introductory quantum physics courses," *Stud. Sci. Educ.*, vol. 58, no. 2, pp. 183–202, 2022, doi: 10.1080/03057267.2021.1963579.

[5] K. Salim and A. Jardani, "E-Learning in Higher Education; Challenges and Opportunities," *Int. J. Innov. Creat. Chang. www.ijicc.net*, vol. 14, no. 11, p. 2020, 2020, [Online]. Available: www.ijicc.net

[6] A. L. Madrazo and R. V. Dio, "Contextualized learning modules in bridging students' learning gaps in calculus with analytic geometry through independent learning," *J. Math. Educ.*, vol. 11, no. 3, pp. 457–476, 2020, doi: 10.22342/jme.11.3.12456.457-476.

[7] S. Ermawati and T. Hidayat, "Penilaian Autentik dan Relevansinya Dengan Kualitas Hasil Pembelajaran (Persepsi Dosen dan Mahasiswa IKIP PGRI Bojonegoro)," *J. Pendidik. Ilmu Sos.*, vol. 27, no. 1, pp. 1412–3835, 2017.

[8] E. M. Ningsih, N. Efendi, and B. Sartika, "Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Keterampilan Berpikir Kritis Siswa Dalam Mata," *J. Ilm. Pendidik. Sains*, vol. 3, no. 01, pp. 1–6, 2022.

[9] K. Falkner and E. E. Stålbrandt, "Meanings of Authentic Learning Scenarios : A Study of the Interplay Between Higher Education and Employability of Higher Education Graduates," vol. 35, no. 2, 2023.

[10] R. Elcullada Encarnacion, A. A. Galang, and B. J. Hallar, "The Impact and Effectiveness of E-Learning on Teaching and Learning," *Int. J. Comput. Sci. Res.*, vol. 5, no. 1, pp. 383–397, 2021, doi: 10.25147/ijcsr.2017.001.1.47.

[11] F. C. Wibowo *et al.*, "Effectiveness interactive digital modul physics (IDMP) based interactive lecture demonstration of concepts vector," *Thabiea J. Nat. Sci. Teach.*, vol. 6, no. 2, p. 118, 2023, doi: 10.21043/thabiea.v6i2.19808.

[12] R. Sujanem, I. Nyoman Putu Suwindra, and I. Suswandi, "The Effectiveness of Problem-Based Interactive Physics E-Module on High School Students' Critical Thinking," *J. Phys. Conf. Ser.*, vol. 1503, no. 1, 2020, doi: 10.1088/1742-6596/1503/1/012025.

[13] N. Asfiya, P. Razi, Hidayati, and S. Y. Sari, "Development of e-Module for Independent Learning of Physics Material Based on Independent Curriculum," *Int. J. Inf. Educ. Technol.*, vol. 14, no. 5, pp. 761–769, 2024, doi: 10.18178/ijiet.2024.14.5.2100.

[14] I. Pratama, F. Akbar, A. Ahmad, and A. Wahyu, "Enhancing Student Learning Outcomes Through the

Development of Interactive Flipbooks Using Heyzine," *J. Hypermedia Technol. Learn.*, vol. 7, no. 2, pp. 50–55, 2024.

[15] R. P. Mahendri, M. Amanda, and U. Latifah, "Pengembangan E-Modul Interaktif Berbasis Flipbook sebagai Media Pembelajaran Distance Learning J-HyTEL : Journal Hypermedia & Technology-Enhanced Learning," *Lett. Inf. Technol. Educ.*, vol. 1, no. 1, pp. 1–14, 2023.

[16] D. S. S. dan M. I. S. Thiagarajan Sivasailam, *Instructional Development for Training Teachers of Exceptional Children: A Sourcebook*. Bloomington: Indiana University, 1974.

[17] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif dan R&D.* Bandung: Alfabeta, 2008.

[18] S. Arikunto, *Prosedur Penelitian: suatu pendukatan praktek*. Jakarta: Rineka Cipta, 2006.

[19] Koentjaraningrat, *Metode-Metode Penelitian Masyarakat*, Ketiga. Jakarta: Gramedia Pustaka Utama, 1997.

[20] E. S. A. Sari, "Pengembangan Lembar Kegiatan Peserta Didik (LKPD) Berbasis Karakter Pada Mata Pelajaran Kimia SMA," *Edu-Sains*, vol. 5, no. 2012, pp. 8–17, 2016.

[21] A. Suarez, S. Kahan, G. Zavala, and A. C. Marti, "Students' conceptual difficulties in hydrodynamics," *Phys. Rev. Phys. Educ. Res.*, vol. 13, no. 2, pp. 1–12, 2017, doi: 10.1103/PhysRevPhysEducRes.13.020132.

[22] L. Albarracín and N. Gorgorió, "Modelling in Science Education and Learning Volume 4, No. 5 , 2011. Instituto Universitario de Matem´ atica Pura y Aplicada," *Model. Sci. Educ. Learn.*, vol. 4, no. 5, pp. 71–82, 2011.

[23] O. Saputra, A. Setiawan, and D. Rusdiana, "Identification of student misconception about static fluid," *J. Phys. Conf. Ser.*, vol. 1157, no. 3, 2019, doi: 10.1088/1742-6596/1157/3/032069.

[24] N. S. Putri, S. Mudaiyah, and N. Munfaridah, "PENGEMBANGAN MODUL ELEKTRONIK IPA BERBASIS MASALAH PADA MATERI PENCEMARAN LINGKUNGAN KELAS 7 SMP," *J. Innov. Teach. Prof.*, vol. 3, no. 2, pp. 260–269, 2025, doi: 10.17977/um084v3i22025p260-269.