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Needs Analysis for the Development of a Dual Space Inquiry-Based E-Module on Momentum and Impulse Material

Zacka Hafidhon Faiz[1], Fuja Novitra[1], Hufri[1], Selma Riyasni[1]

[1] *Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia*
*Corresponding author. Email:*fujanovitra@fmipa.unp.ac.id

ABSTRACT

The implementation of the Merdeka Curriculum emphasizes student-centered learning and supports the development of 21st-century competencies through the integration of technology in learning. However, physics learning in schools still faces several challenges, such as teacher-centered instruction, the use of less interactive teaching materials, and students' difficulties in understanding momentum and impulse concepts. Therefore, interactive digital teaching materials are needed to support meaningful learning. This study aimed to analyze the need for developing a Dual Space Inquiry-based E-Module on momentum and impulse material. This study employed the Research and Development (R&D) method using the 4-D model proposed by Thiagarajan, Semmel, and Semmel, but was limited to the Define stage. The research subjects consisted of 1 physics teacher and 30 grade XI students at SMAN 13 Padang. Data were collected through document analysis, teacher interviews, and student characteristic questionnaires. The data were analyzed descriptively using qualitative and quantitative approaches. The results showed that physics learning was still dominated by conventional teaching methods and printed teaching materials that had not optimally supported inquiry activities and interactive digital learning. Students also experienced difficulties in understanding abstract concepts related to momentum and impulse material. In addition, students showed positive responses toward the use of interactive digital learning media. Based on these findings, the development of a Dual Space Inquiry-based E-Module is considered necessary to support more interactive, meaningful, and student-centered physics learning.

Keywords: Needs Analysis, E-Module, Dual Space Inquiry, Momentum and Impulse, Physics Learning

I. INTRODUCTION

The rapid development of science and technology in the 21st century has encouraged significant changes in the education sector. Learning activities are expected to support the development of 21st-century competencies such as critical thinking, problem-solving, communication, collaboration, and digital literacy skills [1]. Therefore, learning processes should facilitate students in constructing knowledge actively through meaningful learning experiences [2].

Physics is one of the important subjects in developing students' logical, analytical, systematic, and problem-solving skills [3]. In physics learning, students are not only required to memorize formulas but also to understand concepts and relate them to everyday phenomena [4]. One of the physics topics closely related to daily life is momentum and impulse. However, momentum and impulse material involves abstract concepts and mathematical relationships that are often difficult for students to understand [5]. As a result, students frequently experience misconceptions and difficulties in relating mathematical equations to physical phenomena [6].

However, students still experience difficulties in understanding momentum and impulse concepts because these topics involve abstract concepts and mathematical representations. Many students tend to memorize formulas without fully understanding the relationships between physical quantities and real phenomena. Several studies also reported that students frequently experience misconceptions in distinguishing momentum and kinetic energy concepts and understanding the relationship between force and impulse [6]. In addition, physics learning activities are still dominated by lecture methods and problem-solving exercises, causing students to become less actively involved in scientific investigation processes [4], [7]. These conditions may hinder students' conceptual understanding and scientific thinking skills in physics learning.

In addition, the learning process in physics classrooms still tends to emphasize teacher explanations and problem-solving exercises rather than scientific investigation activities. Students are often positioned as passive learners who only receive information from teachers without actively constructing concepts through observation and investigation activities. As a result, students' engagement and learning motivation in physics learning remain relatively low [2], [3].

The integration of technology into learning activities is considered important to support meaningful learning in the digital era. Interactive digital teaching materials can provide concept visualizations, simulations, animations, and multimedia presentations that help students understand abstract physics concepts more effectively [9], [10]. The use of interactive learning media can also increase students' learning interest, motivation, and participation during the learning process.

Based on these learning problems, interactive digital teaching materials are needed to support inquiry activities and conceptual understanding in physics learning. E-Modules integrated with multimedia features such as videos, simulations, animations, and interactive exercises can help students visualize abstract concepts more clearly and improve learning engagement during physics learning activities [21], [22]. Therefore, the development of a Dual Space Inquiry-based E-Module is considered suitable to support more interactive and meaningful physics learning.

In addition to the learning process, the teaching materials used in physics learning also affect students' conceptual understanding. The teaching materials used in schools are still dominated by printed textbooks and conventional worksheets that emphasize formulas and problem-solving procedures rather than conceptual understanding [9]. These teaching materials have not fully facilitated inquiry-based learning, abstract concept visualization, and students' active engagement during learning activities. In fact, the use of interactive digital teaching materials can help students understand abstract concepts through the integration of text, images, videos, animations, and learning simulations [10]. Therefore, innovative teaching materials are needed to support active and meaningful learning in accordance with the characteristics of 21st-century learning.

One alternative teaching material that can be used is an electronic module or E-Module. E-Modules are digital teaching materials designed systematically and interactively so that they can be used independently by students [9]. The use of E-Modules in physics learning can help increase students' engagement and support conceptual understanding through more interesting and interactive material presentations [11]. In addition, the use of E-Modules is considered suitable for technological developments and learning needs in the digital era [10].

In addition to digital teaching materials, the learning model integrated into the E-Module also plays an important role in supporting the learning process. One learning model considered suitable for physics learning is *Dual Space Inquiry* (DSI) [14]. The *Dual Space Inquiry* model is an inquiry-based learning model that integrates conceptual understanding and scientific investigation processes simultaneously [14]. Through this model, students are encouraged to observe phenomena, formulate hypotheses, conduct investigations, analyze data, and actively construct understanding. The integration of the *Dual Space Inquiry* model into E-Modules is expected to help students understand momentum and impulse concepts more meaningfully and systematically.

Several previous studies have shown that the use of digital teaching materials and inquiry-based learning can improve students' engagement and support conceptual understanding in physics learning [4], [11]. However, studies specifically discussing the needs analysis for developing a *Dual Space Inquiry*-based E-Module on momentum and impulse material are still limited. Before developing a learning product, a needs analysis is necessary to identify learning conditions, students' characteristics, and the need for teaching materials suitable for school conditions [12]. Therefore, this study focuses on analyzing the need for developing a *Dual Space Inquiry*-based E-Module on momentum and impulse material.

Based on these problems, physics learning requires interactive teaching materials that support inquiry activities, conceptual understanding, and digital learning integration. Previous studies have shown that E-Modules and inquiry-based learning can improve students' engagement and understanding in physics learning. However, studies specifically discussing the development needs of a Dual Space Inquiry-based E-Module on momentum and impulse material are still limited. Therefore, this study aims to analyze the need for developing a Dual Space Inquiry-based E-Module to support more interactive, meaningful, and student-centered physics learning.

II. METHOD

This study employed the *Research and Development* (R&D) method using the 4-D development model proposed by Thiagarajan, Semmel, and Semmel, which consists of *Define*, *Design*, *Develop*, and *Disseminate* stages [8]. However, this study was limited to the *Define* stage focusing on the needs analysis for developing a *Dual Space Inquiry*-based E-Module on momentum and impulse material.

The research was conducted at SMAN 13 Padang during the odd semester of the 2025/2026 academic year involving 1 physics teacher and 30 grade XI students as research subjects. The participants were selected purposively based on their involvement in physics learning on momentum and impulse material. The needs analysis was conducted to identify physics learning conditions, the use of teaching materials, students' characteristics, and the need for developing interactive digital teaching materials on momentum and impulse material.

The research instruments consisted of document analysis sheets, teacher interview sheets, and student characteristic questionnaires [13]. Document analysis was conducted to identify teaching materials and learning devices used in physics learning on momentum and impulse material. Teacher interviews were conducted to obtain information regarding learning implementation, students' difficulties in understanding momentum and impulse concepts, and teachers' perceptions toward digital teaching materials. Meanwhile, student characteristic questionnaires were used to identify students' learning motivation, learning interests, learning styles, and readiness toward digital-based learning.

Before being used in the study, the instruments were reviewed and validated by experts to ensure the suitability of the indicators with the research objectives. In addition, the research was conducted with permission from the school and all participants were involved voluntarily in the study.

At the Define stage, several analyses were conducted including curriculum analysis, document analysis, teacher interviews, and student characteristic analysis. These analyses aimed to identify learning problems, students' needs, learning conditions, and the suitability of teaching materials used in momentum and impulse learning. The results of the needs analysis were used as the basis for developing a Dual Space Inquiry-based E-Module.

The document analysis focused on identifying the suitability of teaching materials with curriculum objectives, inquiry learning activities, and the integration of interactive technology in learning. Meanwhile, teacher interviews focused on identifying learning implementation, students' learning difficulties, and teachers' perceptions toward digital learning. Student characteristic questionnaires were conducted to determine students' learning motivation, learning interests, learning styles, and readiness toward digital-based learning.

The research data were analyzed descriptively using qualitative and quantitative approaches. Interview data were analyzed descriptively in a qualitative manner, while document analysis data and student characteristic questionnaire data were analyzed using percentage techniques [14].

The percentage of document analysis results was calculated using the following formula:

$$Persentage\ (\%) = \frac{Obtained\ Score}{Maximum\ Score} \times 100\%$$

Where:

- Percentage (%) = suitability level of document analysis results
- Obtained Score = total score obtained from document assessment
- Maximum Score = highest score of all indicators

Meanwhile, the percentage of student characteristic questionnaire results was calculated using the following formula:

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Where:

- P= percentage
- Σx= total score obtained
- Σx_i= maximum score

The data analysis results were then interpreted descriptively to determine the level of need for developing a *Dual Space Inquiry*-based E-Module on momentum and impulse material.

III. RESULTS AND DISCUSSION

The needs analysis was conducted through document analysis, teacher interviews, and student characteristic questionnaires to identify the conditions of physics learning and the need for developing a Dual Space Inquiry-based E-Module on momentum and impulse material. The results of the needs analysis indicate that physics learning still faces several challenges related to teaching materials, inquiry activities, and interactive digital learning implementation. Based on the document analysis results, the obtained score was 30 out of a maximum score of 65, resulting in a percentage of 46.15%. This finding indicates that the teaching materials used in schools still have limited multimedia integration and have not fully supported inquiry-based learning activities [9].

Similarly, the inquiry stages aspect also obtained a relatively low percentage. This finding indicates that students have not been fully facilitated to engage in scientific investigation activities such as observing phenomena, formulating hypotheses, analyzing data, and drawing conclusions independently. As a result, students tend to rely on memorizing formulas rather than constructing conceptual understanding through inquiry processes. This condition may reduce students' critical thinking skills and conceptual understanding in physics learning. Therefore, inquiry-based learning activities are considered important to support more meaningful and student-centered learning processes [16], [17].

Inquiry-based learning is important in physics education because it encourages students to construct concepts through investigation and scientific reasoning processes. Previous studies also reported that inquiry-based learning can improve students' conceptual understanding, critical thinking skills, and learning engagement in physics learning [16], [17]. Through inquiry activities, students are trained to observe phenomena, formulate hypotheses, analyze data, and draw conclusions independently. Therefore, the integration of inquiry activities into E-Modules is expected to support more meaningful and student-centered learning processes.

The results indicate that the teaching materials used in physics learning still have not optimally supported inquiry-based learning and interactive digital learning implementation. Most teaching materials are still dominated by printed materials that mainly focus on formulas and problem-solving exercises. As a result, students have limited opportunities to conduct scientific investigations and construct conceptual understanding independently. Inquiry activities such as observation, data analysis, and concept reflection have not been fully facilitated in the learning process. Therefore, the development of an interactive E-Module integrated with the Dual Space Inquiry model is considered important to facilitate inquiry activities, concept visualization, and more meaningful learning experiences [15], [16], [17]. The results of the document analysis are presented in Table 1.

Table 1. Results of Document Analysis

Aspects	Percentage (%)
Curriculum suitability	60
Inquiry stages	48
Interactive technology	40

The low percentage in the inquiry stages aspect indicates that students have limited opportunities to conduct scientific investigation activities during learning. Learning activities still focus more on completing exercises and memorizing formulas than on observing phenomena and constructing concepts independently. This condition may reduce students' critical thinking and conceptual understanding in physics learning.

Based on Table 1, the interactive technology aspect obtained the lowest percentage of 40%, while the inquiry stages aspect obtained a percentage of 48%. These findings indicate that the teaching materials used in physics learning still have not optimally supported inquiry-based learning and interactive digital learning.

Teacher interviews showed that students still experienced difficulties in understanding abstract concepts in momentum and impulse material, especially concepts related to force, time interval, and momentum changes in physical events. Learning activities were still dominated by lecture methods and problem-solving exercises, while inquiry-based learning activities had not been implemented optimally. Teachers also stated that interactive digital teaching materials could help students understand concepts more effectively through visualizations, videos, simulations, and inquiry activities [21], [22].

Momentum and impulse material requires students to understand the relationships among force, time interval, velocity, and momentum changes simultaneously. These relationships are often difficult for students because they involve abstract concepts and mathematical representations. As a result, many students tend to memorize formulas without fully understanding the physical meaning behind the equations. This condition may lead to misconceptions and low conceptual understanding in physics learning.

The interview results also revealed that students' difficulties in understanding momentum and impulse concepts were related to the abstract nature of physics concepts. Students often experienced difficulties in connecting mathematical equations with real physical phenomena. This condition causes students to rely more on memorization rather than conceptual understanding.

In addition, teachers stated that students showed greater enthusiasm when learning activities used videos, simulations, and interactive digital media. Visual learning media help students understand momentum and impulse concepts more concretely through moving illustrations and phenomenon visualizations. Multimedia integration in learning activities can help students visualize abstract physics concepts more effectively. Videos, animations, and simulations provide concrete representations of physical phenomena that are difficult to observe directly in classroom learning. Therefore, interactive multimedia presentations are considered important to support students' conceptual understanding and learning engagement. Nevertheless, the use of digital teaching materials in learning activities was still limited due to limited facilities and internet access. The summary of teacher interview results is presented in Table 2.

Table 2. Summary of Teacher Interview Results

No	Question Indicator	Teacher Response
Physics Learning		
1	What are your views and assessments regarding physics learning?	Physics learning is important for developing students' logical thinking and problem-solving skills. However, many students still consider physics difficult because it contains abstract concepts and mathematical calculations.
2	How is the implementation of physics learning in school?	Physics learning has referred to the Merdeka Curriculum through discussions, presentations, and problem-solving activities. However, learning activities are still dominated by teacher explanations.
3	What problems and obstacles are encountered in implementing physics learning?	Students still experience difficulties in understanding momentum and impulse concepts, especially in relating force, impulse, time, and momentum changes.
4	What factors cause the problems and obstacles in physics learning?	The lack of interactive teaching materials and concept visualizations causes students to become less active during learning activities.
Use of Learning Models		
1	What are your views and assessments regarding the learning models used in teaching?	Learning models are very important for increasing students' engagement and conceptual understanding in physics learning.
2	Which learning models are used in physics learning?	The teacher frequently uses discussion, discovery learning, and simple inquiry activities in learning.
3	How are the learning models implemented in the classroom?	Learning activities usually begin with concept explanations, followed by group discussions, problem-solving exercises, and simple experiments.
4	What obstacles are encountered in implementing the learning models?	Limited learning time and students' different learning abilities become obstacles in implementing active learning models.
Teacher Perspective on Digital Learning		
1	What are your views on the development of digital learning?	Digital learning has developed rapidly and helps teachers deliver materials more interactively through videos and simulations.
2	What are your experiences using digital teaching materials in learning?	Students become more interested and enthusiastic when learning uses videos, animations, or simulations compared to printed teaching materials.
3	Which digital teaching materials are considered most effective in learning?	Interactive E-Modules are considered effective because they can integrate materials, videos, simulations, and exercises in one learning media.
4	Have you ever used E-Modules in learning?	The teacher has used simple E-Modules, but their implementation has not been optimal due to limited facilities and internet access.
5	What are the advantages of E-Modules	E-Modules are more interactive, flexible, and capable

compared to printed modules?	of helping students understand abstract physics concepts through multimedia integration.

Based on the interview results, teachers emphasized that students often experience difficulties in connecting mathematical equations with real physical events. Momentum and impulse concepts are considered abstract because students must understand relationships among force, time interval, and momentum changes simultaneously. Therefore, visualizations and simulations are needed to help students understand these concepts more concretely.

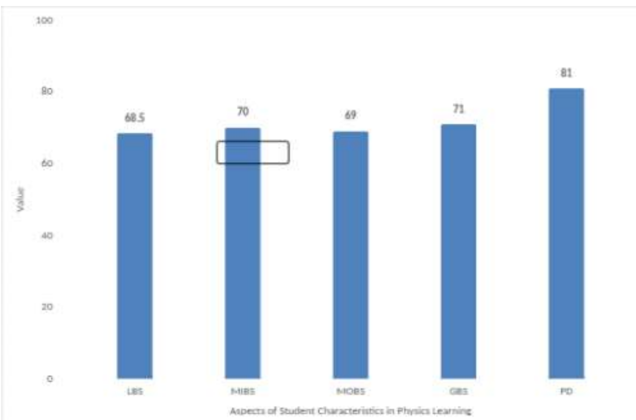
Based on the interview results, physics learning still requires interactive teaching materials capable of facilitating concept visualization and active learning processes. In addition, students need more engaging learning media to help them understand momentum and impulse concepts [18].

The student characteristics questionnaire was conducted to identify students' learning backgrounds, learning interests, learning motivation, learning styles, and perceptions toward digital learning. Based on the questionnaire results, the average score of students' characteristics in physics learning was 71.9. The digital learning aspect obtained the highest percentage of 81, indicating that students are familiar with digital devices and show positive responses toward digital-based learning [19], [20].

The high percentage in the digital learning aspect indicates that students are already accustomed to using technology in their daily learning activities. Most students actively use smartphones and internet platforms to access learning information and multimedia content. This condition shows that students have sufficient readiness toward the implementation of digital-based learning. Therefore, the development of interactive E-Modules integrated with multimedia features is considered suitable for students' learning characteristics in the digital era. Interactive learning media can also support students' motivation, engagement, and conceptual understanding during physics learning activities [19], [20].

Most students frequently use smartphones and digital platforms to access learning information. This condition shows that students have sufficient readiness toward the implementation of digital-based learning. In addition, students showed positive responses toward interactive learning media integrated with videos, animations, and simulations. Interactive multimedia presentations can help students visualize abstract physics concepts more clearly through videos, animations, and simulations. In addition, multimedia-integrated learning activities can increase students' engagement and maintain students' attention during the learning process. Therefore, the development of interactive E-Modules is considered suitable for students' learning characteristics in the digital era.

Meanwhile, the student characteristics analysis showed that students tend to prefer visual learning activities, discussions, and direct learning experiences during physics learning. The learning style aspect obtained a percentage of 71, indicating that students are more interested in interactive and visual-based learning activities. In addition, the learning motivation aspect obtained a percentage of 69, showing that students' motivation in physics learning still needs improvement. These findings indicate that interactive digital teaching materials are needed to support students' learning characteristics and increase learning engagement in physics



learning activities. The results of the student characteristics analysis are presented in Figure 1.

Fig. 1. Results of Student Characteristics Analysis

The high percentage in the digital learning aspect indicates that students are already accustomed to using technology in daily learning activities. Most students actively use smartphones and internet platforms to access learning information. This condition provides strong support for implementing interactive digital teaching materials in physics learning.

The results of the student characteristics analysis indicate that students have sufficient readiness toward digital learning implementation. Students also showed positive responses toward the use of interactive learning media such as videos, animations, and simulations in physics learning activities.

Overall, the results of the needs analysis indicate that physics learning on momentum and impulse material still faces several important challenges. The teaching materials used in learning activities are still dominated by printed materials and have not fully facilitated inquiry activities, concept visualization, and interactive digital learning. In addition, students still experience difficulties in understanding abstract concepts related to momentum and impulse material. These findings indicate that more interactive and student-centered teaching materials are needed to support meaningful physics learning in the digital era [9], [11].

Therefore, the development of an interactive E-Module integrated with the Dual Space Inquiry model is considered necessary to support more meaningful and student-centered physics learning [23]. The integration of inquiry activities and multimedia features is expected to facilitate conceptual understanding, scientific investigation processes, and students' engagement during learning activities. In addition, the developed E-Module is expected to become an alternative teaching material that is relevant to the characteristics of 21st-century learning and current digital learning needs.

The integration of the Dual Space Inquiry model into E-Modules is expected to support conceptual understanding and scientific investigation processes simultaneously. The Dual Space Inquiry model is considered suitable for momentum and impulse material because it facilitates students in connecting mathematical representations with physical phenomena through inquiry activities. Through observation, investigation, data analysis, and concept reflection, students are expected to construct conceptual understanding more meaningfully. In addition, multimedia integration in E-Modules can help students visualize abstract concepts and improve students' engagement during physics learning.

The results of this needs analysis indicate that the development of a Dual Space Inquiry-based E-Module is relevant to current learning conditions and students' needs in physics learning. The integration of inquiry activities and multimedia features is expected to support conceptual understanding, scientific investigation skills, and students' engagement during learning activities. Therefore, the proposed E-Module is expected to become an alternative digital teaching material that supports more interactive, meaningful, and student-centered physics learning.

IV. CONCLUSION

The results of this study indicate that physics learning on momentum and impulse material still requires more interactive and inquiry-based teaching materials to support conceptual understanding and meaningful learning processes.

Therefore, the development of a Dual Space Inquiry-based E-Module is considered relevant to current learning needs. The developed E-Module is expected to support conceptual understanding, scientific investigation activities, learning motivation, and students' engagement through multimedia-integrated learning activities.

The teacher interview results indicated that interactive digital teaching materials are needed to support more meaningful learning processes. Teachers also stated that students showed greater interest and engagement when learning activities used videos, simulations, and interactive learning media. Meanwhile, the student characteristics analysis showed that students had positive responses toward digital learning and were already familiar with digital technology in learning activities.

Based on these findings, the development of a Dual Space Inquiry-based E-Module is considered necessary to support physics learning on momentum and impulse material. The developed E-Module is expected to facilitate concept visualization, scientific investigation activities, and active learning processes to improve students' conceptual understanding and learning engagement.

This study was limited to the needs analysis stage and involved a limited number of participants from one school. Therefore, the findings of this study cannot yet be generalized to broader learning contexts. In addition, this study has not yet examined the validity, practicality, and effectiveness of the proposed E-Module in physics learning activities.

Future studies are recommended to continue the development stage by designing, validating, and implementing the proposed Dual Space Inquiry-based E-Module in physics learning. Further research is also needed to examine the effectiveness of the developed E-Module in improving students’ conceptual understanding, engagement, and inquiry skills on momentum and impulse material.

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REFERENCES

[1] Ramadhani, A. A., & Andriani, A. E. (2024). Development of interactive e-module based on inquiry learning to enhance IPAS learning outcomes for students public elementary school. *Jurnal Pijar Mipa*, *19*(2), 209-215.

[2] Fairuz, T., Kaniawati, I., & Sinaga, P. (2019, February). Integrated science teaching materials oriented on critical thinking skills and information literacy. In *Journal of Physics: Conference Series* (Vol. 1157, No. 2, p. 022037). IOP Publishing.

[3] Asrizal, Amran, A., Ananda, A., Festiyed, & Khairani, S. (2018, April). Effectiveness of integrated science instructional material on pressure in daily life theme to improve digital age literacy of students. In *Journal of Physics: Conference Series* (Vol. 1006, No. 1, p. 012031). IOP Publishing.

[4] Kaniawati, I., Danawan, A., Suyana, I., Samsudin, A., & Suhendi, E. (2021). Implementation of interactive conceptual instruction (ICI) with computer simulation: Impact of students’ misconceptions on momentum and impulse material. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *10*(1), 1-17.

[5] Riduwan. (2012). Skala Pengukuran Variabel-Variabel Penelitian. Bandung: ALFABETA.

[6] Al-Tabany, T. I. B. (2017). Mendesain model pembelajaran inovatif, progresif, dan konteksual. Prenada Media.

[7] Sugiyono. (2013). Metode Penelitian Kuantitatif, Kualitatif Dan R&D. Bandung: ALFABETA.

[8] Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). Instructional Development for Training Teacher of Exeptional Children: A Sourcebook. Minneapolis, Minnesota: Leadership Training Institute/Special Education, University of Minnesota.

[9] Rahmawati, I., Nisrina, N., & Abdani, M. R. (2022). Multi-representation-based interactive physics electronic module as teaching materials in online learning. *Jurnal ilmiah pendidikan fisika Al-Biruni*, *11*(1), 47-55.

[10] Anjarsari, D., Wardani, S., & Tri Prasetya, A. (2023). Development of E-modules to Improve Critical Thinking Skills of Grade IV Elementary School Students. International Journal of Research and Review, 10(1), 553–560. https://doi.org/10.52403/ijrr.20230164

[11] Valfa, Y., Razak, A., Fajrina, S., & Yuniarti, E. (2023). Development of a biology e-module based on google sites on circulatory system and digestive system material. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 52-61.

[12] Asrizal, A., Amran, A., Ananda, A., Festiyed, F., & Sumarmin, R. (2018). The development of integrated science instructional materials to improve students’ digital literacy in scientific approach. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 442-450.

[13] Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of educational technology systems*, *49*(1), 5-22.

[14] Novitra, F. (2021). Development of Online-Based Inquiry Learning Model to Improve 21st-Century Skills of Physics Students in Senior High School. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(9).

[15] Sucilestari, R., Ramdani, A., Sukarso, A. A., Susilawati, S., & Rokhmat, J. (2023). Project-based learning supports students' creative thinking in science education. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 1038-1044.

[16] Soenarko, I. G. K., Purwoko, A. A., & Hadisaputra, S. (2022). The Validity and Reliability of Electronic Studentsâ€™ Worksheet Based on Discovery Learning on Thermochemical Topic. *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, *10*(1), 151-157.

[17] Rahayu, W. P., Zutiasari, I., & Munadhiroh, S. (2021, June). Learning Media of Canva Based on Flipbook in the Subjects of Creative Products and Entrepreneurship to Improve Students' Digital Technopreneurship Competence. In *Sixth Padang International Conference on Economics Education, Economics, Business and Management, Accounting and Entrepreneurship (PICEEBA 2020)* (pp. 220-229). Atlantis Press.
[18] Paidi, P., & Jumadi, J. (2023). Electronic module development science-based learning flipbook theory system breathing in humans for student class VIII SMP/MTs. *Jurnal Penelitian Pendidikan IPA*, *9*(4), 1593-1599.
[19] Pikhart, M., Klimova, B., & Al-Obaydi, L. H. (2024, July). Exploring university students' preferences and satisfaction in utilizing digital tools for foreign language learning. In *Frontiers in Education* (Vol. 9, p. 1412377). Frontiers Media SA.
[20] Ramadhan, W., Meisya, R., Jannah, R., & Putro, K. Z. (2023). E-modul pendidikan pancasila berbasis canva berbantuan flip pdf profesional untuk meningkatkan hasil belajar siswa sekolah dasar. *Jurnal Pemikiran Dan Pengembangan Sekolah Dasar (JP2SD)*, *11*(2), 178-195.
[21] Anggreni, F., & Sari, R. (2022, November). Pendampingan penyusunan e-modul menggunakan aplikasi Heyzine untuk mendukung Program Madrasah Digital. In *The 4th International Conference on University Community Engagement (ICON-UCE 2022)* (Vol. 4, pp. 262-267).
[22] Haniah, H., Mahira, M., & Djuaeni, M. N. (2023). The Development of Interactive E-Book-Based Teaching Materials for Senior High School Students. *Arabiyatuna: Jurnal Bahasa Arab*, *7*(1 May), 53-78.
[23] Hayati, F., Novitra, F., Mufit, F., & Suherman, D. S. (2025). Needs Analysis of Physics E-Modules Based on Dual Space Inquiry Framework to Stimulate Students' Creative Thinking Ability on Static Fluid Material. *Physics Learning and Education*, *3*(3).