

Innovation of Topworksheets-Based Interactive Digital Worksheet on Work and Energy Materials

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ABSTRACT

This study aims to develop an Interactive Digital Student Worksheet (LKPD) based on the TopWorksheets platform for the subject of Work and Energy, which is suitable for use as a physics learning medium. This study uses the Research and Development (R&D) method, referring to the Borg and Gall model, which includes the stages of potential and problems, data collection, product design, validation, and revision. The research subjects involved subject matter experts, media experts, and students. The data collection instruments were validation questionnaires and practicality assessment sheets. The validation results showed an average feasibility of 79% with a “feasible” qualification, and the highest score in the technical aspect was 81% with a “highly feasible” qualification. The developed media is capable of presenting material visually and interactively and can be accessed through various devices, thereby supporting more engaging and contextual learning. In conclusion, this TopWorksheets-based Interactive Digital LKPD is declared valid and has the potential to be used in physics learning. This media provides an innovative alternative in presenting abstract material and has broad prospects for further development and wider implementation at various levels of education.

Keywords: Interactive Digital Worksheets; Top Worksheets; Work and Energy; Learning Media; Physics

INTRODUCTION

Physics is a fundamental science that makes an important contribution to explaining various natural phenomena, including the topics of Work and Energy, which are among the core subjects in the secondary school physics curriculum. This material not only covers theoretical aspects such as the relationship between force, displacement, and energy, but also requires a deep conceptual understanding so that students are able to relate the concepts to real life (Giancoli, 2005). However, the reality in the field shows that many students have difficulty understanding this material because of its abstract presentation and lack of applicable context (Pratiwi, 2024).

The main problem in physics learning in secondary schools still revolves around the lack of learning media that supports the visualization of abstract concepts. Most learning is still oriented towards lecture methods and the use of textbooks, which makes students tend to be passive and have difficulty building connections between theory and practice (Tubagus et al., 2024). In addition, the low level of active student involvement in learning causes a decrease in learning motivation and has a direct impact on low concept mastery (Astalini et al., 2019).

With the development of digital technology, technology-based learning media innovation has become one of the strategic solutions to address these issues. One form of this innovation is the development of Interactive Digital Student Worksheets (LKPD) that enable direct student engagement through drag-and-drop activities, dynamic questions, and audio-visual integration. The TopWorksheet platform is an online medium that can be used to design interactive LKPDs easily and flexibly, supporting various student learning styles (Silmi et al., 2025).

Previous research shows that TopWorksheet-based E-LKPDs are suitable for use as learning media because they can increase student interest and engagement in the learning process (Silmi et al., 2025). In addition, research conducted on inquiry-based learning models and the STEM approach to business and energy material shows a significant effect on concept understanding with an effect size of 1.717 (Pranita et al., 2019). This reinforces the idea that active engagement and problem-solving-based learning are effective approaches in physics learning.

The use of interactive digital media in the form of educational games also has a positive impact on student motivation and learning outcomes. Research by Nurafrani & Mulyawati (2023) found that liveworksheet-based E-LKPD had a validation by media experts of 82.85%, with criteria deemed appropriate; language experts with a percentage of 85%, with criteria deemed appropriate; and subject matter experts with a percentage of 98%, with the criteria of highly suitable. The results of the student response questionnaire showed a percentage of 90.21% in the very good category. Therefore, these results indicate that E-LKPD is very suitable for development for students and very suitable to be used as a learning tool in the learning process.

From the developer's perspective, teacher training in the use of digital platforms such as TopWorksheet also shows encouraging results. Approximately 87.5% of teachers strongly agree that this application is easy to use, and more than 80% state that the process of creating LKPD is quite easy (Mahardika et al., 2023). This shows the great potential of this platform to be widely used in the development of interactive digital teaching materials.

However, a review of the literature shows that there is still limited research specifically developing TopWorksheet-based Interactive Digital Worksheets for Business and Energy material at the high school/MA level. This is the research gap and also the novelty value of this article. This study not only aims to support previous findings on the effectiveness of digital media, but also to develop and test the validity of TopWorksheet-based Interactive Digital Worksheets in physics learning.

METHOD

This research is a research and development study aimed at producing an interactive digital worksheet using the TopWorksheet platform for the subject of Work and Energy, as well as testing the feasibility of the product through validation. The development model used refers to the Borg and Gall model (Sugiyono, 2013), which consists of ten stages of development. However, in this study, only five main stages were used due to time and resource constraints. The stages used include;



Figure 1 Borg and Gall Development Model

This model was used because it is suitable for developing media-based educational products and allows for feasibility testing by experts and users prior to wider implementation. The research subjects consisted of: subject matter experts (lecturers or experienced physics teachers) and media experts (practitioners or lecturers in the field of learning media). The implementation procedure was carried out in several stages, namely: 1) Creation of the initial design of the Interactive Digital Worksheet using the TopWorksheet application by compiling the content, interactive questions, and multimedia components. 2) Validation was carried out by subject matter experts and media experts using an assessment sheet (validation sheet) sent via Google Form.

The tools and materials used in this development include: Computers/laptops and internet connections to design Interactive Digital Worksheets on the website www.topworksheets.com, the Google Form platform for distributing validation questionnaires, and TopWorksheet web-based Interactive Digital Worksheets as the main product. The data collection instruments consist of: Material validation sheets and media validation sheets. All instruments used a 4-point Likert scale and were compiled in Google Form format to facilitate distribution and data collection.

Data analysis techniques were carried out using descriptive quantitative methods. The validation and questionnaire data were analyzed using the following percentage formula:

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

Explanation:

P = Percentage

$\sum x$ = Total number of answers in all items

$\sum xi$ = Total number of ideal scores in all items

100% = Constant

The interpretation of the percentage results refers to the eligibility criteria according to Widoyoko (2013) in Prihatiningtyas et al (2023), as shown in Table 1 below:

Tabel 1 Tabel Skala Persentase

Percentage (%)	Criteria
81.0% – 100.0%	Very valid/feasible
61.0% – 80.0%	Valid/feasible
41.0% – 60.0%	Fairly valid/feasible
21.0% – 40.0%	Less valid/feasible
0.0% – 20.0%	Not valid/feasible

The results of the analysis of each instrument were used to revise the product and determine the final feasibility of the TopWorksheet-based interactive digital Worksheet.

RESULT AND DISCUSSION

Result

This development research aims to produce interactive digital worksheets based on the TopWorksheets platform for the subject of Work and Energy and to test the feasibility of the media through expert validation and limited trials. The results of the research cover five main stages of the development process, namely: (1) Potential and problems, (2) Data collection, (3) Product design, (4) Design validation, and (5) Design revision.

- Potential and problems.

This study was based on the observation that teachers and students, as a creative generation, have technological readiness, such as applying their knowledge to everyday life, operating digital technology (mobile phones, personal computers, gadgets), and being able to adapt to developments in digital technology.

However, reality shows that there are problems in classroom learning, including the use of conventional physics learning media. Printed books and physical teaching aids do not provide adequate visualization of abstract concepts such as work and energy. From questionnaires and interviews with teachers and students, the following main findings were obtained: Learning media are not interactive and are not fully digital-based; teachers have used laptops/smartphones, but their functions have not been maximized in learning; and students show low interest and limited activity in physics learning. As a result, students become less interested and less active in physics learning. There is a lack of innovation in the creation of learning media because the teaching materials available in schools are not in line with the development of students in the digital era.

- Data Collection

The data collection stage was conducted to obtain initial data before developing media and applying it in classroom learning, as well as to analyze the requirements for developing products that meet user needs. Data were collected through observation, interviews, and needs surveys. The information gathered was used as a basis for developing contextual, curriculum-adaptive Interactive Digital Worksheets containing content appropriate to the characteristics of 11th-grade students. Data

collection also included adjusting the material to the Learning Outcomes (CP) in the Merdeka Belajar curriculum.

- **Product Design**

At the Design stage, researchers create an initial product or design for the Interactive Digital LKPD that will be developed, which consists of several stages:

- **Create a written storyline**

Researchers compiled a storyline for the Interactive Digital Worksheet that contains a sequential arrangement of sections, namely identity, learning objectives, materials, and interactive questions. This flow is adjusted to be easy to use through the TopWorksheets platform.

- **Prepare supporting components.**

- **The supporting components prepared include:**

- **Interactive Digital Worksheet identity (title, subject, class, student name).**

- **Clear and measurable learning objectives.**

- **Concise material containing the subject matter of Work and Energy, complete with pictures/diagrams.**

A collection of interactive questions: multiple choice, fill-in-the-blank, drag-and-drop, or matching.

Illustrations or supporting images for the material (if needed).

- **Creating Interactive Digital Worksheets on Business and Energy with Web TopWorksheets.**

An interactive digital worksheet is compiled digitally through Web TopWorksheets. Scan this code to join.



Figure 2 Digital Worksheets

The structure of the Interactive Digital Worksheet is compiled in one interactive working document in a digital format that makes it easy for students to:

- Fill in their personal details
- Read the learning objectives.
- Read the summary material.
- Answer interactive questions online.

Dividing the Interactive Digital Worksheet into three main sections, namely:

- **Identity and Learning Objectives Section**

This section contains: the cover, student identity, school name, subject, class, and learning objectives to be achieved. The design of this section can be seen in Figure 1.



Figure 3 Design of the Identity and Objectives of Interactive Digital Worksheet

- Material Section

This section contains a summary of the Work and Energy material, supplemented with supporting illustrations or diagrams. The material is written concisely and focuses on basic competencies. The design of this section can be seen in Figure 2.



Figure 4 Interactive Digital LKPD Material Design

- Interactive Questions Section

This section contains practice questions in the form of multiple choice, fill-in-the-blank, matching, or drag-and-drop. The questions are designed to be completed directly in TopWorksheets with easy navigation. The design of this section can be seen in Figure 3.

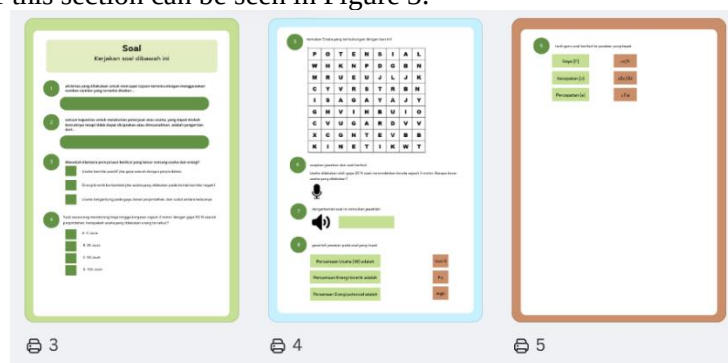


Figure 5 Interactive Digital Worksheet Design for Work and Energy

- Interactive Digital Worksheet on Business and Energy with TopWorksheets.

The completed Interactive Digital Worksheet has been uploaded to the TopWorksheets website. The Interactive Digital Worksheet can be accessed online via a public link shared with students via PC, laptop, or smartphone. The appearance of the Interactive Digital LKPD when accessed via a device can be seen in Figure 4.

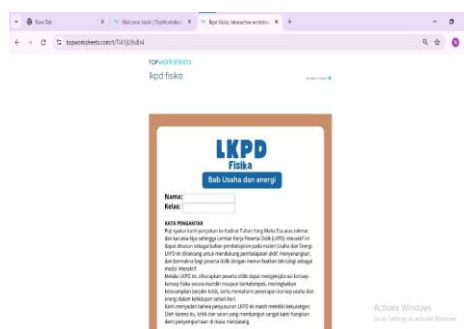


Figure 6 Interactive Digital Worksheet Display of Business and Energy through TopWorksheets

- Design Validation

During the design validation stage, the developed e-Module will be validated by experts to determine its feasibility based on assessments by subject matter experts who are competent in the field of physics education and media experts who are competent in the field of learning media.

- Results of Expert Validation of Materials and Media

The validation of materials and media was carried out by three lecturers from the Physics Education Department at KH. A. Wahab Hasbullah Tambak Beras University, Jombang. The validation was conducted using a validation questionnaire via Google Forms at the following website address: <https://forms.gle/LmWbNPMG2bHfa7ZU6>. The results of the questionnaire completed by the validators are shown in Table 2.

Table 2 Results of Content Expert Validation

	Criteria	Percentage (%)	Average Percentage (%)	Qualifications
Content Suitability				
	In accordance with grade 11 high school level	75	75	Eligible
Presentation Feasibility				
	Arranged systematically and logically	83	77	
	Test instructions/media usage are easy to understand	75		
	Uses various types of interaction (multiple choice, matching, etc.)	75		Eligible
	Duration of completion is in accordance with the difficulty level of the test	75		
Language Aspect				
	Uses proper Indonesian language and complies with PUEBI (Indonesian spelling guidelines)	83	79	
	Sentences are not ambiguous and are easily understood by students	75		Eligible
Graphical/Visual Aspect				
	Design is attractive, proportional, and not confusing	83	78	
	Writing is neat, consistent in size/font/layout	75		Eligible
	Pictures or illustrations support understanding of the material	75		
Technical Aspect				
	All buttons, audio, or other interactive elements function properly	83	81	
	Media can be easily accessed from student devices (HP/laptop)	83		
	No errors occur when the media is run	83		Very Eligible
	Overall, this media is suitable to be used for high school learning	75		
Average Validation Score of Content and Media		79	79	Eligible

Table 2 shows the results of validation by subject matter experts and media experts. Several important aspects were evaluated to ensure the suitability of the content and presentation of the material. The following are the results of the evaluation of relevant aspects with the percentages given:

- Content Feasibility Aspects

The validation results for content feasibility obtained a percentage of 75% with a Valid/Feasible qualification. This percentage indicates that the material is in line with the learning objectives, relevant to basic competencies, and contains the appropriate concepts. However, it is recommended that the material be enriched to improve the completeness of the content in order to support deeper student understanding.

- Feasibility Aspects of Presentation

The presentation aspect received a score of 77%, which also qualifies as Valid/Appropriate. This shows that the order of presentation of the material is systematic and logical, with clear instructions for use and a variety of question types that encourage student engagement. Several improvements could be made to make the presentation more attractive and maximize interaction.

- Language Aspects

The language aspect received a score of 79% with a rating of Valid/Appropriate. The language used is fairly standard, clear, and in accordance with good linguistic rules. However, the instructional sentences need to be reviewed to make them easier to understand for students with varying levels of ability.

- Graphic/Visual Aspects

The results of the graphic/visual aspect validation show a percentage of 78%, which is also considered Valid/Acceptable. The interface design is attractive and consistent, and the use of colors and layout supports readability. The use of illustrations is quite relevant to the material, but minor adjustments to the visual proportions can be made to optimize the display on various devices.

- Technical Aspects

For technical aspects, validation obtained a percentage of 81%, thus qualifying as Very Valid/Very Appropriate. All interactive elements functioned well without any errors. The media was also easily accessible on various devices and stable for use in online and face-to-face learning.

By combining the percentages from all aspects evaluated, an overall average percentage of 79% was obtained. Based on the established criteria, this percentage indicates that the interactive learning media for Work and Energy is deemed Suitable for use in the intended teaching context.

These results show that, in general, the media has met the eligibility criteria, although improvements are still recommended in several aspects, such as enriching the content, refining the presentation, clarifying the language, and optimizing the visual display to make it more relevant and support the achievement of learning objectives to the maximum extent possible. Thus, the evaluation results show that this media has passed the validation process well and can be considered valid and suitable for use as a supporting medium for physics learning on the topic of Work and Energy.

- Design Revision

The validated media products were then revised according to the experts' suggestions and input during the validation process. The validators' comments and suggestions are shown in Table 3 below.

Table 3 Validator comments and suggestions

Validator	Comments and suggestions
Subject matter and media expert	This Interactive Digital LKPD has a good design and is supported by learning outcome evaluations. However, because this is an Interactive Digital LKPD, there should be an Interactive Digital LKPD sheet that needs to be filled out by students regarding practical activities through the PhET simulator, whether it be discussions or data collection. The uploaded PPT media tends to be somewhat slow to respond, and network issues may also need to be anticipated because it is online-based.
	Overall, it is good, but more attention should be paid to which semester and/or class the energy material is taught in. More attention should be paid to EYD (Standard Indonesian Spelling) and the writing of equations. If it is a quadratic equation, it should be written with the correct quadratic notation. Finally, there is still an error in the spring potential energy equation.

Discussion

The results of the study indicate that TopWorksheets-based Interactive Digital Worksheet on Business and Energy material is suitable for use as a learning medium, with an average validation score of 79%, which falls into the “Suitable” category. This medium is designed to support active student engagement through interactive features that present physics material content in a concise and visual manner, as well as providing digital-based exercises that can be responded to immediately by students.

- **Media Suitability in the Context of Learning Theory**

From a constructivist learning theory perspective, the development of this Interactive Digital Worksheet is in line with the view that learning is an active process of constructing knowledge from experience (Piaget, 1977). Interactive Digital Worksheets provide direct learning experiences through visual exploration, manipulation of interactive elements, and context-based problem solving. This reinforces Vygotsky's (1978) theory of scaffolding, where this medium acts as a tool in the student's zone of proximal development.

Furthermore, this medium supports a multimodal learning approach, where students gain a better understanding when information is conveyed through text, images, and interaction (Mayer, 2014). TopWorksheets Interactive Digital Worksheets combine these components into one medium, which facilitates the transfer of information from abstract to concrete.

- **Comparison with Previous Research**

The results of this study reinforce the findings of Silmi et al (2025), which state that the use of TopWorksheets-based e-LKPD effectively improves the quality of learning and student engagement. Similarly, research by Zalukhu et al. (2022) also indicates that web-based interactive digital media can improve understanding of physics concepts because it provides a more enjoyable and contextual learning experience.

Meanwhile, research by Chutami & Suhartini (2021) shows that the use of interactive e-modules with self-evaluation features has an impact on improving learning outcomes with high effectiveness, especially in abstract materials such as energy. This is in line with the development of Interactive Digital LKPD in this study, which emphasizes interactive questions and direct feedback as a form of learning process evaluation.

Technical validation reaching 81% also confirms that this media is compatible with various devices and learning environments. This is in line with Arifin's (2024) study, which shows that web-based digital media has high flexibility and is suitable for use in hybrid and online learning.

- **Integration and Innovation of Existing Knowledge**

This research provides a new contribution by integrating a digital interactive approach into web-based Interactive Digital Worksheets in the context of the Merdeka Belajar curriculum. Previously, many interactive media were only developed in the form of standalone applications or interactive PowerPoint presentations, but not many have utilized web-based platforms such as TopWorksheets to develop Interactive Digital Worksheets that are responsive, structured, and easily accessible.

Furthermore, this approach adapts the principles of Design-Based Research in the form of gradual development, expert validation, and improvements based on feedback, thereby strengthening the position of this research as a model for developing contextual and user-need-based digital media.

- **Implications of Research Results**

The results of this study have several important implications:

- For teachers, this media can be used as an alternative to Interactive Digital Worksheets that can be customized and shared online with students, supporting distance and hybrid learning.
- For students, this media can increase motivation and engagement in learning because of its attractive, concise form and accessibility at any time.
- For media developers, this research demonstrates the potential of TopWorksheets as a teaching media platform that can be used more widely, not only for practice questions, but as a complete interactive digital worksheet structure.
- For theory development, these results support the integration of constructivist learning theory and web-based digital technology in learning media.
- **Limitations and Directions for Further Research**

This study is still limited to validation testing by experts and does not yet include effectiveness testing on a broader class scale. For further research, it is recommended to:

- Test the effectiveness of Interactive Digital Worksheets on improving student learning outcomes and motivation through quasi-experiments.
- Develop adaptive versions of Interactive Digital Worksheets based on TopWorksheets for other levels and topics, such as fluids, optics, or dynamic electricity.
- Including digital laboratory simulations integrated with resources such as PhET to complement the learning experience.

CONCLUSIONS

Based on the validation results conducted by subject matter experts and media experts on the interactive Business and Energy LKS, it can be stated that the media is deemed suitable for use in learning. Validation of the five aspects assessed shows that content suitability received a score of 75%, presentation suitability 77%, language 79%, graphics/visuals 78%, and technical aspects 81%. These scores prove that the media has been well-designed in terms of relevant and appropriate content, methodical and easy-to-understand presentation, communicative and appropriate language, aesthetic visual display, and technical operation free from interference. Combining all these elements, a validation median score of 79% was obtained, indicating that the media has met the established suitability standards. However, there are still several aspects that need to be improved, such as enriching the content, minimizing instructions, and improving the context and image quality to be more optimal and suitable for the students' conditions. Overall, this interactive worksheet media is declared valid and suitable for use as physics learning media, especially on the subject of Work and Energy, and is capable of improving the effectiveness and understanding of student learning outcomes.

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