

IMPROVING STUDENTS' CONCEPTUAL UNDERSTANDING AND LEARNING MOTIVATION THROUGH CANVA-BASED INTERACTIVE E-MODULES ON WORK AND ENERGY

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ABSTRACT

Low understanding of concepts and motivation to learn remain challenges in learning physics, specifically in the material on Work and Energy. This condition is influenced by the material's abstract nature and by teaching that is not conducive to effective, interactive, and independent learning. This study aims to develop a valid, practical, and effective Canva-based Work and Energy e-module to improve high school students' conceptual understanding and learning motivation. The study used the Research and Development (R&D) method with the Four-D (4D) model, which includes the define, design, develop, and disseminate stages. Material, media, and language experts assessed product validity, while student responses evaluated practicality. Product effectiveness was tested using a Posttest-Only Nonequivalent Control Group Design by comparing conceptual understanding and learning motivation between the experimental and control classes. The results showed that the developed e-module met the criteria for very valid, with an average score of 3.67 for the display aspect, 3.59 for the material aspect, and 3.67 for the language aspect. The practicality test showed an average score of 3.58, categorized as very practical. The effectiveness test showed that students' conceptual understanding in the experimental class was higher than in the control class, with a score of 3.67. Significance 0.037 ($p < 0.05$). In addition, average motivation to learn in the experimental class reached 81.54% (very high category), while the control class obtained 70.07% (high category). Thus, the developed Canva-based e-module is valid, practical, and effective, and is suitable for use as digital teaching material to improve the quality of physics learning, especially in the material on Work and Energy.

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1. INTRODUCTION

The development of science and technology has driven education toward more innovative, adaptive, and student-centered learning. This transformation aligns with the needs of 21st-century learning, which emphasizes developing students' competencies through meaningful, contextual learning supported by digital technology (Yulianti et al., 2022). In this context, teachers are not only required to master the subject matter but are also expected to provide interactive digital learning materials that are appropriate to students' characteristics. This need is particularly important in physics education because physics requires not only mathematical skills but also the

ability to understand concepts and connect various representations to explain physical phenomena (Busyairi et al., 2021).

Although digital technology has become increasingly integrated into education, students' conceptual understanding in science learning, including physics, remains a challenge. Program for International Student Assessment (PISA) results indicate that Indonesian students' scientific literacy remains below the OECD average. In PISA 2018, Indonesia scored 396, compared with the OECD average of 489; in PISA 2022, Indonesia scored 383, compared with the OECD average of 485 (OECD, 2019, 2023). These results indicate that Indonesian students continue to face challenges in understanding and applying scientific knowledge to explain phenomena and solve contextual problems (Basam et al., 2017; Ummah et al., 2018). This condition highlights the importance of learning materials that can help students understand concepts and apply scientific knowledge meaningfully. In physics education, using learning materials appropriate to the subject matter and students' needs is essential to support the learning process and students' conceptual understanding (Cristina et al., 2016).

This condition was also specifically identified in physics learning at MAN 2 Pekanbaru. Based on a needs analysis involving 70 tenth-grade students, 68.6% reported that they liked physics; however, 42% still experienced difficulties understanding the learning materials. In addition, only 45.7% of the students reported being motivated to participate in physics learning. Lectures, presentations, and assignments still dominated the learning process, while the learning materials used were limited to text books, Power Point presentations, and e-books. This indicates that the available learning materials have not fully met students' needs for interactive learning and understanding abstract physics concepts. This result further supports the finding that 95.7% of students expected more interactive and accessible digital learning materials that could help them understand physics concepts. Therefore, there is a clear need for digital learning materials that are not only visually appealing but also capable of supporting conceptual understanding and enhancing students' motivation to learn. Research on digital learning materials also demonstrates their potential to support students' cognitive and affective aspects. Akbari et al. (2025) developed digital learning materials and found that their use could foster increased student interest and improve cognitive learning outcomes.

In this context, conceptual understanding and learning motivation are two crucial aspects to consider in physics education. Conceptual understanding enables students to grasp physics concepts meaningfully, rather than merely memorizing information or equations (F. Putra et al., 2018). Similarly, Ute et al. (2021) explain that conceptual understanding allows students to comprehend physics concepts and apply them to problem-solving. Beyond conceptual understanding, learning motivation also plays a vital role in the learning process. According to Hariyono et al. (2023), learning motivation is a factor that drives students to engage in learning activities. Meanwhile, Nusli et al. (2026) explain that learning motivation fosters student engagement and persistence in understanding physics concepts.

The use of interactive electronic modules in physics instruction can serve as an alternative teaching resource that supports the digital learning process while facilitating the presentation of material through various representations (Rahmawati et al., 2022). E-modules present learning materials in a more structured way and integrate various digital elements, potentially providing a more interactive and meaningful learning experience. In physics education, e-modules have shown positive outcomes. Sari et al. (2021) developed a physics e-module on Work and Energy. They

found that it effectively improved students' critical thinking skills and learning independence. Furthermore, Lubis et al. (2025) developed a physics e-module oriented toward differentiated learning on Work and Energy. It demonstrated that the developed product was valid, practical, and effective in improving students' conceptual understanding. These findings indicate that e-modules can serve as an alternative learning material to support physics education and improve the quality of the learning process. In line with these developments, Canva has increasingly been utilized as a platform for developing digital learning materials because it enables learning content to be presented through various visual and multimedia formats. Yunita et al. (2024) developed an interactive e-module using a STEM approach and the Canva application for physics learning. The results showed that the developed e-module was suitable for use and improved students' critical thinking skills. Cintami et al. (2024)) also found that Canva-assisted physics learning can enhance students' problem-solving skills. Meanwhile, Setiani et al. (2024) demonstrated that interactive learning media utilizing Canva are suitable for use and capable of improving students' conceptual understanding. These findings indicate that Canva has potential as a platform for developing interactive e-modules that integrate various digital learning elements into physics instruction. Therefore, Canva-based interactive e-modules can serve as an alternative for providing learning materials that are more engaging, interactive, and aligned with the needs of physics learning in the digital era.

Although research on e-modules and the use of Canva in physics education continues to develop, previous studies still have several limitations. Research on e-modules for the topic of Work and Energy has been conducted, including the development of e-modules based on Problem-Based Learning that focused on product validity and practicality, as well as the development of e-modules oriented toward differentiated learning that demonstrated improvements in students' conceptual understanding (Lubis et al., 2025; Panggabean & Sembiring, 2022). However, these studies did not specifically develop Canva-based interactive e-modules that integrate conceptual understanding and learning motivation as learning outcomes. In contrast, Yunita et al. (2024) developed an interactive e-module using Canva for physics learning, but the study focused on improving students' critical thinking skills. Research on Canva-based e-modules that specifically examines learning motivation has also been more commonly conducted in subjects other than physics. Therefore, its application in physics learning, particularly on the topic of Work and Energy, remains open for further investigation. Thus, research integrating Canva-based interactive e-modules on Work and Energy with comprehensive evaluations of product validity, practicality, and effectiveness, while also examining improvements in students' conceptual understanding and learning motivation at the senior high school level, remains limited.

Based on these research gaps, this study's novelty lies in integrating a Canva-based interactive e-module on Work and Energy with two learning outcomes: conceptual understanding as a cognitive aspect and learning motivation as an affective aspect. Unlike previous studies that tend to focus on the use of e-modules or Canva on a single aspect, such as conceptual understanding, critical thinking skills, learning outcomes, or product feasibility, this study integrates conceptual understanding and learning motivation within a single digital learning material. This novelty is further strengthened by developing the product using the 4D model (Define, Design, Develop, and Disseminate) and evaluating it for validity, practicality, and effectiveness. Therefore, this study aims not only to produce a feasible and practical digital e-module but also to provide empirical evidence on the effectiveness of a Canva-based interactive

e-module in improving students' conceptual understanding and learning motivation on the topic of Work and Energy. Based on the aforementioned discussion, this study aims to develop a Canva-based interactive e-module on the topic of Work and Energy that meets the criteria of validity, practicality, and effectiveness, and to analyze improvements in students' conceptual understanding and learning motivation after using the developed e-module. The development process uses the 4D model to ensure the product is based on students' needs, aligned with the characteristics of physics content, and systematically evaluated before implementation in the learning process. This study is expected to contribute to the development of more interactive digital learning materials and support student-centered physics learning.

2. METHOD

This is study and development (Research and Development) which uses the 4D development model (Four-D Model) developed by Thiagarajan, Semmel, and Semmel (1974). This model consists of four stages: Define, Design, Develop, and Disseminate. At the Define stage, an initial analysis is carried out to identify physics learning problems. on material Work and Energy, analysis characteristics participant educates, analysis task Based on basic competencies, concept analysis to determine the structure of the material, and the formulation of learning objectives that form the basis for compiling the e-module. The design stage includes compiling research instruments, selecting media and presentation formats, and creating an initial draft of the e-module. based Canva. Furthermore, on stage Develop done validation by expert that is 3 A Master of Physics Education lecturer, as an expert in aspects of appearance, material, and language, followed by revisions to determine the feasibility of the e-module. Furthermore, a limited trial was conducted on 10 students at MAN 2 Pekanbaru City to determine the practicality of the e-module.

The dissemination stage, which is the effectiveness test, used a posttest-only nonequivalent control group design involving two classes: an experimental class using a Canva-based e-module and a control class using conventional learning. The study population was 140 class X students of MAN 2 Pekanbaru City. The sample consisted of 70 students from classes X-1 and X-2. The experimental and control classes were selected using random sampling techniques. The research instruments included an expert validation sheet, a practicality questionnaire, a conceptual understanding test, and a learning motivation questionnaire. The conceptual understanding test consisted of 20 items that were declared valid based on research by Sukri (2018), with a reliability of 0.87, while the learning motivation questionnaire used a four-level Likert scale.

The data were analyzed using descriptive and inferential statistics. Data validity and practicality were analyzed using the average value with the equation:

$$X = \frac{\sum X}{N}$$

with X is average score, $\sum X$ is total score obtained, and N is number of aspects assessed. The interpretation of the average score validation can be seen in Table 1.

Table 1. Criteria for Validation Scores

Range Score	Classification
$3,25 < \bar{x} \leq 4,00$	Very Valid
$2,50 < \bar{x} \leq 3,25$	Valid
$1,75 < \bar{x} \leq 2,50$	Less Valid
$1,00 < \bar{x} \leq 1,75$	Invalid

Source: Riduwan dan Sunarto (2013)

The interpretation of the average score practicality can be seen in Table 2.

Table 2. Criteria for Practicality Scores

Range Score	Classification
$3,25 < \bar{x} \leq 4,00$	Very Practical
$2,50 < \bar{x} \leq 3,25$	Practical
$1,75 < \bar{x} \leq 2,50$	Enough Practical
$1,00 < \bar{x} \leq 1,75$	Not Practical

Source: Riduwan dan Sunarto (2013)

The analysis of understanding drafts began with a normality test using the Kolmogorov–Smirnov test and a homogeneity test using Levene's test in SPSS. The data are considered normally distributed and homogeneous if the $p\text{-value} > 0.05$. Furthermore, to determine differences in students' conceptual understanding between the experimental class using Canva-based e-modules and the control class using conventional learning, an Independent-Samples T-Test was conducted. The difference was declared significant if the probability value was < 0.05 .

The effectiveness of e-modules was reviewed by comparing average conceptual understanding scores between the experiment and control classes. Descriptive analysis of understanding draft per indicator was done by calculating students' absorption capacity using the formula:

$$\text{Absorption Power} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100\%$$

The interpretation of Power Absorb can be seen in Table 3.

Table 3. Category Power Absorb Students

Interval (%)	Category Absorption
$85 \leq DS \leq 100$	Very Good
$70 \leq DS < 85$	Good
$50 \leq DS < 70$	Good Enough
$0 \leq DS < 50$	Less Good

Source: Depdiknas (2006)

Data motivation Study analyzed using percentage score with equality:

$$P = \frac{K}{l \times m} \times 100\%$$

with P is percentage of learning motivation, K is amount of score obtained, l is number of statement items, and m is maximum score.

Interpretation of the percentage motivation Study can be seen in Table 4.

Table 4. Criteria Evaluation Motivation Study

Percentage Which obtained (%)	Interpretation
0 – 20	Very Low
21 – 40	Low
41 – 60	Enough
61 – 80	High
81 – 100	Very High

Source: Riduwan and Sunarto (2013)

3. RESULTS AND DISCUSSION

This research is a research and development (R&D) study that aims to produce a Canva-based interactive e-module on Work and Energy for grade 10 high school students. The research was conducted at MAN 2 Pekanbaru City using the 4D development model (Four-D Model), which includes the stages of Define, Design, Develop, and Disseminate. However, in accordance with the room scope study, the process was restricted to the Develop stage, whereas the Disseminate stage was not implemented. Results The research included the e-module development process, expert validation, practicality testing with students, and effectiveness testing on conceptual understanding and learning motivation. Each development stage generated data that served as the basis for product refinement, ensuring the resulting e-module met the aspects of validity, practicality, and effectiveness. The research results and discussion are presented based on the development stages implemented.

This study employed a research and development (R&D) design to develop a Canva-based interactive e-module on Work and Energy for Grade 10 high school students. The research was conducted at MAN 2 Pekanbaru using the 4D development model (Four-D Model), which consists of four stages: Define, Design, Develop, and Disseminate. However, due to the study's scope, the development process was limited to the Develop stage, and the Disseminate stage was not implemented. The research activities included e-module development, expert validation, practicality testing involving students, and effectiveness testing focusing on students' conceptual understanding and learning motivation. Data obtained at each development stage were used to refine the product and ensure the resulting e-module met the criteria of validity, practicality, and effectiveness. The research results and discussion are presented according to the development stages that were implemented.

3.1. Stage Define (Definition)

The Define stage aimed to establish the specifications for developing a Canva-based interactive e-module on Work and Energy. This stage was based on the results of the needs analysis, described in the Introduction section, which indicated a need for digital learning materials to support improved students' conceptual understanding and learning motivation. Based on these findings, a concept analysis was conducted to identify the essential concepts, develop a preliminary concept map, and determine the relationships among concepts in the topic of Work and Energy. Furthermore, a task analysis was conducted based on the learning outcomes and learning objectives of the Merdeka Curriculum to ensure the content aligned with the expected competencies. An analysis of the learning objectives was then conducted as a basis for developing learning indicators, instructional materials, learning activities, and assessment components in the e-module.

The results of the Define stage indicate that the analysis of needs, concepts, tasks, and learning objectives provided a clear foundation for determining the characteristics of the e-module being developed. Concept analysis helped organize the "Work and Energy" material based on inter-concept relationships, while task and learning objective analysis ensured that the content, activities, and evaluations aligned with the competencies students are required to achieve (Fauziah & Rusilowati, 2025; Lubis et al., 2025).

3.2. Stage Design (Design)

In the design stage, the e-module was developed as a reference for the product development process. This stage includes preparing the e-module content structure, concept maps, learning objectives, developing validation instruments, and determining the presentation format. The presentation format is designed systematically and consists of a cover page, user instructions, learning outcomes and objectives, concept maps, learning materials, sample questions, exercises, evaluations, and a bibliography. Each section is arranged sequentially to help students study the Work and Energy material independently. In addition, the layout focuses on consistent use of color, typography, illustrations, and navigation so the e-module display is structured, easy to read, and supports the learning process. The initial design (prototype I) produced at this stage then serves as the basis for validation and product refinement during the development stage.

The results of the design phase indicate that the initial prototype incorporates comprehensive learning components arranged systematically, ranging from learning objectives, concept maps, and content to exercises and evaluations. This arrangement aligns with the findings of Setiasiwati & Nugroho (2023), who emphasize the importance of a systematic structure in e-module development. Meanwhile, B. R. Putra & Ellianawati (2024) demonstrate that components organized in a purposeful manner are crucial for producing e-modules suitable for use in instruction.

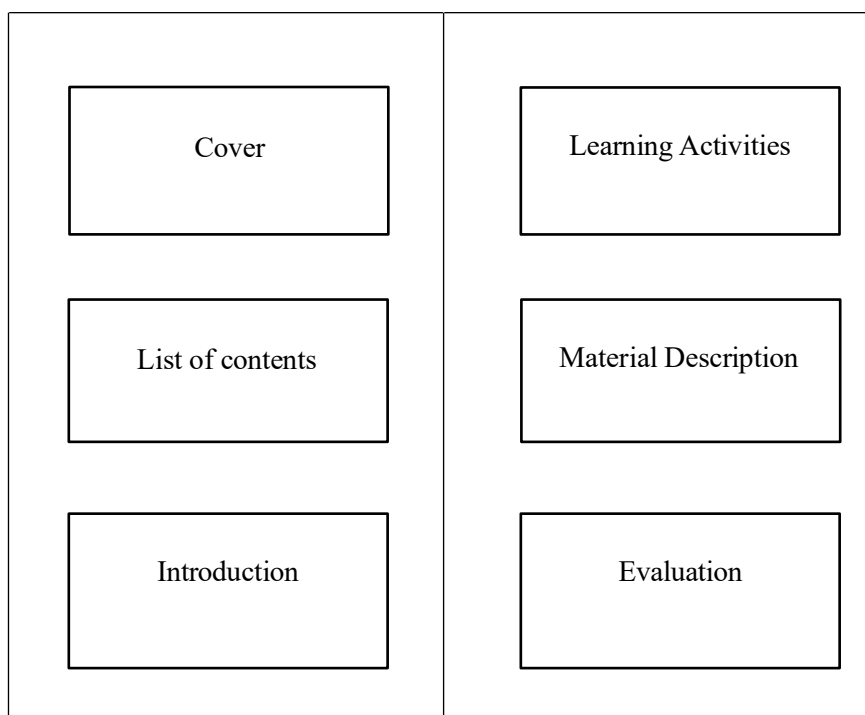


Figure 1. Design beginning (Prototype I) e-modul interactive based Canva

3.3. Stage Develop (Development)

Stage Development aims to produce an interactive e-module based on Canva that meets the criteria of being valid, practical, and suitable for use in physics learning on the topic of Work and Energy. At this stage, the initial prototype prepared in the Design stage was developed into a product ready for expert validation. The development process began by refining the material content, compiling illustrations, presenting example questions and exercises, and evaluating learning in accordance with the predetermined learning objectives. Next, expert validators validated the product to assess the material, appearance, and language. The validators' input served as the basis for revisions to improve the e-module's quality before it was tested for practicality with students. After the revision process, the e-module was declared valid and practical and therefore suitable for use in the effectiveness test stage.

The results of the validity test were obtained from a questionnaire that had been filled out by 3 Master of Physics Education Lecturers, as expert material, expert media, and expert Language. The results of validity in terms of appearance, material, and language can be seen in the following Figure 2:

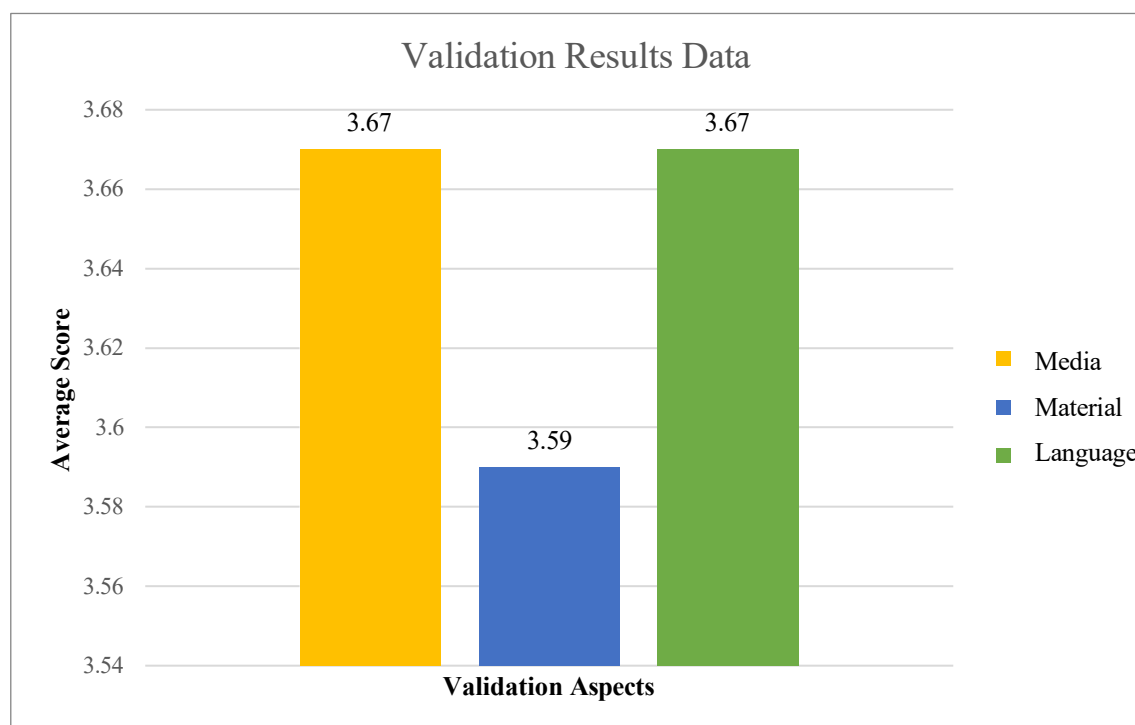


Figure 2. Results validation e- module

Figure 2 shows that the Canva-based interactive e-module was categorized as very valid across all assessed aspects. The display aspect received an average score of 3.67, the content aspect received a score of 3.59, and the language aspect received a score of 3.67. These results indicate that the developed e-module has met the eligibility criteria in terms of presentation. The substance, material, and language use are suitable for use as teaching materials in physics learning on the material Work and Energy.

The validation process aims not only to determine the product's suitability but also to obtain expert input as a basis for improving the e-module and testing with participants. Based on results validation, validator give several suggestion repairs, between other improvement appearance so that more consistent, adjustment presentation material so that more systematic, improving the writing of physics symbols and notation to conform to scientific principles, and refining the use of language to make it more communicative and easier for students to understand. All of this input was accommodated through a revision process, improving the quality of the content, presentation, and readability of the e-module. Thus, the results of internal validation indicate that the e-module has met the aspects of construct, content, Language, and presentation, so it is ready to proceed to the practicality test stage.

After the Canva-based interactive e-module was declared valid based on the results of internal validation by experts, the product then entered the external validation stage through limited trials. To educate participants. Results validation internal show that e-modul has fulfill aspects content, presentation, linguistics, and appearance so that worthy for tested on This limited trial aims to obtain feedback on the practicality of using the e-module, ease of operation, readability, and appropriateness of the material presentation before conducting an effectiveness test on the experimental and control classes. The trial was conducted with 10 participants in Class X MAN 2 City Pekanbaru. The number of participants fulfilled the small-group evaluation criteria recommended by Tessmer (1993), involving around 8–12 participants to gather input and improve the product before applying it on a wider scale. The results of this limited trial are then used as a basis for refinement. End the e-module before implementing to test effectiveness. The results of the test can be seen in Figure 3 below:

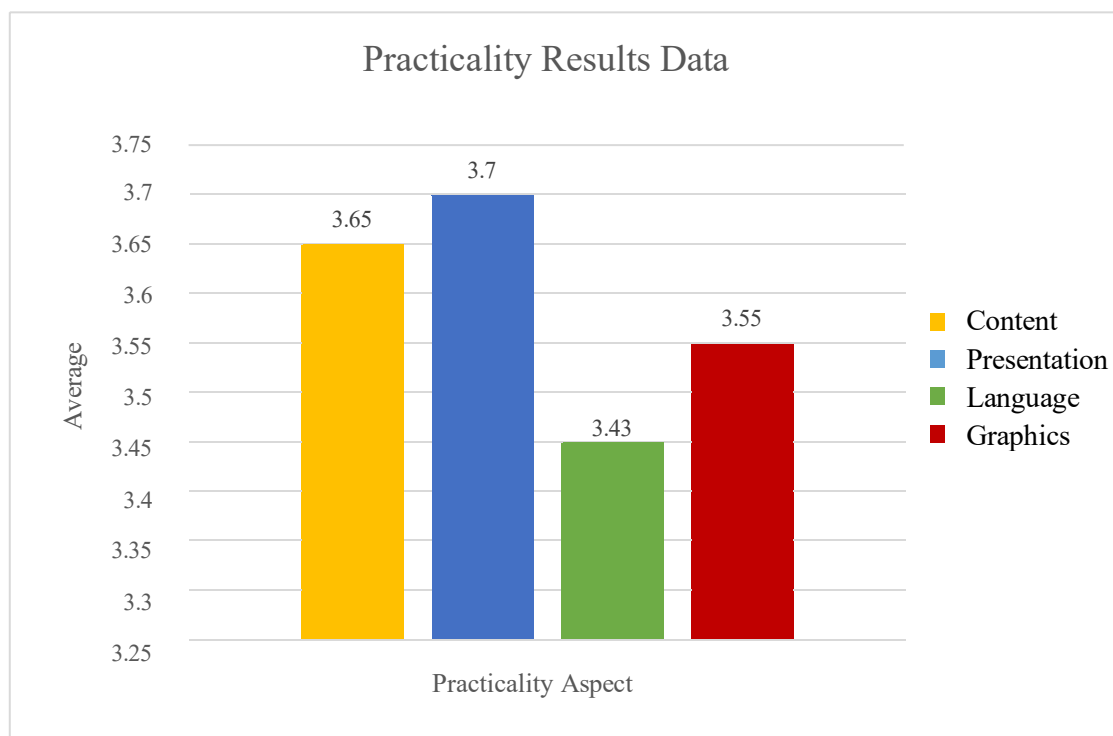


Figure 3. Results Test Practicality

Figure 3 shows that the Canva-based interactive e-module received a very practical rating across all assessed aspects. The presentation aspect received the highest average score of 3.70, followed by the content aspect at 3.65, the graphics aspect at 3.55, and the language aspect at 3.43. These results indicate that students could use the e-module easily, understand the flow of the material presentation, and participate in the learning activities independently without significant obstacles. In addition to providing assessments, students also provided input to improve the e-module, especially regarding language and display. Improvements included simplifying several sentences for easier understanding, adjusting the layout of several pages for better proportions, and refining the illustrations to provide clearer information. These revisions resulted in a more communicative and user-friendly e-module. Thus, the external validation results not only reinforce the internal validation results but also demonstrate that the e-module meets the practicality requirements, making it suitable for use in the effectiveness testing phase.

The high validity of the e-module is supported by the alignment of the content with learning objectives, conceptual accuracy, systematic presentation, and clarity of language and layout. This aligns with the findings of Lubis et al. (2025), which indicate that content and presentation validation are crucial components in the development of physics e-modules, including those covering the topic of Work and Energy. The practicality of the e-module relates to its ease of use, readability, navigation clarity, and the appeal of its presentation. Prihatiningtyas et al. (2025) demonstrated that ease of use and appropriate presentation are key aspects in assessing e-module practicality. Similar findings were reported by Defitasari & Wahyuni (2024) who noted positive student responses to the use of the e-module. Furthermore, Faizah & Sugianto (2025) showed that ease of use and presentation quality contribute to the practicality of the e-module, as evidenced by student feedback.



Figure 4. Example appearance of the e-module after revision

3.4. Stage Disseminate (Spread)

After the Canva-based interactive e-module was declared valid through internal and practical validation based on the results of limited trials, the product was then implemented in the effectiveness test stage. The effectiveness test was conducted on class X students of MAN 2 Pekanbaru City, consisting of two classes: class X-1 as the experimental class that used the interactive e-module. Based on Canva, class X-2 was the control class, which used teaching materials commonly used by teachers. Class selection was carried out using a random sampling technique on classes with relatively similar characteristics, in accordance with the research procedures described in the methods section. Both classes followed the developed learning tools, and learning outcomes and student motivation were then compared to determine the effectiveness of the developed e-module.

3.4.1. Analysis Of Conceptual Understanding

This study used a posttest-only design with nonequivalent groups to test the effectiveness of the developed e-module based on Canva on the material Work and Energy. To test the hypothesis, the posttest data were tested for normality and homogeneity as prerequisites for parametric statistics. The analysis results showed that the data in the experimental class ($n = 35$)

and the control class ($n = 35$) were normally distributed and had homogeneous variance ($p > 0.05$), thus fulfilling the requirements for an independent-samples t-test. Furthermore, class X-1 was designated as the experimental class using e-modul interactive-based Canva, whereas class X-2 was designated as the control class, which used teaching materials commonly used by teachers.

The results of the Independent Sample t-test on the posttest scores showed a significance value (Sig. 2-tailed) of 0.037, which is smaller than the significance level of 0.05. This result indicates a significant difference in conceptual understanding between students in the experimental and control classes.

Table 5. Power Absorb Student on Material Work and Energy

Interval (%)	Category	Frequency (%)	
		Experimental Class	Control Class
$85 \leq \bar{x} \leq 100$	Very Good	22.86	8.571
$70 \leq \bar{x} < 85$	Good	54.29	31.43
$50 \leq \bar{x} < 70$	Enough Good	22.86	45.71
$0 \leq \bar{x} < 50$	Less Good	0	14.29
Average		75	63
Category		Good	Enough Good

The average posttest mark of participants in the experimental class was higher than that of the control class. In addition, the results of the absorption analysis showed that the experimental class obtained an average of 75% in the good category. In comparison, the control class obtained an average of 63% in the category Enough. As many as 54.29% of participants in the experimental class were in the good category, and 22.86% were in the Very Good category, whereas 14.29% of participants in the control class were in the Not Enough category. Findings: This shows that using Canva-based interactive e-modules positively contributes to improving students' conceptual understanding of the Work and Energy material.

The superior conceptual understanding observed in the experimental class can be attributed to the systematic presentation of material, the use of visual representations, and the availability of examples, exercises, and evaluations. Panggabean & Sembiring (2022) demonstrated that a Problem-Based Learning (PBL)-based e-module on Work and Energy possesses high validity and practicality, making it a viable alternative teaching resource. Artsheila Anggraini et al. (2023) also found that Canva-assisted physics instruction positively influences students' conceptual understanding.

The use of interactive media and learning activities enables students to process information and link concepts to more concrete representations. Ramadhanti et al. (2022) reported that Canva-assisted interactive learning media achieved an N-gain score of 0.71 regarding conceptual understanding. Asrizal et al. (2024) further demonstrated that physics e-modules incorporating learning activities can support students' conceptual understanding. These findings align with the work of Lubis et al. (2025), who developed an e-module on Work and Energy to foster students' conceptual understanding. Similarly, Rafidah et al. (2024) showed that e-modules on Work and Energy featuring activities and virtual simulations can provide a more concrete and interactive learning experience.

Theoretically, these findings are consistent with Ausubel's theory of Meaningful Learning,

which posits that new information is more easily understood when connected to students' existing knowledge. Thus, the systematic presentation of material, visual representations, learning activities, and the inclusion of exercises and evaluations serve as factors contributing to the higher levels of conceptual understanding observed in the experimental class.

3.4.2. Analysis Of Learning Motivation

To determine the level of learning motivation, data were collected using a distributed questionnaire via Google Forms. Results of the questionnaire motivation Study can be seen in Table 6.

Table 6. Score Questionnaire Motivation Student Learning

Interval (%)	Category	Frequency (%)	
		Experimental Class	Control Class
0 - 20	Very Low	0	0
21 - 40	Low	0	0
41 - 60	Enough	0	14.29
61 - 80	High	51.43	80
81 - 100	Very High	48.57	5.71
Average		81.54	70.07
Category		Very High	High

The results show that the average learning motivation of students in the experimental class was 81.54 (Very High), while in the control class it was 70.07 (High). Besides that, all participants in the experimental class were in the Very High and High categories. In contrast, in the control class, some students were in the Enough category. The results show that Canva-based interactive e-modules increase students' learning motivation compared with conventional teaching materials.

The learning motivation of students in the experimental class can be linked to the characteristics of the Canva-based interactive e-module, which offers a learning experience that is flexible, visual, and actively engaging. The e-module allows students to access materials independently according to their needs, while the systematic presentation of content complemented by illustrations, examples, exercises, and evaluations provides a clear learning trajectory. Seftianingsih & Supahar (2021) demonstrated that presenting Work and Energy content within an e-module by linking it to daily life can foster student interest in the subject matter. Millen & Supahar (2023) also emphasized the importance of learning activities that involve students in using the e-module to build engagement throughout the learning process.

The visual and interactive elements of the e-module provide stimuli that help sustain student attention. Rifa'i et al. (2025) showed that using interactive e-modules with visual elements can create a more engaging learning experience. Furthermore, presenting material linked to real-life situations or phenomena helps students perceive the connection between the subject matter and their own experiences. This aligns with the work of Nurahmi et al. (2024), who developed an e-module based on Contextual Teaching and Learning by integrating real-life contexts into physics instruction. Hafni et al. (2025) also demonstrated that e-modules designed with problem-based activities provide opportunities for students to engage more actively in the learning process.

Theoretically, these conditions can be explained through Ryan & Deci, (2000) Self-Determination Theory (SDT), which posits that motivation develops when the needs for autonomy, competence, and relatedness are met. The e-module supports autonomy by offering opportunities for independent study, competence through progressive exercises and evaluations, and relatedness by linking the material to everyday phenomena. Thus, the characteristics of the e-module create conditions that foster student learning motivation.

The characteristics of the e-module align with Keller's (2010) ARCS model, which encompasses Attention, Relevance, Confidence, and Satisfaction. Setyowati et al. (2022) demonstrated that these four aspects are relevant in describing student motivation within e-learning-based physics instruction. Yulianti et al. (2019) also showed that implementing the ARCS model influences students' learning motivation and outcomes in physics. In the context of the developed e-module, visual and interactive elements capture interest (Attention), real-life phenomena establish a connection to the material (Relevance), scaffolded exercises help build self-confidence (Confidence), and activities combined with feedback foster a sense of achievement (Satisfaction). Thus, the e-module's characteristics collectively create conditions that support student engagement and motivation in learning the topic of Work and Energy.

4. CONCLUSION

This study successfully developed a Canva-based interactive e-module on Work and Energy using the 4D development model, meeting the criteria for validity, practicality, and effectiveness as physics teaching material for senior high school students. The validation results indicated that the e-module was categorized as highly valid, with an average score of 3.64. At the same time, the practicality test yielded an average score of 3.58, categorized as highly practical. The implementation of the e-module in the learning process showed that students who used the e-module demonstrated better conceptual understanding than those involved in conventional learning, as indicated by the Independent Samples t-test with a significance value of 0.037 (<0.05) and an average learning achievement of 75% in the experimental class compared with 63% in the control class. Furthermore, the e-module positively affected students' learning motivation, as indicated by an average motivation score of 81.54 (very high category) in the experimental class, higher than the control class score of 70.07 (high category). These findings indicate that the Canva-based interactive e-module is not only suitable as digital teaching material but also improves the quality of physics learning by strengthening students' conceptual understanding and learning motivation. Practically, the developed e-module can serve as an alternative teaching material for teachers to support more interactive, flexible, and student-centered physics learning.

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