P-ISSN: 1693-1246
E-ISSN: 2355-3812
June 2025

Jurnal Pendidikan Fisika Indonesia 21 (1) (2025) 109-128
DOI: 10.15294/jpfi.v21i1.9495

http://journal.unnes.ac.id/journals/jpfi

A Differentiated Instruction-Oriented Physics e-Module: Development and Its Impact on Conceptual Understanding

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Received: 25 February 2025. Accepted: 30 April 2025. Published: 12 June 2025

Abstrak

Based on observations conducted at a senior high school in Medan, the previously utilized e-module proved to be underexploited, primarily due to its limited format, comprising static text, images, and video links, which failed to accommodate the varied learning preferences of students. This misalignment contributed to low impact on learning outcomes, particularly in Work and Energy. The present study sought to design a differentiated-instruction-based e-module that is pedagogically valid, practically feasible, and demonstrably effective in fostering conceptual understanding. Employing a Research and Development (R&D) framework grounded in the 4-D model (Define, Design, Develop, Disseminate), data were gathered through expert validation instruments, response questionnaires, and achievement tests. Subject matter experts rated the module highly valid, while media specialists deemed it moderately valid. Teacher feedback and field trials affirmed its practical applicability. N-gain analysis of pretest–posttest results indicated substantial learning gains. The findings underscore the module's efficacy and pedagogical value in delivering structured, engaging, and accessible instruction.

Keywords: physics e-module, differentiated approach, concept understanding

INTRODUCTION

A flexible, innovative, and goal-oriented learning approach aims to create a structured learning environment where students feel motivated and actively engage in developing their potential. Learning outcomes are more likely to be achieved when both teachers and students are well-prepared and maintain effective interaction during the learning process, as communication between teachers and students plays a key role in supporting successful instruction (Salsabila, Agustin, Lestari, & Anshori, 2023). The learning process in schools, which supports the delivery of education and fosters the development of students' potential, is increasingly inseparable from the role of digital technology in education (Yudhistira, Rifaldi, & Satriya, 2020; Haleem, Javaid, Qadri, & Suman, 2022). The digitalization of the education system serves to coordinate all educational components to adapt to the pace of ongoing technological advancement (Barz, Benick, Dörrenbächer-Ulrich, & Perels, 2024; Rahayu, Putri, & Risdinato, 2021). Integrating technology in education involves incorporating innovative tools into teaching and learning activities (Winter, Costello, O'Brien, & Hickey, 2021; Marryono, 2018). Furthermore, the use of technological devices continues to evolve and can be leveraged as instructional tools, particularly in e-modules (Putri, Risdianto, & Rohadi, 2019). Technology enables broader access to learning resources and can support students in learning in ways that are better aligned with their individual needs, especially when paired with appropriate instructional approaches.

One such level of understanding is concept understanding, which is defined as the utilization of appropriate concepts in problem-solving (Rahayu & Pujiastuti, 2018). Concept understanding is defined as the ability of students to re-express what has been communicated to them, use concepts in a variety of different situations, and develop several consequences of a concept (Mi, Zong, Yang, & Gui, 2024; Harefa & Telaumbanua, 2020). Concept understanding is a critical learning component, enabling students to develop competencies in various subjects (Batlolona, Jamaludin, & Kalean, 2023; Yuliani, Zulfah, & Zulhendri, 2018). Conversely, the findings of the research conducted by Wicaksono, Chasana, & Sukoco (2021) demonstrate that students' comprehension and assimilation of information are influenced by variations in their learning styles, which can be categorized as visual (through images), auditory (through hearing), reading/writing (through text), and kinesthetic (through hands-on practice) (Rosidah, Mudzanatun, & Nuvitalia, 2022).

Teaching materials that are sufficient and can add to the learning experience are teaching materials that are by the student's personality, adapted to the tendencies and experiences that students often do, straightforward, according to the demands of the education program (curriculum) (Magdalena, Prabandani, Rini, Fitraini, & Putri, 2020). One of the Works to improve learning quality is using appropriate teaching materials (Suratmi, Laihat, & Santri, 2018). The form of teaching materials can be realized in a digital technology product that can adapt to the needs of students such as teaching materials that suit diverse learning styles (visual, auditory, kinesthetic, or mixed) so that digital teaching materials need to adjust their format (text, images, videos, or interactive) (Puspitasari, 2019).

Based on observations at SMA Dharma Pancasila Medan, the questionnaire results show that students rarely ask questions during teaching and learning activities, teaching materials have not been tailored to students' needs, and most teaching materials are printed books provided by the school. Another problem in the field is that teachers assume students have the same understanding abilities and learning style needs.

Based on the problems obtained, a solution is needed to overcome the problem. The solution offered is to develop teaching materials in the form of e-Modules based on a differentiated approach to improve students' concept understanding. Differentiated learning is an attempt to adjust the learning process in the classroom to meet the individual learning needs of each student (Tomlinson, 2001). While Rusmiyati (2024) and VanTassel-Baska (2012) stated that the description of differentiated learning is specific to each domain in education, where differentiation means adjusting teaching to meet the needs of specific students and the way they learn. It is concluded that differentiated learning requires adjustments not only limited to teaching methods, but also includes the learning media used, such as e-Modules.

E-Modules are electronic learning materials prepared by teachers to be studied by students independently and presented in a structured manner (Ayani, Sundari, & Sari, 2023). E-Modules are educational, independent, versatile, and easy to understand. They can also contain one learning asset to assist students in learning by handling and combining different approaches and strategies, such as original practices and guides to make learning more meaningful (Wulansari, Kantun, & Suharso, 2018). The characteristics of e-Modules are clear instructions (self-instruction), independent learning materials (self-contained), independent of other learning resources (stand-alone), adaptable (adaptive), and easy to use by users (user-friendly) (Kurniawan & Piyana, 2020).

Physics e-Modules based on a differentiated approach increase student involvement in learning. By utilizing digital technology, this e-Module allows the delivery of material that is more interactive, interesting, and easily accessible to students, so it is expected to improve their learning outcomes (Mayer, 2009).

Developing teaching materials in differentiated e-Modules has not been widely carried out. Among these studies were those conducted by Pohan & Harahap (2023), Astiti, Supu, Sukarjita, & Lantik (2021), and Fatmianeri, Hidayanto, & Susanto (2021). However, no one has developed an e-Module based on a differentiated approach focusing on student learning styles. The difference between relevant research and this research lies in the object studied. The implementation of differentiated learning is realized in learning activities that provide media and learning resources according to the type and learning style of students (Nepal, Walker, & Dillon-Wallace, 2021), in the results of Marlina's research (2022) also stated that the teaching module based on the differentiation of the independent curriculum on scientific work measurement material has been prepared with sufficient validity and practicality so that it deserves to be used in the high school physics learning process.

The results of Astiti, Supu, Sukarjita, and Lantik (2021) and Mujiatun, Handayani, and Rakhmawati (2023) prove that students can more easily meet their learning needs with differentiated lessons. In addition, the research results of Fitra (2022), Estuhono, Aditya, and Asmara (2023), as well as Gusteti and Neviyarni (2022) also prove that in terms of content, process, and product, the differentiated learning approach encourages students to be actively involved during the learning process. In addition, differentiated learning can meet the needs by considering students' interests, learning styles, profiles, and learning readiness (Arumsari & Susanti, 2024). Based on the literature review that has been conducted, e-Modules using a differentiated approach are very effective in improving students' understanding of concepts because e-Modules can adjust to the interests, learning styles and readiness of students which have an effect on increasing students' understanding of concepts, which is also supported by the results of research by Elisa et al (2023) which states that the development of e-Modules based on differentiated learning can improve students' understanding of concepts.

Therefore, this study aims to develop a physics e-Module based on a differentiated approach to produce teaching materials in the form of e-Modules based on a differentiated approach to the material of Work and Energy that are feasible, practical, and effective to improve students' concept understanding.

METHOD

The research conducted is a type of R&D (Research and Development) that uses the 4D model, which consists of four main stages, namely define, design, develop, and disseminate (Thiagrajan, 1974), because the 4D development model is used to develop various types of learning media (Arkadiantika, Ramansyah, Effindi, & Dellia, 2020) and does not take a long time because the stages are relatively not too complicated (Riani, Iriani, & Maulana, 2023). The stages of the 4D model used are presented in Figure 1.

This study analyzed the data using descriptive and quantitative analysis techniques. Descriptive analysis techniques in research using two techniques: a) Qualitative descriptive analysis obtained from the score of expert validation results (Material and Media), the results of teacher and student responses, and qualitative tests in the form of comments in the questionnaire. The results of the analysis were used to revise the development product. (b) Quantitative descriptive statistics in the form of percentages are used for data processing. The percentage technique presents the data in the form of the frequency of responses from the test subjects, validation, and effectiveness tests of the differentiation-based physics e-module products.

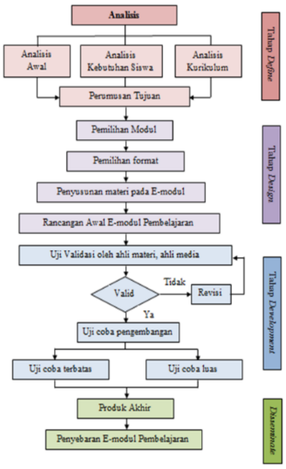


Figure 1. Flowchart of research and development of the 4D model

The data collection technique in this study is a questionnaire in the form of questions given to each of the two expert validators, namely material experts and media experts with the assessment criteria Very Unfeasible (STL), Unfeasible (TL), Quite Feasible (CL), Feasible (L), Very Feasible (SL) presented in Table 1.

Table 1. Indicators and Material Expert Validation Grid (Mario, Muhdi, & Ahmad, 2021)

Aspects assessed	Indicators	Number of Items
Aspects of Content Appropriateness	A. Suitability of material with Basic Competencies	3
	B. The accuracy of the material	7
	C. The currency of the material	4
	D. Encourages curiosity	2
Presentation feasibility aspect	A. Presentation technique	2
	B. Supporting presentation	6
	C. Presentation of learning	1
	D. Coherence and flow	2

Table 2. Indicators and Media Expert Validation Grid (Ningtyas & Rahmawati, 2023)

Aspects assessed	Indicators	Number of items
Feasibility of Graphic	A. Size of e-module	2
	B. Design cover	7
	C. Design of e-Module	12
Aspects of Language Appropriateness	A. Straightforward	3
	B. Communicative	1
	C. Dialogical and interactive	2
	D. Appropriateness of language	2
	E. Appropriateness of symbol terms	2

Per the validation results through expert lecturers, each aspect will be assessed using a Likert scale score. The formula for determining the final score is as follows:

$$\bar{X} = \frac{\Sigma x}{n}$$

The general assessment of the item set ((X̅)) is determined by the sum of the scores (Σx) and the number of items (n). Aiken's validity index determines content validity based on the agreement of expert validators. The formula used to calculate it is as follows:

$$V = \frac{\Sigma s}{n(c-1)}$$

where,
V: V-Aikens' index
s: the score given to each rater minus the lowest score in the category used $(s = r - lo)$
r: score given by the validator
lo: lowest score
c: highest score
n: number of validators

After the validator has completed the assessment on the validation sheet, the Aiken's V coefficient value will be obtained for each aspect assessed. In this assessment, there are two assessors with five rating scales. The criteria used to declare a question item valid, according to Aiken, the Aiken index must have a V value ranging from 0 to 1. A question is valid if it meets the validation value requirements that depend on the number of assessors/experts and the assessment category (Aiken, 1985).

The subsequent data collection method involves administering questionnaires to teachers and students to assess the e-Module's practicality and evaluate the application of differentiated instruction during the learning process. Teacher and student response questionnaires are presented in Table 3 (Nazara, Halang, & Rezeki, 2022).

Table 3. Indicators and Grids of Teacher and Student Response Questionnaires

Aspects assessed	Indicators	Number of Items
Teacher questionnaire		
Feasibility Aspects	A. Suitability of material with Basic Competencies	3
	B. The accuracy of the material	7
	C. The currency of the material	4
Presentation Feasibility	A. Presentation technique	1
	B. Supporting presentation	6
	C. Presentation and learning	1
	D. Coherence & Logic	2
Language Appropriateness	A. Straightforward	3
	B. Communicative	1
	C. Dialogical and interactive	1
	D. Compliance with student development	1
	E. Compliance with language rules	3
Students Questionnaire		
Students' response	A. e-Modul Presentation	7
	B. Clarity of material	2
	C. Design of e-Modules	5
	D. Attractiveness of e-Modules	2
	E. Learning components	1

Data from teacher and student responses will be analyzed by recapitulating the results in a checklist arranged in the form of a Guttman scale table, where the answer "yes" is given a score of 1 and the answer "no" is given a score of 0. The questionnaire results were analyzed using the formula:

$$P = \frac{f}{N} x\ 100\%$$

Where:

P: Percentages of Categories

f: Frequency being sought (number of students who answered) "Yes"

N: Number of students

After obtaining the percentage of categories, the next step is to classify the scores, convert them into percentages, and then interpret with sentences similar to those in Table 4.

Table 4. Practicality Criteria

Percentage	Criteria
86-100	Very practical
76-85	Practical
60-75	Quite practical
55-59	Less practical
0-54	Not practical

The following data collection technique is the e-Module effectiveness test, which is taken from calculating multiple-choice pretest-posttest scores with an initial number of 25 questions in the C1-C6 domain of Bloom's Revised Taxonomy. However, after validation by material expert validators, there are 15 valid questions with the grids shown in Table 5.

Table 5. Concept Understanding Pretest-Posttest Grid

Sup Topics	Number of items and level			Total
	C_2	C_3	C_4	
Concept of work	1	3, 11	5	4
Kinetic, Potential, and Mechanical Energy	9	2,8, 10, 12, 13	4	7
Relationship between work and changes in kinetic energy		6,7		2
Relationship between work and changes in Potential energy		14,15		2
Total	2	11	2	15

Analysis of effectiveness data using the N-Gain method. N-Gain is the difference in data obtained from the pretest-posttest; this calculation was obtained for students who followed. The magnitude of the increase is calculated using the formula (Hake, 1998) and the criteria in Table 6.

$$\langle g \rangle = \frac{\langle posttest\ score \rangle - \langle pretest\ score \rangle}{maximum\ score - \langle pretest\ score \rangle}$$

Table 6. N-Gain Criteria

N-gain	Criteria
$\langle \boldsymbol{g} \rangle < 0{,}3$	Low
$0{,}3 \le \langle \boldsymbol{g} \rangle \le 0{,}7$	Moderate
$\langle \boldsymbol{g} \rangle > 0{,}7$	High

RESULTS AND DISCUSSION

1. Define

The define stage is the first step in e-Module development, which aims to identify problems that may arise in the learning process and analyze the needs of e-Module development.

The define stage starts with planning the purpose of writing the module, which is to produce teaching materials in e-Modules based on a differentiated approach to the material of Work and Energy that is feasible, practical, and effective in improving students' understanding of concepts. Feasibility can be obtained through validation tests from experts, practicality can be obtained through teacher and student responses to e-modules, and effectiveness in improving students' understanding of concepts can be obtained through students' pretest and posttest scores through the N-gain test.

In the initial phase, the results of the analysis of teaching materials through the relevance of previous research articles on the development of e-Modules that there has been no research that focuses on students' learning styles, namely differentiated learning on the material of Work and Energy, and also analyzes the needs of e-Modules by conducting interviews with teachers at Dharma Pancasila Medan High School. Based on the results of interviews conducted by physics teachers, the following information was obtained: 1) Teachers have not implemented differentiated learning. 2) Students have difficulty understanding the material on Work and Energy, especially the formulas. 3) Teachers have used e-Modules, but the e-Modules used have not been adjusted to students' learning styles.

The results of the initial analysis showed that during the learning process, the teacher still dominantly uses printed books from publishers, it is considered less attractive and result in a lack of student involvement during learning. Teachers still assume that all students have the same learning style, so differentiated learning has not been appropriately implemented. Therefore, teachers and students agree that an e-Module should be developed that is interesting and easy for students to understand during the learning process. The advantages of the developed e-Module are that it is easily accessed only through a link without requiring additional applications, so it does not take up cellphone storage. The disadvantage of the e-Module is that the signal/network must be smooth so that accessing the e-Module is not slow.

Based on the analysis of the Define stage in the development of e-Modules on Work and Energy material, several problems were found in learning which caused low understanding of student concepts. Teachers have not implemented differentiated learning, which should be adapted to students' learning styles, while students have difficulty understanding the concepts of Work and energy, especially in formulas. This is in line with the opinion of Nurlia, Nurrahmah, and Rosa (2021), which states that learning styles affect concept understanding, and students who have different learning styles have different concept understanding ability results (Sari, Sutirna, & Firmansyah, 2023). In addition, teachers tend to use printed books, which are considered less interesting by students, so that involvement in learning decreases. This is in line with the research of Meliana, Dedy, & Budilaksana (2023) that one of the things that affects student activeness in learning is interesting teaching materials.

Based on the analysis of the define stage, the objectives of developing an e-Module based on a differentiated learning approach on the material of Work and Energy that is feasible, practical, and effective to improve students' concept understanding are formulated. Students' concept understanding will be well developed if it accommodates learning according to their interests and learning styles. Dewi's research (2024) suggests helping students understand concepts better by taking an approach that accommodates students' learning styles, because differentiated learning accommodates various levels of student abilities and interests. In addition, according to the findings of Lupia (2024), this differentiated learning-oriented e-module is very feasible to use in learning, gets a positive response from students, and has a potential effect, namely, it can increase students' learning activity. Each learner must have a unique way of understanding and processing information easily, and teachers must undoubtedly be able to understand students' learning styles to make learning more optimal. Based on the learning style diagnosis test results, in this study, the learning styles determined by the students' learning abilities and interests are Reading, Visual, Audio-Visual, and Kinesthetic.

2. Design

The purpose of the design stage is to prepare all the elements needed to design an effective and relevant e-Module. For the topic of Work and Energy at SMA Dharma Pancasila Medan, this stage involves several key steps:

A. Preparation of Materials

The syllabus identification is the first step to understanding the applicable syllabus at SMA Dharma Pancasila Medan to ensure that the e-Module developed is aligned with the curriculum used. This includes identifying the topics, subtopics, and competency standards to be achieved by the students. Preparation of Materials: Based on the syllabus, the materials on Work and Energy were carefully organized. This involves dividing the material into structured sections, ranging from basic concepts to more complex applications. The materials should include theory, sample problems, and exercises to ensure thorough understanding. Content Development: The content is structured to explain concepts such as Work, kinetic energy, potential energy, and the law of energy conservation. Each part of the material should be explained clearly, using language appropriate for the level of understanding of high school students.

The steps of preparing the material are in line with the opinion of Sudrajat (2008) which states that several principles must be considered in compiling material in teaching materials, namely the principle of relevance in this study adjusting to the curriculum used, the principle of consistency, namely in this study making material for each sub-chapter consistently which includes discussion of basic concepts to complex theoretical structures, example problems and exercises and finally the principle of adequacy, namely in this study the material written in the e-Module is concise and concise and by basic competencies.

B. Presentation of Material in e-Modules:

The presentation of material in the developed e-Module uses accurate references or sources to obtain clear learning material information from various books and e-Modules. The material is presented by adjusting students' learning styles (Visual, Audiovisual, Reading, and Kinesthetic) so that the material is presented repeatedly, but adjusted to each learning style. This is in line with the opinion of Linskman (2015), who states that the material we will learn must be presented in a way most easily digested by our brains, namely, adapted to the learning style. Each individual tends to have one particular way or style. The material in the physics e-Module consists of Work, Energy, Division of Energy, Relationship between Work and Energy, and the Law of Conservation of Energy. The choice of format in the preparation of e-Modules aims to design the content of e-Modules (Figure 2).

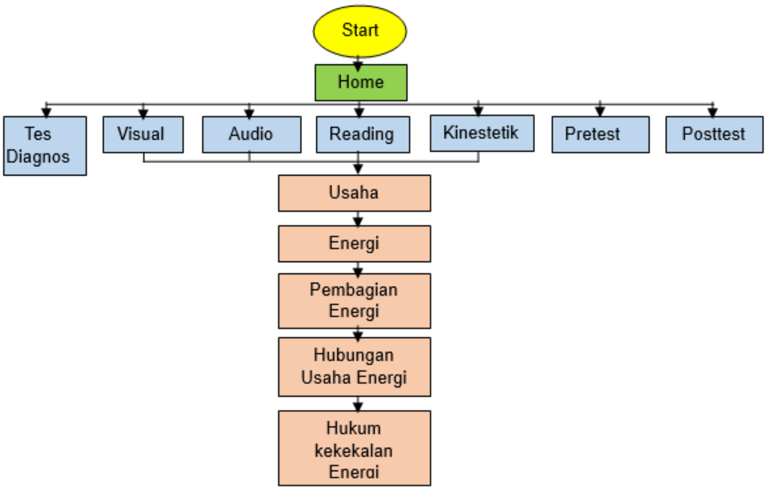


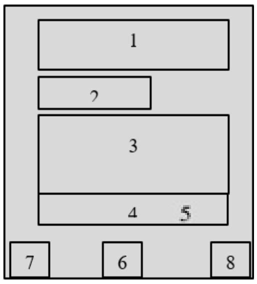
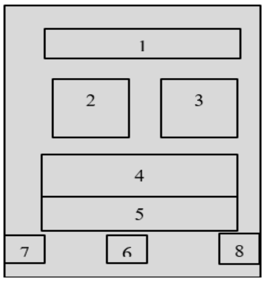
Figure 2. E-Module Preparation Scheme and Material Structure.

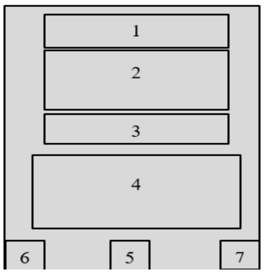
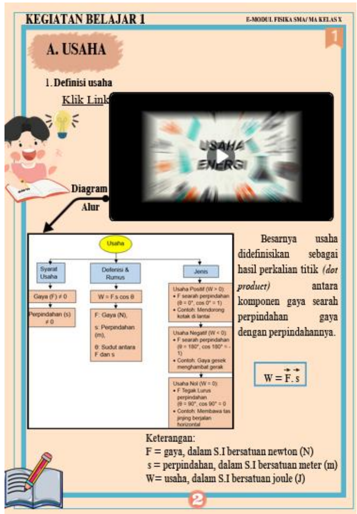
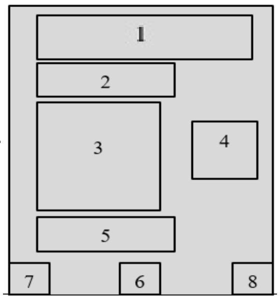
C. Format selection and e-Module draft preparation.

Format selection starts from paper type, font type, and font size. The type of paper used is A4, with the typeface "Times New Roman". The format that has been chosen is then adjusted using Heyzine in Canva. This format has been proven practical and effective in the research of Azizah, Maufur, and Basukiyatno (2024). The results of the product development of differentiated teaching modules assisted by Canva are valid and effective. Teachers can use them as teaching tools in learning due to creating attractive and interactive layouts, and integrating visual elements that can enhance students' learning experience.

This initial design stage is the drafting and design of the e-Module before it is tested. The differentiated e-Module draft includes a cover, instructions for using the e-module, a diagnostic test questionnaire, material for each learning style (Reading, Visual, Audiovisual, and Kinesthetic), and an Evaluation. The next stage is designing the e-Module by making a storyboard according to the learning style. Table 7 presents an example of the results of the development design on Business material.

Table 7. Example of Differentiated e-Module Design Results with Storyboard on Work Materials

No	Design	Text	Description	Figure
1.		*Reading* 1. Title 2. Sub-title 3. Content 4. Equation 5. Description 6. Backspace 7. Next space 8. Backspace	The reading section contains material only in text; the background is cream, and the title and content can be adjusted to the background color.	 
2.		*Visual* 1. Title 2. Figure 3. Figure 4. Figure 5. Text 6. Page 7. Backspace 8. Next space	The visual section presents the material in images related to the discussed topic and includes a brief text as guidance or explanation of the displayed images. .	

No	Design	Text	Description	Figure
3		*Audio-visual* 1. Title 2. Video 3. Flowchart 4. Text 5. Page 6. Backspace 7. Next space	In the design of the audio-visual section, there are many videos related to the material discussed.	
4.		*Kinesthetic* 1. Title 2. Text 3. Experiment 4. Supporting Figure (optional) 5. Observation Results Table 6. Page 7. Backspace 8. Next space	Presents instructions for learning activities, such as practicums, that involve learners directly with learning practices	

At the Design stage, the Business and Energy e-Module development focuses on creating a practical, adaptive, and relevant module for the curriculum. The preparation of the material begins with identifying the syllabus that refers to the Learning Outcomes (CP) and the Flow of Learning Objectives (ATP). The materials are organized hierarchically from basic concepts to advanced applications, such as the relationship between effort, kinetic energy, potential energy, and energy conservation law. One of the significant innovations and a distinctive feature that distinguishes it from other e-modules is the delivery of material based on four main learning styles (visual, audiovisual, reading, and kinesthetic), which aims to fulfill the principle of differentiated learning. Thus, e-Modules are expected to facilitate various learning preferences, increase active engagement, and improve students' concept understanding. This aligns with Susanti's research (2023), which states that differentiated learning effectively improves teachers' ability to increase students' concept understanding. Strengthened by the results of research from Hidayah, Suharti, and Daesusi (2024) stated that the development of differentiation-based teaching modules gave a positive response from students and was very influential in improving student learning outcomes due to students being free to learn independently learning about the learning material provided by adjusting their respective learning styles.

3. Develop

a. Validation Step

This validation stage was carried out by two expert lecturers: material and media experts. The material expert validator assessment results for each item were analyzed using the formula, and the V-Aiken validation index is presented in Table 8.

Table 8. Material Expert Validation

Validator	Aspect	V-Aiken	Criteria
1	Content Validity	0.83	Very Valid
2	Presentation Validity	0.83	Very Valid
Average		0.83	Very Valid

Based on data in Table 8, the overall percentage of validation by material experts obtained an average V-Aiken score of 0.83, which indicates that the teaching materials prepared on the material of Effort and Energy are included in the “very valid” category. E-Modules as learning devices are generally considered to meet validity standards with general evaluation and make minor revisions.

According to the assessment of the material experts who evaluated the e-Modules developed by the researchers, it was concluded that the feasibility aspect of the e-Module content had a feasibility level in the very valid category (V-Aiken = 0.83) because the material was by the Basic Competencies (KD), the material presented was by the concept, and illustrated with examples from everyday life, the accuracy of the images, symbols and icons and the material presented encouraged students' curiosity and created the ability to ask questions. The feasibility of presentation is (V-Aiken=0.83) due to the adoption of effective presentation techniques, such as inter-subject cohesion, structured explanation of concepts, and consistency in material delivery. Various supporting elements support the presentation, including instructions for use, concept maps, introductions, glossaries, summaries, and assessment tools. The overall percentage of validation by material experts is calculated using the V-Aiken formula to obtain a score of 0.83, indicating that the teaching materials prepared on the material of Effort and Energy are included in the “very valid” category. Aligned with the research conducted by Rizki, Nasution, & Hidayat (2022), Syafrudin, Nurhadi, & Iskandar (2021), Amin & Hidayat (2020).

The results of the e-Module validation for media experts are displayed in Table 9.

Table 9. Media Expert Validation

Validator	Aspect	V-Aiken Score	criteria
1	Graph	0.83	Very Valid
2	Language	0.67	Moderate
Average		0.75	Moderate

The data from the e-Module validation by media experts obtained an average V-Aiken score of 0.75, which proves that the e-Module falls into the "sufficiently valid" category. Based on the media expert validators, the e-Module developed by the researcher is stated to have graphical feasibility (V-Aiken=0.83) because the e-Module size, cover design, and content design have been made and arranged as well as possible. The language feasibility (V-Aiken=0.67) is due to some title texts lacking contrast with the background color, but the clarity, specifically the accuracy of sentence structure, has been well done. The overall percentage received a score of (V-Aiken=0.75), which falls into the "fairly valid" category. The selection of colors, layout, and other visual elements has been adjusted to support learning comfort and facilitate student navigation using the module. Additionally, the module has been designed with technology easily accessible on various devices (laptops, tablets, or smartphones), making it easier for students to learn anywhere. Furthermore, interactive features such as quizzes, simulations, or videos in the e-Module have been assessed by media experts as practical tools in encouraging student engagement and reinforcing concept understanding. For this reason, it is concluded to be sufficiently valid from the perspective of media experts, in line with the findings of Pratama & Nuraini (2022) and Susanto

& Yuliana (2021). The research results developed by the researcher and previous researchers regarding media expert validation almost obtained the same percentage.

The validity score of the e-Module received improvements, and the revisions were made according to feedback from academic and practical experts, making the e-Module suitable for use during the learning process. The assessment obtained in all categories is declared very valid or valid. Still, revisions are required on several items in the e-Module, such as improving the clarity of titles and subheadings and adjusting the colors to contrast with the background color. Therefore, with the suggested improvements, the e-Module is suitable for testing with minor revisions and can reflect good language, presentation, and content, making it ready for use. After conducting validation tests by subject matter experts and media experts, the practicality test phase of the e-Module is carried out.

b. Practicality of e-Modul

Data on the e-Module's practicality was obtained from students' responses according to their learning styles in a small group test consisting of 10 respondents, and a significant group test consisting of 38 respondents and physics teachers towards the product, which was then analyzed through a questionnaire. The results of the analysis of student responses from the small and large group tests can be seen in Tables 10 and 11.

Table 10. Small Group Testing

No	Learning Style	Aspect					Average Percentage (%)	Criteria
		1	2	3	4	5		
1	Visual	82	78	85	88	81	82.8	Practical
2	Audio visual	80	75	84	90	81	82.0	Practical
3	Reading	78	73	82	90	78	82.0	Practical
4	Kinesthetic	80	74	85	92	80	92.2	Very Practical
Average							84.8	Practical

Table 11. Large Group Testing

No	Learning Style	Aspect					Average Percentage (%)	Criteria
		1	2	3	4	5		
1	Visual	92	91	86	83	87	87.8	Practical
2	Audio visual	90	89	88	85	86	87.6	Practical
3	Reading	93	94	85	84	85	88.2	Very Practical
4	Kinesthetic	90	95	90	85	90	90.0	Very Practical
Average							88.4	Very Practical

where in Table 10 dan 11:
1: Presentation of e-Modul
2: Clarity of Content
3: Design of e-Modul
4: Attractiveness of e-Modul
5: Learning components

Based on Table 10 from the small group test, the overall average score for all aspects was 84.8% with practical criteria, and based on Table 11 from the large group test, the overall average score for all aspects was 88.4% with very practical criteria. Then the results of the physics teacher response analysis can be seen in Table 12.

Table 12. Physics Teacher Response

Aspect	Percentage (%)	Category
Content Feasibility	96.82	Very practical
Presentation	87.20	Very practical
Language	92.00	Very practical
Average	92.00	Very practical

The practicality of teaching materials encompasses how easy it is for students and teachers to use and implement the teaching materials. The ease of use of the e-Module is measured through student responses to the developed e-Module based on a differentiated approach. The practicality test was conducted on a small group of 10 people and a large group of 38. The students' responses to the developed e-Module were evaluated based on various aspects in small and large groups.

Based on the small group test, each learning style stated that the developed e-Module falls into the practical category, and the kinesthetic learning style even falls into the very practical category. However, when viewed from the five aspects of practicality, the e-Module scores highest in the aspect of interest, thus falling into the very practical category. The high interest score of the e-Module is due to the presentation and delivery of the material in the e-Module being engaging, which generates students' interest in learning using the e-Module.

The clarity of the material received the lowest score among the other aspects, making it fall under the reasonably practical criteria. The clarity of the material is considered quite practical due to the lack of collective understanding within the group and communication barriers among group members for discussion. Effective communication is an important component in the learning process. However, various communication barriers often disrupt the interaction between educators and learners, negatively impacting the achievement of learning objectives (Jawhari & Yusuf, 2024). Therefore, the solution to these obstacles is to ensure that everyone in the group fully understands the material by providing opportunities to ask questions, open discussions, and additional resources if needed. Setting clear goals and managing time well can also enhance the clarity of the material, so it is necessary to conduct large group tests to address any issues or shortcomings found in small group tests.

Based on the large group test results, the students' responses to the visual and audiovisual learning styles were in the practical category, while the responses to the reading and kinesthetic learning styles were in the very practical category. Additionally, when viewed from five aspects of practicality, the presentation aspect of the e-Module scored 91.36% because the material presentation in the e-Module was well-made and encouraged students' curiosity. The clarity of the material received the lowest score of 92.25% because the learning was directed to match the students' learning styles. The design of the e-Module received a score of 87.3% because the sentences, language, images, illustrations, and videos presented were engaging. The interest in the e-Module received a score of 84.2% because the developed e-Module is engaging and makes students interested in using the e-Module for learning. The learning component received a score of 86% because with the e-Module, learning physics is not dull. Thus, the average percentage score of all indicators is 88.13%, which falls into the very practical category. Furthermore, when viewed from the practicality based on the responses of physics teachers, it is stated that the developed e-Module falls into the very practical category.

The teachers' responses were based on several aspects, namely the feasibility of content, the feasibility of presentation, and the feasibility of language. The content feasibility aspect received a score of 96.82%, the presentation feasibility aspect received a score of 87.2%, and the language feasibility aspect received a score of 92%, resulting in an average score of 92% for the physics teachers' responses, which is considered very practical. Several reasons can explain the practicality of the differentiated approach-based Physics e-Module. First, this e-Module is easily accessible to students anytime and anywhere, providing flexibility in learning without being limited by space and time. Additionally, this module allows for self-directed learning, where students can set the pace and order of the material according to their needs. The simple and intuitive interface makes it easy for students and teachers to use without requiring special training. The material presented in digital form also facilitates integration with other learning devices such as laptops or tablets. The presence of interactive features such as quizzes, simulations, and videos, which are directly integrated into the modules, makes it practical to use as a comprehensive learning resource without additional tools.

The results of the e-Module practicality analysis are in line with the research of Hidayah & Susilo (2020), Dewi & Ahmad (2021), Rizki & Setiawan (2022), The practicality of the developed learning materials is assessed based on several factors, including ease of use, time efficiency, clear interpretation, relevance to the material, attractiveness, and the ability to be used as a self-learning tool. The evaluation by teachers aims to assess the practicality of the e-Module and assist them in the teaching process. Based on the trial results in small and large groups, it can be concluded that the e-Module developed using a differentiation approach is very practical. The practicality of this e-Module is particularly evident from its ease of use and accessibility through smartphones, laptops, or computers. All the content presented in the e-Module is easily understood by students, tailored to their learning needs, including readiness, interest, and learning styles. It supports students to learn independently and actively engage in the learning process.

c. Effectiveness of e-Module

The effectiveness level of the e-Module on work and energy material based on a differentiated approach was obtained from test results conducted on 38 students in a large-scale test. The test was obtained through the results of a pretest and posttest by students, consisting of 15 questions. The results of the analysis can be seen in Figure 3.

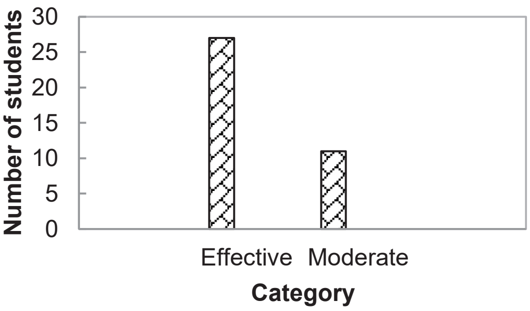


Figure 3. Effectiveness Category

The effectiveness of the e-Module can be measured by its impact on student learning outcomes, which is reflected in the difference between pretest and posttest results. E-Module is considered adequate if it can positively impact students' learning outcomes. Evaluation was conducted through student learning tests using pretests and posttests, which were given to a large group of 38 students, each containing 15 multiple-choice questions. It was found that the improvement in learning mastery scores significantly impacted the students' response scores. Twenty-two students fall into the very effective category, meaning these 22 students achieved the highest scores. Students who achieved the highest scores, thus falling into the very effective category, did so because they followed the lessons well, understood the material in the e-Module, and found it much easier to complete the given test questions since they already understood the content. Then 15 students fall into the effective category, meaning they also achieved high scores but not as high as those in the very effective category. The least number of participants, one student, falls into the category of fairly effective. This category is assigned because the student was somewhat unfocused in understanding the provided material and questions during the learning process, resulting in a low score. Therefore, the effectiveness score is assessed based on each student's pretest and posttest scores, which are considered "very effective."

The calculation of the N-gain value shows that students' learning outcomes in the cognitive knowledge section fall into the high category because they have a value of 0.81. The development of teaching materials in the form of e-Modules based on a differentiated approach can facilitate students in accessing e-Modules flexibly, whether anywhere or anytime, using their smartphones. The results of the large group trial, by administering pretests and posttests, obtained an N-Gain of 81, categorized as effective. The research results are in line with Fatmianeri, Hidayanto, & Susanto (2021) and Cahyanto, Lesmono, & Handayani (2022), which show that the development of the e-Module in the effectiveness test is considered effective, as evidenced by the improvement in understanding of physics concepts from the pretest and posttest results. Therefore, the e-Module is effective in learning because the differentiated approach allows the module to be tailored to students' diverse needs and learning styles, thereby increasing engagement and understanding. In addition, the interactive e-Module, equipped with simulations, videos, and animations, helps visualize abstract physics concepts. This module also supports self-directed learning, where students can learn at their own pace and according to their needs, along with formative assessments that provide instant feedback.

Ease of access and flexibility of use also enhance motivation and learning efficiency, while a systematic structure of the material gradually reinforces students' understanding. Combining these factors makes the e-Module effective in improving students' understanding of physics concepts. Students also demonstrate a better understanding of physics concepts and an overall improvement in learning outcomes. These findings align with Gibbs' (2023) research, which indicates that differentiated learning can maximize educational opportunities for all students by planning lessons and collecting student data to inform teachers' understanding and capacity to plan for varying student readiness, using structured formative and summative assessments, organizing flexible learning groups, and employing adaptable teaching processes that support all learners. The supporting factors and obstacles in the conducted research, as well as the advantages and disadvantages of the developed e-Module, include supporting factors such as the willingness of both teachers and the principal to cooperate, making it easy to obtain permission to enter the classroom and use smartphones during the research period. Additionally, each student had completed individual facilities, such as smartphones and internet quotas for studying. The research constraints are that some students have older versions of smartphones, which require more time to access the e-Module, and the conditions of each student vary outside of school, such as internet connectivity and supporting facilities for carrying out activities, making it difficult for some students to complete all the activities in the e-Module.

The developed e-Module also has advantages and disadvantages, as follows. The advantages of the e-Module are that it is easy to use and can be accessed on a Laptop, PC, or Smartphone. It has an attractive module interface that fosters students' reading interest. The e-Module is also created based on four different learning styles, combined into one forum on Google Sites, with the material presented in the e-Module well-structured. Students can choose the e-Module according to their respective learning styles. The disadvantage of the e-Module is that it requires internet data to access the e-Module link, and when accessing the e-Module, the signal/network must be in good condition. In addition, formative tests in the e-Module cannot be directly completed within the e-Module.

The implication of the e-Module developed in physics learning is as a tool for delivering information, designed and used according to the principles of learning theory, to stimulate the learning process (Rahman, Munandar, Fitriani, Karlina, & Yumriani, 2022). With the aid of the e-Module, students are expected to access information more effectively and engagingly, and to help them understand the Work and Energy material in a structured and straightforward manner, compared to conventional learning without using the e-Module. Using the developed e-Module is expected to increase students' interest in physics learning, particularly in understanding the concepts of Work and Energy, and serve as an additional learning resource in the learning process.

CONCLUSION

Based on the research results and discussions presented, the conclusion is that the e-Module based on a differentiated approach to work and energy material falls into the very valid criteria, with a percentage rating from subject matter experts being very valid and media experts in the reasonably valid category, thus it can be used in learning. The practicality of the e-Module received an average score of both, which was categorized as very practical. The physics teacher's response scored ninety-two percent (very practical). The effectiveness of the physics e-Module based on a differentiated approach was obtained from the analysis of the N-Gain test results from the pretest-posttest, with high N-Gain results. This research and development are still imperfect; implementing the e-Module, which adjusts to students' learning styles, takes considerable time, so sometimes the learning outcomes are not sufficiently met within the lesson hours. Therefore, it is recommended that future researchers develop this differentiated e-Module to be more time-efficient.

REFERENCES

Adam, K. R., Arafah, K., & Usman, D. (2023). Pengembangan E-Modul Pembelajaran Fisika Berbasis Web Pada Materi Momentum Dan Impuls. *Jurnal Sains Dan Pendidikan Fisika (JSPF) Jilid, 19*(3), 2548–6373.

Amin, M. M., & Hidayat, S. (2020).Validitas dan Praktikalitas E-Modul Biologi Berbasis Teknologi Informasi. *Jurnal Pendidikan Biologi Indonesia, 6*(2), 145-157. https://doi.org/10.15294/jpbi.v6i2.3773

Andila, K., Yuliani, H., & Syar Inayah, N. (2021). Pengembagan Bahan Ajar Fisika Berbentuk E-Modul Berbasis Kontekstual Menggunakan Aplikasi eXe-Learning Pada Materi Usaha dan Energi. *Kappa Journal, 5*(1), 68–79. https://doi.org/10.29408/kpj.v5i1.2757

Arkadiantika, I., Ramansyah, W., Effindi, M. A., & Dellia, P. (2020). Pengembangan Media Pembelajaran Virtual Reality Pada Materi Pengenalan Termination Dan Splicing Fiber Optic. *Jurnal Dimensi Pendidikan Dan Pembelajaran*, *8*(1). https://doi.org/10.24269/dpp.v0i0.2298

Arumsari, A., & Susanti, R. (2024). Pembelajaran Berdiferensiasi Dalam Keragaman Peserta Didik Terhadap Pemenuhan Target Kurikulum. Guruku: *Jurnal Pendidikan Profesi Guru, 2*(2), 90–104. https://doi.org/10.19109/guruku.v2i2.16032

Astiti, K. A., Supu, A., Sukarjita, I. W., & Lantik, V. (2021). Pengembangan Bahan Ajar IPA Terpadu Tipe Connected Berbasis Pembelajaran Berdiferensiasi Pada Materi Lapisan Bumi Kelas VII. *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia (JPPSI), 4*(2), 112–120. https://doi.org/10.23887/jppsi.v4i2.38498

Ayani, N. I., Sundari, P. D., & Sari, S. Y. (2023). Desain E-Modul Fisika Berbasis Poe (Predict-Observe-Explain) Berbantuan Computer - Assisted Feedback Pada Materi Dinamika Partikel. *Jurnal Pendidikan Fisika*, *12*(1), 59–69.

Bahri, S., Rosa, F. O., Alarifin, D. H., & Prihandono, E. (2022). Pengembangan E-Modul Berbasis Web Aplikasi Pada Materi Gelombang Kelas Xi. *Jurnal Firnas, 3*(2), 1–7. https://doi.org/10.24127/firnas.v3i2.3413

Barz, N., Benick, M., Dörrenbächer-Ulrich, L., & Perels, F. (2024). Students' acceptance of e-learning: extending the technology acceptance model with self-regulated learning and affinity for technology. *Discover Education*, *3*(1), 114. https://doi.org/10.1007/s44217-024-00195-7

Batlolona, J. R., Jamaludin, J., & Kalean, A. (2023). The Effect of Homogeneity Psycho Cognition Strategies on Students' Understanding of Physics Concepts in Static Fluid Topics. *Jurnal Pendidikan Fisika Indonesia*, *19*(1). https://doi.org/10.15294/jpfi.v19i1.40325

Cahyanto, A., Lesmono, A. D., & Handayani, R. D. (2022). Pengembangan E-Modul Interaktif Berbasis Articulate Storyline 3 untuk Melatihkan Kemampuan Berpikir Kritis pada Pokok Bahasan Gelombang Bunyi. *Jurnal Literasi Pendidikan Fisika (JLPF), 3*(2), 154–164. https://doi.org/10.30872/jlpf.v3i2.1551

Dewi, E. H. (2024). *Pengembangan e-modul berdiefrensiasi materi energi alternatif untuk meningkatkan hasil belajar siswa Kelas V Sekolah Dasar* [Thesis (Masters)]. Universitas Negeri Malang.

Dewi, I., & Ahmad, R. (2021). Development and Practicality of Interactive E-Modules for Mathematics: A Validation Study. *Journal of Educational Technology & Society, 23*(4), 112-125

Elisa, Pohan, H. M., & Suryani, F. (2023). Pengembangan E-Modul Fisika Berbasis Pembelajaran Differensiasi Sebagai Implementasi Kurikulum Merdeka Belajar di Era Society 5.0. *Jurnal UM-Tapsel*, *8*(2).

Estuhono, E., Aditya, A., & Asmara, D. N. (2023). Pengembangan E-Modul Berbasis Model Research Based Learning Menggunakan Pageflip Application Pada Pembelajaran IPAS Kurikulum Merdeka. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah, 6*(1), 159–168. https://doi.org/10.54069/attadrib.v6i1.483

Farida, N., & Ratnawuri, T. (2020). Pengembangan E-Modul Interaktif Berbantu Flipbook Pada

Mata Kuliah Statistik. *Seminar Nasional Penelitian Dan Pengabdian Kepada Masyarakat, 0*(0), 0–00.

Fatmianeri, Y., Hidayanto, E., & Susanto, H. (2021). Pengembangan Modul Elektronik Berbasis Differentiated Instruction untuk Pembelajaran Blended Learning. *JIPM (Jurnal Ilmiah Pendidikan Matematika), 10*(1), 50. https://doi.org/10.25273/jipm.v10i1.8709

Fitra, D. K. (2022). Analisis Penerapan Pembelajaran Berdiferensiasi Dalam Kurikulum Merdeka Pada Materi Tata Surya Di Kelas VII SMP. *Tunjuk Ajar: Jurnal Penelitian Ilmu Pendidikan, 5*(2), 278. https://doi.org/10.31258/jta.v5i2.278-290

Gibbs, K. (2023). Differentiation in practice: an exploratory investigation in an Australian mainstream secondary school. *Teaching Education*, *34*(4), 384–402. https://doi.org/10.1080/10476210.2022.2161508

Gusteti, M. U., Neviyarni, N. (2022). Pembelajaran Berdiferensiasi Pada Pembelajaran Matematika Di Kurikulum Merdeka. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika, 3*(3), 636–646. https://doi.org/10.46306/lb.v3i3.180.

Hake, R. R. (1998). Interactive engagement versus traditional methods: A six-thousand-student survey of mechanics tests data for introductory physics courses. *American Journal of Physics, 66*(1), 64–74.

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*. https://doi.org/10.1016/j.susoc.2022.05.004

Harefa, D., & Telaumbanua, T. (2020). *Belajar Berpikir dan Bertindak Secara Praktis Dalam Dunia Pendidikan Kajian untuk Akademis*. CV. Insan Cendekia Mandiri.

Hasanah, U., & Nulhakim, L. (2015). Pengembangan Media Pembelajaran Film Animasi Sebagai Media Pembelajaran Konsep Fotosintesis. *Jurnal Penelitian Dan Pembelajaran IPA, 1*(1), 91. https://doi.org/10.30870/jppi.v1i1.283

Hidayah, N.E., Susilo, J.A. (2020). Practicality and Effectiveness of E-Modules in Science Education: A Case Study. *Journal: International Journal of Science Education, 42*(5), 785-800

Hidayah, S., Suharti, P., & Daesusi, R. (2024). Pengembangan Modul Ajar Berbasis Diferensiasi Siswa Dan Investigation Based Scientific Collaborative Pada Topik Perubahan Lingkungan di SMA Muhammadiyah 7 Surabaya. *Prosiding Fakultas Keguruan Dan Ilmu Pendidikan*

Kurniawan, D. A., & Piyana, S. O. (2020). Ethnoconstructivism E-Module to Improve Perception, Interest, And Motivation of Students in Class V. *Elementary School*. *9*(1), 30–41. https://doi.org/10.23887/jpi-undiksha.v9i1.19222

Linksman, R. (2015). *Cara Belajar Cepat* (S. Nurmawati, Trans.). Dahara Prize.

Lupia. (2024). *Pengembangan Modul Eletronik (E-Modul) Berorientasi Pembelajaran Berdiferensiasi Pada Mata Pelajaran Pendidikan Pancasila Kelas 7 Semester Ganjil di UPT SMP N 1 Indralaya Utara* [Thesis]. Universitas Sriwijaya.

Magdalena, I., Prabandani, R. O., Rini, E. S., Fitriani, M. A., & Putri, A. A. (2020). Analisis Pengembangan Bahan Ajar. *Jurnal Pendidikan Dan Ilmu Sosial, 2*(2), 170–187.

Marcelina, V., Setiawan, I., & Purwanto, A. (2023). Pengembangan E-Modul Fisika untuk Melatihkan Literasi Sains Peserta Didik SMA pada Materi Fluida Dinamis. *Amplitudo : Jurnal Ilmu Pembelajaran Fisika, 2*(2), 115–124.

Mario, G., Muhdy, H. A. A., & Ahmad, Abd. A. (2021). Media Pembelajaran Infografis Dengan Materi Unsur Dan Prinsip Seni Rupa. *Jurnal Imajinasi, 10*(2), 153–158.

Marlina, L., Dariyani, N., Sriyanti, I., Sudirman, S., & Meilinda, M. (2022). Development of Differentiated Physics Teaching Modules Based on Kurikulum Merdeka. *Jurnal Penelitian Pendidikan IPA, 8*(5), 2286–2292. https://doi.org/10.29303/jppipa.v8i5.2061

Marryono Jamun, Y. (2018). Dampak Teknologi Terhadap Pendidikan. *Jurnal Pendidikan Dan Kebudayaan Missio, 10*(1), 1–136.

Mayer, R. E. (2009). Multimedia Learning. Cambridge: Cambridge University Press.

Meliana, M., Dedy, A., & Budilaksana, R. (2023). Analisis Faktor-Faktor yang Menyebabkan Rendahnya Hasil Belajar Siswa di SD Negeri Karang Ringin 1. *Journal on Education*, *5*(3). https://doi.org/10.31004/joe.v5i3.1742

Mi, S., Zong, T., Yang, X., & Gui, W. (2024). Physics Pre-service Teachers' Conceptual Understanding of Scientific Literacy. *Science & Education*. https://doi.org/10.1007/s11191-024-00520-4

Mujiatun, S., Handayani, A., & Rakhmawati, D. (2023). Pembelajaran Berdiferensiasi Dengan Berbantuan Flipbook Untuk Meningkatkan Motivasi Belajar Anak. *Jurnal Kajian Dan Penelitian Umum, 1*(2).

Nazara, A. W., Halang, B., & Rezeki, A. (2022). Respon Siswa Terhadap Modul Elektronik Subkonsep Sistem Peredaran Darah Manusia Berbasis Problem Based Learning. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan), 6*(2), 3804–3811. https://doi.org/10.58258/jisip.v6i2.2978

Nepal, S., Walker, S., & Dillon-Wallace, J. (2021). How do Australian pre-service teachers understand differentiated instruction and associated concepts of inclusion and diversity? *International Journal of Inclusive Education*, *28*(2), 109–123. https://doi.org/10.1080/13603116.2021.1916111

Ningtyas, H. A., & Rahmawati, L. E. (2023). Kelayakan Isi , Penyajian , Kebahasaan , dan Kegrafikan Bahan Ajar Teks Deskripsi di SMP Kelas VII. *Jurnal Pendidikan Bahasa Dan Sastra Indonesia, 6*(1), 52–71.

Nora Yuliani, E., Pahlawan Tuanku Tambusai, U., & Tuanku Tambusai No, J. (2018). Kemampuan Pemahaman Konsep Matematis Siswa Kelas VIII SMPN 1 Kuok Melalui Model Pembelajaran Koopearatif Tipe Group Investigation. *Junral Program Studi Pendidikan Matematika*, *2*(2).

Noveridha Utama, & Zulyusri. (2022). Meta-Analisis Praktikalitas Penggunaan E-Modul Oleh Guru Dan Peserta Didik Dalam Pembelajaran. *Jurnal Biologi Dan Pembelajarannya (JB&P), 9*(1), 27–33. https://doi.org/10.29407/jbp.v9i1.17671

Nurlia, S., Nurrahmah, A., & Rosa, N. M. (2021). Peran gaya belajar terhadap kemampuan pemahaman konsep matematika siswa kelas XI SMK Al-Khairiyah 2. *Prosiding Diskusi Panel Nasional Pendidikan Matematika*, *80*.

Pohan, H. M., & Harahap, F. S. (2023). Pengembangan E-Modul Fisika Berbasis Pembelajaran Differensiasi Sebagai Implementasi Kurikulum Merdeka Belajar Di Era Society 5.0. *Jurnal Penelitian Dan Pembelajaran MIPA, 8*(2), 227–234.

Prasetyaning, P., Vitasari, M., & Wilujeng, I. (2021). Development of Guided Inquiry-Oriented Science Interactive E-Module on Wave and Disaster Themes. *Jurnal Penelitian Dan Pembelajaran IPA, 7*(2), 134. https://doi.org/10.30870/jppi.v7i2.12058

Pratama, B., & Nuraini, M. (2022). Evaluasi Kelayakan E-Modul dalam Pembelajaran IPA: Aspek Desain dan Bahasa. *Jurnal Pendidikan IPA Indonesia, 12*(3). DOI: 10.11591/jpii.v12i3.2022

Puspitasari, A. D. (2019). Penerapan Media Pembelajaran Fisika Menggunakan Modul Cetak dan Modul Elektronik Pada Siswa SMA. *Jurnal Pendidikan Fisika, 7*(1), 17–25.

Putri, R. M., Risdianto, E., & Rohadi, N. (2019). Pengembangan Media Pembelajaran Interaktif Dengan Menggunakan Adobe Captivate Pada Materi Gerak Harmonik Sederhana. *Jurnal Kumparan Fisika, 2*(2), 113–120. https://doi.org/10.33369/jkf.2.2.113-120

Rahayu, O., Putri, D. H., & Risdianto, E. (2021). Pengembangan Modul Elektronik Materi Momentum Dan Impuls Berbasis Mind Mapping Di SMAN Kota Bengkulu. AmplitudoP: *Jurnal Imu Dan Pembelajaran Fisika, 1*(1), 27–34.

Rahayu, Y., & Pujiastuti, H. (2018). Analisis Kemampuan Pemahaman Matematis Siswa SMP Pada Materi Himpunan: Studi Kasus di SMP Negeri 1 Cibadak. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education*, *3*(2).

Rahman, A., Munandar, S. A., Fitriani, A., Karlina, Y., & Yumriani. (2022). Pengertian Pendidikan, Ilmu Pendidikan dan Unsur-Unsur Pendidikan. *Al Urwatul Wutsqa: Kajian Pendidikan Islam, 2*(1), 1–8.

Retnawati, H. (2016). VALIDITAS RELIABILITAS & KARAKTERISTIK BUTIR:(Panduan untuk Peneliti, Mahasiswa, dan Psikometrian). Yogyakarta: Parama Publishing.

Riani Johan, J., Iriani, T., & Maulana, A. (2023). Penerapan Model Four-D dalam Pengembangan Media Video Keterampilan Mengajar Kelompok Kecil dan Perorangan. *Jurnal Pendidikan West Science*, *01*(06).

Rizki, M., & Setiawan, B. (2022). Assessing the Practicality of E-Modules in High School Physics Education. *Journal of Physics Education, 15*(2), 90-105

Rizki, M., Nasution, M., & Hidayat, R. (2022). Developing Differentiated E-Modules to Enhance Student Learning Outcomes. *Jurnal: International Journal of Instruction, 15*(1), 489-508

Rosidah, U., Mudzanatun, & Nuvitalia, D. (2022). Analisis Gaya Belajar Siswa Kelas V Pada Pembelajaran Tematik Tema 1 Subtema 1 SD Negeri Kalikalong 01 Pati. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, *8*(2). https://doi.org/10.36989/didaktik.v8i2.488

Rusmiyati, R. (2024). Implementasi pembelajaran berdiferensiasi di taman kanak-kanak (TK) Gita Bangsa Citra Raya_Tangerang. *Jurnal Pendidikan, Sains Sosial, Dan Agama, 9*(2). https://doi.org/10.53565/pssa.v9i2.966

S, T. (1974). No Title. Instructional Development for Training Teachers of Exceptional Children: A Sourcebook.

Sari, L. M., Sutirna, & Firmansyah. (2023). Analisis Kemampuan Pemahaman Konsep Matematis Berdasarkan Gaya Belajar Siswa. *Jurnal Pembelajaran Matematika Inovatif*, *6*(1), 207–218.

Salsabila, U. H., Lestari, A., Agustin, E., Lestari, W., & Anshori, A. A. (2023). Penerapan Blended Learning Untuk Meningkatkan Pemahaman Dalam Pembelajaran Pendidikan Agama Islam. *EDUSAINTEK: Jurnal Pendidikan, Sains Dan Teknologi, 10*(1), 362–380. https://doi.org/10.47668/edusaintek.v10i1.729

Sudrajat, A. (2008). *Konsep Pengembangan Bahan Ajar*. Wordpress. https://akhmadsudrajat.wordpress.com/2008/03/04/konsep-pengembangan-bahan-ajar-2/

Sugiyono. (2018). Metode penelitian Pendidikan. Alfabeta.

Suratmi, S., Laihat, L., & Santri, D. J. (2018). Development of Teaching Materials Based on Local Excellences of South Sumatra for Science Learning in Elementary School. *Jurnal Penelitian Dan Pembelajaran IPA, 4*(1), 35. https://doi.org/10.30870/jppi.v4i1.3336

Susanti, W. H. (2023). Pembelajaran Diferensiasi Untuk Peningkatan Pemahaman Tentang Gaya Magnet Siswa Kelas 4B SDN Oro-Oro Ombo 02 Batu Tahun Pelajaran 2022/2023. *Jurnal Pendidikan Taman Widya Humaniora (JPTWH)*, *2*(3).

Susanto, H., & Yuliana, S. (2021). Pengembangan dan Evaluasi E-Modul untuk Pembelajaran Matematika Berbasis Multimedia. *Jurnal Teknologi Pendidikan*, *17* (2). DOI: 10.1234/jtp.v17i2.2021

Syafrudin, M., Nurhadi, N., & Iskandar, T. (2021). The Validation of E-Module Based on Local Wisdom for Science Learning. *Jurnal Pendidikan IPA Indonesia, 10* (2), 231-240

Tomlinson, C. A. (2001). How to Differentiate Instruction in Mixed-Ability Classrooms. Alexandria: ASCD.

VanTassel-Baska, J. (2012). Analyzing Differentiation in the Classroom. *Gifted Child Today,* *35*(1), 42–48. https://doi.org/10.1177/1076217511427431

Wakiah, W. N., Ruhiat, Y., & Utami, I. S. (2019). Development of Physics Learning E-Modules Based on Problem-Based Learning (PBL) on the Material of Work and Energy for High School Students Grade X. *Prosiding Seminar Nasional Pendidikan Fisika Untirta, 2*(1), 131–136.

Wicaksono, A. B., Chasanah, A. N., & Sukoco, H. (2021). Kemampuan Pemecahan Masalah Geometri Berbasis Budaya Ditinjau Dari Gender dan Gaya Belajar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(1). https://doi.org/10.24127/ajpm.v10i1.3256

Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of COVID-19. *Irish Educational Studies*, *40*(2), 235–246. https://doi.org/10.1080/03323315.2021.1916559

Wulansari, E. W., Kantun, S., & Suharso, P. (2018). Pengembangan E-Modul Pembelajaran Ekonomi Materi Pasar Modal Untuk Siswa Kelas XI Ips Man 1 Jember Tahun Ajaran 2016/2017. *Jurnal Ilmiah Ilmu Pendidikan, Ilmu Ekonomi Dan Ilmu Sosial*, *12*(1), 1-7. https://doi.org/10.19184/jpe.v12i1.6463

Yudhistira, R., Rifaldi, A. M. R., & Satriya, A. A. J. (2020). Pentingnya perkembangan pendidikan di era modern. *Prosiding Samasta, 3*(4), 1–6.

Yuliantari, V., Putri Hanisa, D., & Risdianto, E. (2021). Pengembangan E-Modul Berbasis Web Dengan Model Arcs Pada Materi Usaha Dan Dengan Model Arcs Pada Materi Usaha Dan Energi di SMA. *Jurnal Ilmu Pembelajaran Fisika, 2*(2), 99–106.