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Developing and Validating an Interactive Flipbook E-Book to Foster Critical Thinking in Modern Physics Education

Dewi Hikmah Marisda*
[1] - Doctoral Program in Education, Makassar State University,
Jl. Bonto Langkasa, UNM Gunungsari Baru Campus, Makassar, 90222, Indonesia

[2] - Faculty of Teacher Training and Education, Universitas Muhammadiyah Makassar,
Jl. Sultan Alauddin No. 259 Makassar, 90221, Indonesia
[**Corresponding author*]

Ismail Tolla
Doctoral Program in Education, Makassar State University,
Jl. Bonto Langkasa, UNM Gunungsari Baru Campus, Makassar, 90222, Indonesia

Muhammad Arsyad
Doctoral Program in Education, Makassar State University,
Jl. Bonto Langkasa, UNM Gunungsari Baru Campus, Makassar, 90222, Indonesia

Abstract
The advancement of digital technology has changed education, so innovative learning tools are needed that can improve critical thinking skills. This study uses a descriptive approach that aims to describe the validity of an interactive flipbook-based modern physics e-book in supporting critical thinking skills. The e-book was developed through structured content design, integration of interactive multimedia elements such as video, animation, and simulation, and the addition of exploratory exercises to support active learning. Validation was carried out by experts in the fields of physics, multimedia learning, and educational technology. The content and multimedia aspects were assessed using Aiken's V, with a validity score of 0.93 for both aspects, categorizing the e-book as valid. Validator feedback highlighted the effectiveness of the interactive features and suggested minor revisions to improve navigation and clarity. The results showed that this interactive flipbook-based e-book effectively supports modern physics learning by presenting interesting and relevant materials, in line with the Merdeka Belajar Kampus Merdeka curriculum. This e-book addresses the limitations of traditional teaching materials by integrating dynamic and flexible features that encourage critical thinking skills. This study contributes by presenting an innovative learning tool that has been tested for validity, combining technological advances with educational needs. Further research is recommended to evaluate the impact of e-books on learning outcomes and critical thinking skills in a wider-scale implementation.

Keywords
Critical Thinking Skills, DEWI Model, Development and Validation, Interactive Flipbook E-Book, Modern Physics Education

INTRODUCTION

The rapid advancement of digital technology has changed the way education takes place, offering new opportunities to improve the teaching and learning process. In the context of modern physics education, learning often faces challenges in conveying abstract concepts such as relativity and quantum mechanics to students (Park et al., 2019). These concepts are not only difficult to understand but also require innovative teaching approaches to encourage critical thinking skills (Marisda et al., 2023b; Marisda, Sultan, et al., 2024). As prospective physics teachers, students are not only expected to understand these concepts but also be able to teach them in a relevant and effective way. However, the traditional approach that is still often used tends to focus on memorization and mathematical calculations, thus less facilitating the development of higher-order thinking skills, including critical thinking (Hadi et al., 2018; Marisda, Nurlina, et al., 2024).

The main problem that is the focus of this research is the lack of interactive teaching materials that can meet the needs of modern physics learning. The results of observations show that most of the available modern physics teaching materials, including e-books, only convert printed materials into digital format without utilizing the potential of multimedia technology. This causes learning to be monotonous, less interesting, and not effective enough to improve students' critical thinking skills. In addition, many students have difficulty in accessing teaching materials that are relevant to modern physics courses, either due to limited availability or lack of accessibility to technology-based teaching materials. Therefore, innovation of technology-based teaching materials is needed that not only provides information but is also able to create interactive and constructive learning experiences.

The literature gap that is an important basis in this study reveals that most previous studies on educational e-books have focused on digitizing printed teaching materials without optimizing the available interactive features (Mohd Dahlan et al., 2024). Existing e-books tend to ignore multimedia elements, such as simulations or interactive videos, which can improve understanding of abstract concepts (Asrowi et al., 2019) in modern physics. In addition, only a few studies have integrated a constructivist approach through e-book media to support critical thinking skills-based learning (Djamas et al., 2018; Febliza et al., 2023). The need for an effective technology-based learning approach is becoming increasingly relevant along with the demands of the digital era and 21st-century education. The absence of innovative and integrated solutions emphasizes the need for research that can fill this gap.

This study is also in line with the implementation of the Merdeka Belajar Kampus Merdeka (MBKM) curriculum currently being implemented in Indonesia. This curriculum places students as the center of learning (student-centered learning) by encouraging them to be active and independent in developing high-level thinking skills, including critical thinking (Hunaepi & Suharta, 2024). In the context of MBKM, technology-based teaching materials such as interactive e-books not only support learning flexibility but also enrich students' learning experiences by providing access to relevant, interesting, and easily accessible learning resources (Apoko et al., 2022). With this approach, this study is not only relevant to the challenges of the digital era but also supports the achievement of national education goals carried out by the MBKM curriculum (Purwanti, 2021)

This study offers novelty by developing an interactive flipbook-based e-book that optimally utilizes multimedia technology to support modern physics learning. Different from conventional digital teaching materials, this e-book is designed to present content through a combination of text, images, videos, and interactive simulations, creating a richer learning experience. The flipbook-based approach not only facilitates accessibility but also encourages student involvement in the active learning process (Permata et al., 2021). This study also stands out for its focus on validating content and multimedia aspects using measurable scientific methods, ensuring that the resulting product meets modern pedagogical standards.

The main objective of this study is to develop and validate an interactive flipbook-based e-book designed to support modern physics learning and improve the critical thinking skills of prospective physics teacher students. Specifically, this study aims to produce a valid e-book prototype in terms of content and multimedia and to provide real contributions to providing innovative teaching materials that are relevant to educational needs in the digital era.

MATERIALS AND METHODS

Research Approach

This study uses a descriptive approach with a primary focus on the validation of an interactive flipbook-based modern physics e-book. This approach aims to describe the feasibility and validity of the e-book developed based on the assessment of experts in the fields of physics, multimedia learning, and educational technology. Descriptive research was chosen to provide a systematic overview of the quality of the content and multimedia of the e-book so that it can support the critical thinking skills of prospective physics teacher students. Validation is carried out by measuring the suitability of the content and design of the e-book using measurable scientific methods to ensure its relevance and effectiveness in modern physics learning.

Research Instruments

The research instruments used include expert validation sheets and revision guides. The validation sheet is used to assess the quality of e-book content and multimedia based on certain criteria, such as suitability to learning objectives, material relevance, and interactive design. The revision guide is prepared based on input from validators, which is the basis for refining the e-book prototype.

Data Analysis Technique

The validation results were analyzed using Aiken's V method, which measures the level of validity based on input from experts. The assessment given by experts consists of 4 (four) criteria as follows:

Table 1 Assessment Criteria Given by Experts (validators) (Marisda et al., 2023a)

Value	Description
1	Irrelevant
2	Less relevant
3	Relevant
4	Very relevant

After being assessed by experts, the researcher then calculates the results of the validator's assessment using the following Aiken Validation formula:

$$V = \frac{(\sum S)}{(N(c-1))}, \text{ where } s = r\text{-}l_0 \quad (1)$$

information:

r = rater rating
l_0= low category assessor rating
c = highest category
N = number of respondents (Aiken, 1980)

Furthermore, to determine product feasibility, researchers refer to the Aiken table. Based on the results of the analysis, revisions were made to address the weaknesses identified in the validation. Thus, the validation process not only ensures the feasibility of the product but also improves its quality to meet pedagogical standards (Yusoff, 2019).

RESULTS AND DISCUSSION

The main innovation produced in this study is an interactive flipbook-based e-book. An interactive flipbook is a digital form of a book that provides an experience as if "flipping" pages like a physical book but is equipped with interactive features that are not possible in traditional printed books. This e-book is designed to present information dynamically with the integration of various multimedia elements, such as videos, animations, simulations, and interactive quizzes (Susanto & Lestari, 2020). These features aim to improve student's learning experience through a deeper and more effective understanding of concepts.

The advantages of interactive flipbooks lie in their ease of navigation and flexibility of use (Emilia et al., 2018; Rahayu et al., 2021). Students can explore the content intuitively according to their learning needs, without being limited to a linear sequence like in printed books (Divayana et al., 2019). This provides an opportunity for students to be more independent in accessing information and understanding the material being taught (Andini et al., 2018). In addition, the integration of interactive features allows students not only to read theory but also to directly interact with physics concepts through simulations or other activities that require analysis and application.

In the context of modern physics lectures, this interactive flipbook-based e-book has proven to be relevant to support the development of student's critical thinking skills (Susiaty et al., 2022). This technology not only conveys abstract theories but also creates an interactive and constructive learning environment (Baihaqi et al., 2022). Through the activities provided, students are encouraged to think critically in analyzing and applying modern physics concepts (Marisda, Tolla, et al., 2024; Susanto & Lestari, 2020). Thus, interactive flipbooks are an innovative and effective learning medium to meet the needs of physics education in the digital era.

Modern Physics E-Book Prototype Based on Interactive Flipbook

The modern physics e-book prototype based on an interactive flipbook is an innovative digital learning media designed to support modern physics learning interactively and engagingly. This e-book combines dynamic features such as animation, video, simulation, and interactive quizzes that allow students to not only read the material but also actively participate in learning (Gyllen et al., 2018). Through intuitive and flexible navigation, students can explore the content as needed (Bhimasta & Suprapto, 2016; Mufit et al., 2022), explore abstract concepts such as relativity and quantum mechanics, and develop their critical thinking skills. This prototype is designed to provide a rich learning experience, relevant to the demands of the digital era, and in line with a technology-based learning approach. Some parts of the e-book prototype can be seen in Table 2 below.

Table 2 Display and Description of Modern Physics E-Book Based on Interactive Flipbook

View	Description
 Appearance	This page is a cover view of the modern physics e-book based on an interactive flipbook.

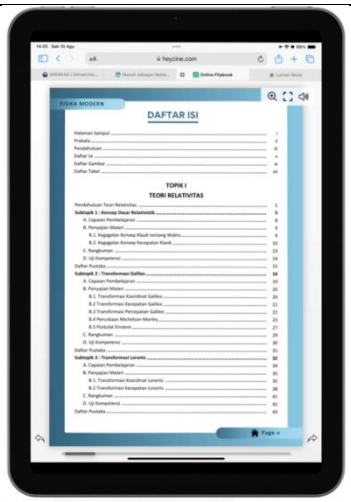

Table of contents view page

The table of contents page contains topics or content in the modern physics e-book. The purpose of having a table of contents in the modern physics e-book based on interactive flipbooks is to provide an overview of the structure and scope of the book's contents, facilitate navigation, help with learning planning, and increase efficiency by making it easier for readers to choose the material page they want to go to.

Teaching materials page

This page contains modern physics content supported by teaching materials in the form of images and videos that are relevant to the learning material, for this page the teaching material is the basic concept of relativity. The display of images and learning videos supports the interactivity of the material presented.

Critical discussion page

This page contains critical discussions that encourage students to think critically.

Book evaluation page

This page contains exercises to test students' understanding of competency for each topic. In addition to presenting questions in the book, quizzes are also presented interactively via barcode. This barcode, if clicked, will direct students to the quiziz page which contains a quiz on understanding the material on that topic.

The appearance of the modern physics e-book based on interactive flipbooks to improve critical thinking skills can be accessed not only via tablets as in Table 2 above, but also on smartphones and computers (laptops).

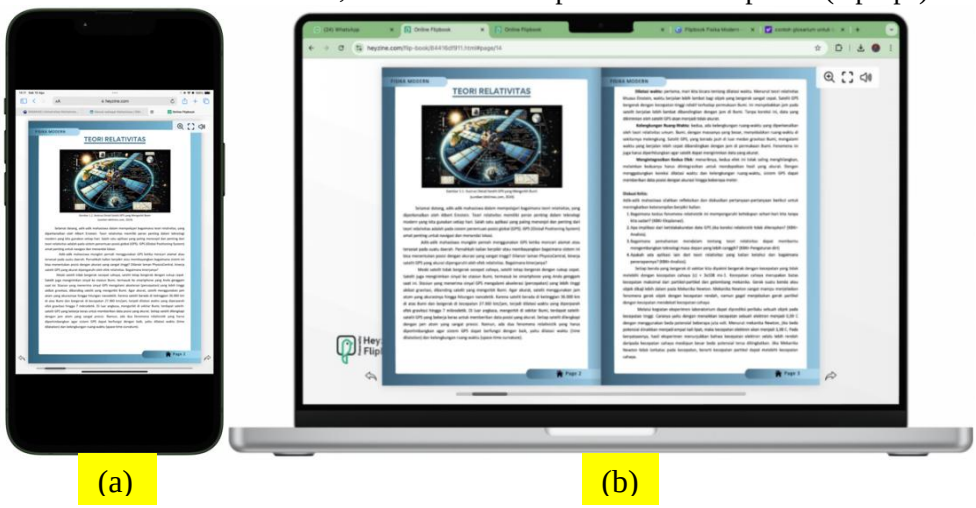

Fig.1 Display of material on (a) smartphone; and (b) computer (laptop)

Validation Results of Modern Physics E-Books Based on Interactive Flipbooks

One of the important stages in the development of learning devices is the validation stage (Leite et al., 2018; Lichtenberger et al., 2017). The validation stage of the developed product is very necessary to test the validity of modern physics e-books based on interactive flipbooks. The validation carried out in this study is content validity. The content validity of the developed product uses validator (expert) assessments. Expert validation was chosen because the instrument is considered reliable if the experts state that the instrument is appropriate for measuring the intended research variables (Rahmawati et al., 2018). Validation was carried out by five validators on the materials and multimedia of the developed e-books. The results of the content validity analysis based on expert assessments are presented in Table 2.

Table 2 Table 2 Summary Results of Aiken Validation Analysis on Modern Physics E-Books Based on Interactive Flipbooks

Assessment	Number of Validator	V_{count}	V_{table}	Conclusion
Material Aspect of e-book	4	0,93	0,92	Valid
Multimedia Aspect of e-book	5	0,93	0,88	Valid

Table 2 shows the recapitulation results of the validation analysis of the Aiken method on modern physics e-books based on interactive flipbooks. Each aspect is assessed using the Aiken formula to calculate the validity value (Vcount), which is then compared with the critical table value (V_{table}).

Based on the analysis results, the Vcount value for the e-book material aspect is 0.93, which is higher than the Vtable of 0.92, so it is declared valid. Similar things were also found in the multimedia aspect of the e-book, where the Vcount value is 0.93, which also exceeds the Vtable value of 0.88, so this aspect is also declared valid. Thus, both validated aspects, both material and multimedia, meet the validity criteria and can be used as part of an interactive flipbook-based e-book to support modern physics learning.

In addition to quantitative data analysis based on the assessment of validators (experts), validators also provide comments and suggestions to improve the developed product (Mulhayatiah et al., 2022). These comments cover aspects of physics content, critical thinking skills assessment, interactive multimedia, accessibility and language, while suggestions focus on improving content quality, multimedia clarity, and optimizing interactive features. These inputs are the basis for revising the product so that it can meet the expected pedagogical standards and increase the attractiveness and effectiveness of e-books in supporting the learning process. These suggestions and comments are presented in Table 3 below;

Table 3 Validator Comments and Suggestions on the Assessment of Modern Physics E-Book Material Based on Interactive Flipbooks to Improve Critical Thinking Skills

Validators and Aspects Commented	Comments and Improvement Suggestions	Improvement Results
Physics Field (Physics Content)	- Modern physics materials already cover core topics such as relativity, wave-particle dualism, and atomic structure. The presentation is coherent and follows the development of physics. - Add more examples of applications of modern physics concepts in real life, such as GPS in the	Adding application examples such as an explanation of GPS utilizing relativity, and illustrations of each key concept to strengthen students' understanding of the relevance of theory to the real world.

	theory of relativity, to help students understand the relevance of the material.	
Assessment and Evaluation of Learning (Critical Thinking Skills Assessment)	- The material is appropriate for training critical thinking skills. The structure of the practice questions is good but needs reinforcement to ensure students' in-depth understanding. - Add more varied exploratory questions at the end of each topic so that students can develop their analytical and reflective skills. For example, questions that invite students to evaluate classical and modern physics theories.	Added exploratory questions at the end of each topic with an analytical and reflective approach. These questions are designed to encourage students to evaluate and compare classical and modern concepts, enhancing students' critical thinking skills.
Physics Learning Multimedia (Interactive Multimedia)	- This e-book already has interesting multimedia elements, such as simulations and videos. However, navigation between pages and interactive elements need to be made more accessible.	-
Physics Field (Accessibility and Language)	- The language used in the e-book is quite easy to understand, but some scientific terms need to be included in the glossary. In addition, accessibility on various devices needs to be tested. - The material has been compiled comprehensively and from credible reference sources.	-

Table 3 summarizes the comments and suggestions from the validators and the results of improvements made to the modern physics e-book based on interactive flipbooks to improve students' critical thinking skills. The validators consist of four main assessment aspects: physics content, critical thinking skills assessment, interactive multimedia, and accessibility and language.

In terms of physics content, the validator stated that modern physics material has covered core topics such as relativity, wave-particle dualism, and atomic structure, with a coherent presentation according to the development of physics. However, the validator suggested adding more examples of applications of modern physics concepts in real life, such as an explanation of GPS based on the theory of relativity, to help students understand the relevance of the material. This comment is in line with Lopez's research which also examines the use of computer simulations as teaching materials for modern physics (J.A.Lopez et al., 2018). As a result of the improvements, the e-book added application examples and illustrations to each main concept to strengthen students' understanding of the relevance of physics theory in the real world.

In the aspect of critical thinking skills assessment, the validator stated that the question structure was appropriate for training critical thinking skills, but it was necessary to add exploratory questions with wider variations. The validator suggested questions that encourage students to evaluate classical and modern physics theories to improve analytical and reflective skills. This is by Quinn, Wieman, and Holmes (2018) who also emphasized the importance of critical thinking orientation in the context of physics learning, which can be reflected through physics data in exploratory questions (Quinn et al., 2018). As a follow-up, the e-book was improved by adding exploratory questions at the end of each topic, which were designed to help students compare classical and modern physics concepts, as well as improve critical thinking skills.

For the interactive multimedia aspect, the validators appreciated the multimedia elements in the e-book, such as simulations and videos, which were considered interesting. However, they suggested improvements in navigation between pages and interactive elements to make them more accessible. The validator's comments are by the research of Gunturu et al. (2024) which paid attention to improvements in terms of navigation and interactive elements in Physics learning devices (Gunturu et al., 2024). Improvements in this aspect are aimed at improving the overall user experience.

In terms of accessibility and language, the validator stated that the language in the e-book was quite easy to understand, but suggested adding a glossary for certain scientific terms. This is intended so that the teaching materials are easily accessible and understood by students through clear and structured language (Gerhart et al., 2017). In addition, accessibility on various devices also needs to be tested to ensure that the e-book can be optimally accessed by students. The validator also noted that the material has been compiled comprehensively and based on credible sources.

In addition to providing suggestions and comments on the material aspects of the modern physics e-book, the validators also provided notes and input related to the multimedia aspects of the e-book. These notes and comments aim to improve the quality of interactivity, navigation, and multimedia elements in the e-book to more effectively support modern physics learning. The results of the validator's assessment of the multimedia aspects of the e-book can be seen in Table 4 below.

Table 4 Recapitulation of Comments, Validator Suggestions, and Improvement Results

Validators and Commented Aspects	Comments and Suggestions	Improvement Results
	Physics Field	
General View	- The design is attractive, but the numbering system needs to be improved to be neater. - Improve the numbering system in each section to be more consistent and neat.	The numbering system has been revised for consistency across all parts of the e-book.
Completeness of Learning Resources	- The e-book is complete with practice questions, bibliography, and video clips.	No repairs required.
	Physics Education Field (Learning Assessment and Evaluation)	
General View	- The font type and size are clear and easy to read, but emphasis variations (bold, italic) need to be considered for important terms. - Use emphasis variations such as bold or italic for important terms to make them stand out more.	Add variations in letter emphasis for important terms to make them easier for students to recognize.
	Physics Education Field (Multimedia Physics Learning)	
General View	- Videos and animations already support the content, but some videos are still unclear in quality.	No repairs required
Completeness of Learning Resources	- The e-book is equipped with video displays and practice questions on each topic, helping students understand the material.	No repairs required
	Educational Technology Field	
General Presentation	- The presentation of the material is simple and clear, but the e-book can be more effective with the addition of interactivity in each section for student engagement. - Add interactive elements, such as short quizzes within the e-book to strengthen student engagement.	Adding interactive elements in the form of short quizzes in several sections to increase student engagement in learning.
General View	- The e-book design is attractive and has appeal, but some images need to be clarified to make the information easier to understand.. - Clarify the quality of less sharp images, especially images that explain important concepts.	Images updated to be clearer and easier to understand, especially those explaining important concepts.
Layout Placement and Appearance	- Margins and layout are proportional, but page numbering needs to be adjusted to textbook standards. - Adjust page numbering to recognized standards for textbooks.	Page numbering has been adjusted to textbook standards to improve the professionalism of the appearance.
	Physics Field	
Appearance	- The presentation of the material is simple and clear. The barcode on the material is functioning well.	No repairs required

Table 4 presents a recapitulation of comments, suggestions, and improvement results from the validators on the multimedia aspects and general appearance of the modern physics e-book based on interactive flipbooks. The validators provided assessments in several areas, namely physics, physics education, physics learning multimedia, and educational technology.

In the field of physics, the validator highlighted the importance of improving the page numbering system to ensure consistency across all parts of the e-book. The validator also noted that the e-book has been equipped with practice questions, a bibliography, and video clips that support the completeness of the learning resources. As a follow-up, the page numbering system has been improved to improve the neatness and professionalism of the e-book's appearance. In the field of physics education, especially in the aspect of assessment and evaluation of learning, the validator provided input to add variations in letter emphasis, such as the use of bold and italics for important terms. This aims to make it easier for students to recognize important terms in the material. This input has been accommodated by adding variations in letter emphasis to the e-book.

For the multimedia field of physics learning, the validator stated that e-books already support learning through multimedia elements, such as videos and animations, which complement the content and help students understand the material. However, some videos are considered to require improvement in visual quality. This is in line with the research of Dunser et al. (2012) which emphasizes the importance of visual quality in improving the understanding of physics

concepts through interactive materials (Dünser et al., 2012). However, no additional improvements are needed for the multimedia aspect because the existing elements are considered sufficient to support learning.

In the field of educational technology, the validator provided several important notes, especially on the general presentation, design, and layout. The validator suggested adding interactive elements, such as short quizzes, to increase student engagement. In addition, some images in the e-book require quality improvement to be clearer and easier to understand, especially images that explain important concepts. Page numbering is also recommended to be adjusted to textbook standards. The study by Zainuddin et al. (2019) showed that interactive elements, such as quizzes and good visuals, can increase student engagement and understanding (Zainuddin et al., 2019). As a follow-up, interactive elements have been added, images updated, and page numbering adjusted to textbook standards to improve the professionalism of the appearance.

CONCLUSION

This study successfully developed and validated a prototype of an interactive flipbook-based modern physics e-book designed to support modern physics learning and improve critical thinking skills of prospective physics teacher students. Validation was carried out by experts from various fields, including physics content, learning multimedia, and educational technology. The validation results showed that this e-book was valid in terms of content and multimedia, with an Aiken's V value of 0.93 for both aspects. This e-book is also equipped with multimedia elements, such as videos, animations, and interactive simulations, as well as exploratory questions to support student analysis and reflection.

The main findings of this study indicate that an interactive flipbook-based e-book is not only able to present material in an interesting and interactive way, but is also relevant to the demands of 21st-century learning and the Merdeka Belajar Kampus Merdeka (MBKM) curriculum. This product provides a solution to the limitations of traditional teaching materials in facilitating modern physics learning.

This study contributes to the literature by presenting innovative technology-based learning media. Its practical implications include the use of this e-book to support independent and collaborative learning. Further research is recommended to evaluate the effectiveness of e-books on a large scale, including an analysis of their impact on improving student learning outcomes and critical thinking skills**.**

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DECLARATION OF CONFLICT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

1. Aiken, L. R. (1980). Content validity and reliability of single items or questionnaires. *Educational and Psychological Measurement*, *40*(4), 955–959. https://doi.org/10.1177/001316448004000419
2. Andini, S., Budiyono, & Fitriana, L. (2018). Developing flipbook multimedia: The achievement of informal deductive thinking level. *Journal on Mathematics Education*, *9*(2), 227–238. https://doi.org/10.22342/jme.9.2.5396.227-238
3. Apoko, T. W., Hendriana, B., Umam, K., Handayani, I., & Supandi. (2022). The Implementation of Merdeka Belajar Kampus Merdeka Policy: Students' Awareness, Participation, and its Impact. *Journal of Education Research and Evaluation*, *6*(4), 759–772. https://doi.org/10.23887/jere.v6i4.48040
4. Asrowi, Hadaya, A., & Hanif, M. (2019). The impact of using the interactive e-book on students' learning outcomes. *International Journal of Instruction*, *12*(2), 709–722. https://doi.org/10.29333/iji.2019.12245a
5. Baihaqi, H. K., Purwaningsih, E., Sulur, S., & Sutopo, S. (2022). Development of Physics E-book Based on Technological Pedagogical Content Knowledge (TPACK) on Thermodynamic Laws Topic. *Jurnal Pendidikan Fisika Indonesia*, *18*(1), 67–74. https://doi.org/10.15294/jpfi.v18i1.28924
6. Bhimasta, R. A., & Suprapto, B. (2016). An empirical investigation of student adoption model toward mobile e-textbook: Utaut2 and ttf model. *ACM International Conference Proceeding Series*, *November*, 167–173. https://doi.org/10.1145/3018009.3018046
7. Divayana, D. G. H., Suyasa, P. W. A., Ariawan, I. P. W., Mahendra, I. W. E., & Sugiharni, G. A. D. (2019). The Design of Digital Book Content for Assessment and Evaluation Courses by Adopting Superitem Concept Based on Kvisoft Flipbook Maker in era of Industry 4.0. *Journal of Physics: Conference Series*, *1165*(1), 12020. https://doi.org/10.1088/1742-6596/1165/1/012020

8. Djamas, D., Tinedi, V., & Yohandri. (2018). Development of interactive multimedia learning materials for improving critical thinking skills. *International Journal of Information and Communication Technology Education*, *14*(4), 66–84. https://doi.org/10.4018/IJICTE.2018100105
9. Dünser, A., Walker, L., Horner, H., & Bentall, D. (2012). Creating interactive physics education books with augmented reality. *Proceedings of the 24th Australian Computer-Human Interaction Conference, OzCHI 2012*, *November*, 107–114. https://doi.org/10.1145/2414536.2414554
10. Emilia, D. P. S., Hidayat, S., & Indawan. (2018). Needs Analysis for Development of Interactive Electronic textbooks Based (IETB) on Kvisoft Flipbook Maker Applications Integrated with Islamic Values. *Jurnal Pendidikan Biologi*, *8*(1), 36–45.
11. Febliza, A., Afdal, Z., & Copriady, J. (2023). Improving Students' Critical Thinking Skills: Is Interactive Video and Interactive Web Module Beneficial? *International Journal of Interactive Mobile Technologies*, *17*(3), 70–86. https://doi.org/10.3991/ijim.v17i03.34699
12. Gerhart, N., Peak, D., & Prybutok, V. R. (2017). Encouraging E-Textbook Adoption: Merging Two Models. *Decision Sciences Journal of Innovative Education*, *15*(2), 191–218. https://doi.org/10.1111/dsji.12126
13. Gunturu, A., Wen, Y., Thundathil, J., Zhang, N., & ... (2024). Augmented Physics: A Machine Learning-Powered Tool for Creating Interactive Physics Simulations from Static Diagrams. *ArXiv Preprint ArXiv …*. https://doi.org/10.1145/3654777.3676392
14. Gyllen, J., Stahovich, T., & Mayer, R. (2018). How students read an e-textbook in an engineering course. *Journal of Computer Assisted Learning*, *34*(6), 701–712. https://doi.org/10.1111/jcal.12277
15. Hadi, S. A., Susantini, E., & Agustini, R. (2018). Training of Students' Critical Thinking Skills through the implementation of a Modified Free Inquiry Model. *Journal of Physics: Conference Series*, *947*(1). https://doi.org/10.1088/1742-6596/947/1/012063
16. Hunaepi, & Suharta, I. G. P. (2024). Transforming Education in Indonesia: The Impact and Challenges of the Merdeka Belajar Curriculum. *Path of Science*, *10*(6), 5026–5039. https://doi.org/10.22178/pos.105-31
17. J.A.Lopez, M.Suskavcevic, & C.Velasco. (2018). Modern Physics Simulations. *Computers in Physics*, *10*(3), 256. https://doi.org/10.1063/1.4822394
18. Leite, S. de S., Áfio, A. C. E., Carvalho, L. V. de, Silva, J. M. da, Almeida, P. C. de, & Pagliuca, L. M. F. (2018). Construction and validation of an Educational Content Validation Instrument in Health. *Revista Brasileira de Enfermagem*, *71*(suppl 4), 1635–1641. https://doi.org/10.1590/0034-7167-2017-0648
19. Lichtenberger, A., Wagner, C., Hofer, S. I., Stern, E., & Vaterlaus, A. (2017). Validation and structural analysis of the kinematics concept test. *Physical Review Physics Education Research*, *13*(1). https://doi.org/10.1103/PhysRevPhysEducRes.13.010115
20. Marisda, D. H., Nurlina, N., Maruf, M., Rahmawati, R., Idamayanti, R., & Akbar, M. (2024). Challenges in secondary school education: profile of physics students' critical thinking skills. *Journal of Education and Learning (EduLearn)*, *18*(3), 1091–1098. https://doi.org/10.11591/edulearn.v18i3.21666
21. Marisda, D. H., Sultan, A. D., Basri, S., & Sakti, I. (2023a). *Development of Practical Photoelectric Effect Based on Arduino Uno : Instrument Validation Analysis*. *12*(4), 444–452.
22. Marisda, D. H., Sultan, A. D., Basri, S., & Sakti, I. (2023b). Digital-Based Photoelectric Effect Curriculum and Student Analysis Practicum Toolkit : *Journal of Research in Science Education*, *9*(11), 9410–9415. https://doi.org/10.29303/jppipa.v9i11.5014
23. Marisda, D. H., Sultan, A. D., Basri, S., Sakti, I., Nurjannah, & Aprilia, M. S. (2024). Design of Digital-Based Photoelectric Effect Practicum Devices. *Proceedings of the 9th Mathematics, Science, and Computer Science Education International Seminar (MSCEIS 2023), Advances in Social Science, Education and Humanities Research 860, Msceis*, 159–167. https://doi.org/10.2991/978-2-38476-283-5_16
24. Marisda, D. H., Tolla, I., & Arsyad, M. (2024). Trends in the Development of Interactive Flipbooks in Physics Learning in the 2014-2024 Time Range : Literature Review. *International Journal of Current Science Research and Review*, *07*(11), 8429–8435. https://doi.org/10.47191/ijcsrr/V7-i11-29
25. Mohd Dahlan, M., Sabri, S., Mohtaram, S., Kamarudin, N. S., Syazana, F., & Ahmad, Z. (2024). Empowering Learning: The Impact Of Interactive Ebooks. *Theory And Practice*, *2024*(5), 12231–12237. https://doi.org/10.53555/kuey.v30i5.5079
26. Mufit, F., Asrizal, Puspitasari, R., & Annisa. (2022). Cognitive Conflict-Based E-Book With Real Experiment Video Analysis Integration To Enhance Conceptual Understanding of Motion Kinematics. *Jurnal Pendidikan IPA Indonesia*, *11*(4), 626–639. https://doi.org/10.15294/jpii.v11i4.39333
27. Mulhayatiah, D., Sinaga, P., Rusdiana, D., Kaniawati, I., & Junissetiawati, D. (2022). Modern Physics E-book Based Multirepresentation for Hybrid Learning. *European Online Journal of Natural and Social Sciences*, *11*(4), 1166–1177. http://www.european-science.com
28. Park, W., Yang, S., & Song, J. (2019). When Modern Physics Meets Nature of Science: The Representation of Nature of Science in General Relativity in New Korean Physics Textbooks. *Science and Education*, *28*(9–10), 1055–1083. https://doi.org/10.1007/s11191-019-00075-9
29. Permata, M. D., Safitri, A., & Jumadi. (2021). Developing an E-Module Physics-Based Kvisoft Flipbook Maker to Enhance the Concept of Understanding for the Senior High School Student. *Proceedings of the 6th*

International Seminar on Science Education (ISSE 2020), *541*(Isse 2020), 495–501. https://doi.org/10.2991/assehr.k.210326.071
30. Purwanti, E. (2021). *Preparing the Implementation of Merdeka Belajar – Kampus Merdeka Policy in Higher Education Institutions* . *518*(ICoSIHESS 2020), 384–391. https://doi.org/10.2991/assehr.k.210120.149
31. Quinn, K. N., Wieman, C. E., & Holmes, N. G. (2018). *Interview Validation of the Physics Lab Inventory of Critical thinking (PLIC)*. *2*, 324–327. https://doi.org/10.1119/perc.2017.pr.076
32. Rahayu, W. P., Zutiasari, I., & Munadhiroh, S. (2021). Learning Media of Canva Based on Flipbook in the Subjects of Creative Products and Entrepreneurship to Improve Students' Digital Technopreneurship Competence. *Proceedings of the Sixth Padang International Conference On Economics Education, Economics, Business and Management, Accounting and Entrepreneurship (PICEEBA 2020)*, *179*(Piceeba 2020), 220–229. https://doi.org/10.2991/aebmr.k.210616.033
33. Rahmawati, Rustaman, N. Y., Hamidah, I., & Rusdiana, D. (2018). The development and validation of conceptual knowledge test to evaluate conceptual knowledge of physics prospective teachers on electricity and magnetism topic. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 483–490. https://doi.org/10.15294/jpii.v7i4.13490
34. Susanto, R., & Lestari, E. S. (2020). The Effect Of Flipbook-Based Field Teaching Materials With Anchored Instruction Model To Improve Students' Critical Thinking Skills. *European Journal of Education Studies*, *7*(12), 642–652. https://doi.org/10.46827/ejes.v7i12.3475
35. Susiaty, U. D., Oktaviana, D., & Firdaus, M. (2022). Development of College Student Analytical Thinking Skills Through Evaluation Learning with Flip Book Assisted E-Books. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *13*(2), 283–295. https://doi.org/10.15294/kreano.v13i2.38050
36. Yusoff, M. S. B. (2019). ABC of Content Validation and Content Validity Index Calculation. *Education in Medicine Journal*, *11*(2), 49–54. https://doi.org/10.21315/eimj2019.11.2.6
37. Zainuddin, Hasanah, A. R., Salam, M. A., Misbah, & Mahtari, S. (2019). Developing the interactive multimedia in physics learning. *Journal of Physics: Conference Series*, *1171*(1), 12–17. https://doi.org/10.1088/1742-6596/1171/1/012019