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Bridging Science and Society: PBL-Based Digital Teaching Materials on Renewable Energy to Enhance Critical Thinking

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ABSTRACT

The enhancement of critical thinking skills has been extensively documented as effective through the application of the Problem-Based Learning (PBL) model. Furthermore, the integration of Socio-Scientific Issues (SSI) as contextual learning content has demonstrated significant potential in fostering students' critical and context-aware reasoning. Integrating both approaches into a unified instructional framework offers the potential to optimize the development of students' critical thinking skills. This leverages the strengths of each approach, creating a more robust and contextually rich learning experience. This study aims to assess the feasibility and practicality of digital teaching materials based on the Problem-Based Learning (PBL) model and Socio-Scientific Issues (SSI) approach in enhancing students' critical thinking skills on the topic of renewable energy. The research employed a Research and Development (R&D) design utilizing the ADDIE model, which consists of the phases: Analysis, Design, Development, Implementation, and Evaluation. The feasibility of the digital teaching materials was validated by experts, with material experts assigning a validity score of 0.91 and media experts a score of 0.93, both of which fall within the high validity category. The practicality assessment yielded a practicality percentage of 91.28% from teachers and 86.50% from students, both categorized as highly practical. These findings indicate that the PBL–SSI–based digital teaching materials on renewable energy are both feasible and practical for fostering students' critical thinking skills.

1. Introduction

The quality of a nation's education determines the progress of the nation itself. But in reality, the quality of education in Indonesia is still in the low category [1]. Improving the quality of education can be pursued through improving skills, knowledge, attitude, and changes in the education curriculum [2]. In the 21st century, Indonesia has changed the curriculum from the *kurikulum 2013* to the *kurikulum merdeka*, thus requiring changes in the approaches, strategies, and learning models used. In implementing the *kurikulum 2013*, there are several main problems including material

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completeness being prioritized over learner understanding and schools being given less freedom to create and innovate according to the needs of the school environment. The *kurikulum merdeka* comes as a solution to these problems, where this curriculum focuses on freedom and creative thinking [3]. The characteristics of the *kurikulum merdeka* according to the National Curriculum Information System in 2021 include focusing on essential material, developing *soft skills* and character according to the Pancasila learner profile, and the freedom of differentiated learning according to the needs of students while still adjusting the context and local content.

One important part that can help achieve the objectives of a *kurikulum merdeka* is the learning tools used, including teaching materials. Teaching materials are a series of materials, evaluations, and learning methods that are arranged to achieve learning objectives [4]. Teaching materials can facilitate teachers and students during the learning process in the classroom [5,6]. Teaching materials can also make the learning process more effective and efficient [7,8]. The effectiveness of learning will certainly affect the learning outcomes of students. In this case, teachers play a role in designing and compiling innovative teaching materials [9] both in print and digital form according to the curriculum, the needs of students, and following the development of information technology [10]. Therefore, it is necessary to develop teaching materials in digital form.

Digital teaching materials are teaching materials that integrate various types of learning media, both in the form of audio, visual, and audio-visual to realize interactive learning [11] and increase students' interest and motivation to learn [12]. This allows for differentiated learning that facilitates various learning styles of students. In today's digital native era, several activities can be done simultaneously, for example, students can still absorb what they read while listening to music. Digital natives are more interested in digital-based teaching materials because they spend more time with their digital devices. This certainly encourages teachers to be more innovative in developing teaching materials [13] and provides space for students to be able to interact with these teaching materials freely through their respective cellphones [14].

In developing teaching materials, it is necessary to have an appropriate learning model to train students' critical thinking skills in achieving learning success. One of the appropriate learning models is the Problem Based Learning (PBL) learning model. PBL presents contextual problems in everyday life that make it easier for students to understand the material by linking it to the surrounding environment so as to make learning more meaningful [15]. The PBL learning model develops students' thinking, problem-solving, and intellectual abilities by focusing learning on real problems [16,17]. Students are trained to think critically in solving problems through a discussion process by integrating various previously acquired knowledge thoroughly [18,19]. Learning with the PBL model makes the class more active because students become the main subjects in learning [20]. The real relevance between the PBL learning model and everyday life requires students to learn actively, so this learning model is considered more innovative [21].

Teaching materials that can make it easier for students to master content include teaching materials with *Socio Scientific Issues* (SSI) content. SSI is a learning approach that raises scientific issues that cause controversy in society so that students are asked to be actively involved in discussing these issues [22-24]. In making learning media, there are several important aspects of SSI that need to be considered [25] including (1) problems in the form of real events, (2) contemporary relevance, (3) controversy, (4) describing the nature and process of science, (5) complex and open, (6) integrating science, technology, and social issues, (7) considering the ethical dimension. SSI contains the relevance of social issues or problems in society that are closely related to science concepts [26], so that there is no gap between what students get in school and the facts that occur in the field. Thus, SSI makes learning more meaningful because SSI bridges social problems in society with the context of science [27,28]. Learning with the SSI context can build students' argumentation skills through various perspectives [29]. The SSI context focuses on critical thinking and argumentation skills, so it is the right solution to improve students' critical thinking skills [30,31].

Teaching materials with the SSI approach can develop students' critical thinking skills. Critical thinking skills are included in the crucial skills in the 21st century that students must have to be able to adapt [32,33]. Critical thinking is thinking reflectively, reasonably or based on reason, and focused on determining what to do [34,35]. Someone who is able to solve problems is considered capable of thinking critically, reasonably, and creatively [36]. Critical thinking skills include five major aspects, namely the skills of providing simple explanations (basic classification), building basic skills, concluding (inference), providing advanced explanations, organizing strategies and tactics. With critical thinking skills, students can make the right decisions based on systematic, logical efforts, and through consideration of various points of view [37]. However, the critical thinking skills of students in physics learning are still relatively low even though this skill is a very crucial part in facing the demands of the current digital era [38]. The results of the analysis show that one of the factors causing the low critical thinking skills of students is the difficulty experienced by students in linking and interpreting between aspects in real life with mathematical model problems [39]. Thus, efforts are needed to improve critical thinking skills. Critical thinking skills have an adaptive mindset that is more sensitive to surrounding phenomena so that students become more familiar with their own environment [40]. Therefore, SSI is the right effort to be made in improving students' critical thinking skills.

Social environmental issues that continue to grow to this day include the issue of renewable energy. Renewable energy is a crucial issue that has long been discussed in Indonesia, especially related to fossil energy dependence [41]. This is certainly a big challenge for Indonesia, so it needs to be elaborated in learning. Renewable energy is one of the learning topics that requires good concept understanding because there are parts with quite complex concepts accompanied by mathematical calculations in it [42]. Some students still have difficulty in understanding concepts and solving problems on the sub-topic of effort and energy [43]. One of the efforts that can be made as a solution to this problem is by linking the relationship between the topic of renewable energy and the surrounding environment. Basically, the education curriculum will be better if it is integrated with the renewable energy potential of each region [44]. In addition to improving critical thinking skills, teaching materials that are integrated with regional potential can also train concept mastery and environmental care attitudes [45]. Thus, it is necessary to develop teaching materials with SSI content on the topic of renewable energy as a whole, so that they can train students' critical thinking skills optimally as a solution to existing problems.

Based on the background of the problems that have been described, it is necessary to develop PBL-based digital teaching materials and SSI content with phenomena that occur in real life, so that they can train students' critical thinking skills. Teaching materials in this research were developed in digital form in the form of a flipbook by integrating the syntax of the PBL learning model to facilitate students' critical thinking skills, where each sub-material presented in the teaching materials is accompanied by different SSI content.

1.1 Problem Formulation

Based on the description of the background, the following problem can be formulated:

i. What is the feasibility of PBL-based renewable energy digital teaching materials with SSI content to improve students' critical thinking skills?
ii. What is the practicality of PBL-based renewable energy digital teaching materials with SSI content to improve students' critical thinking skills?

1.2 Research Objectives

Based on the formulation of the problems that have been described, the objectives of this research are to:

i. Producing PBL-based renewable energy digital teaching materials with SSI content to improve students' critical thinking skills that are suitable for use in learning.
ii. Knowing the practicality of PBL-based renewable energy digital teaching materials with SSI content to improve students' critical thinking skills.

2. Methods

The research method used in this research is the Research and Development (R&D) method. The R&D method produces products based on needs analysis and tests the effectiveness of these products [46]. The development model used is the ADDIE model which consists of the Analysis, Design, Development, Implementation, and Evaluation stages [47,48]. The ADDIE model not only improves existing products, but also creates new products. In this research, the product development of PBL-based digital teaching materials with SSI content was only carried out up to the development stage on small-scale trials.

The analysis stage is the stage of analyzing the needs and identification of problems in the research subject before the implementation of development activities. Then, proceed with the design stage, namely the design of the digital teaching material products developed. Furthermore, the development stage is carried out to realize the product that has been designed at the design stage. The stages of the ADDIE model in full can be seen in Figure 1 below.

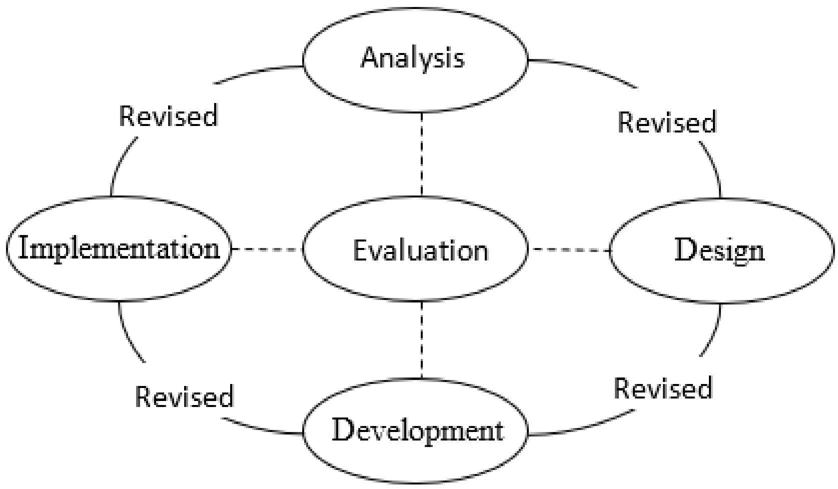


Fig. 1. Schematic of the ADDIE model approach

At the development stage, in addition to the realization of making digital teaching material products, the preparation of research instruments and validation of teaching materials that have been made is also carried out. Research instruments made in the form of teaching material validation instruments and practicality questionnaires. The validation instrument is used as a tool for assessing the validation of teaching material products developed, through the validation test of material experts and media experts. This validation test was conducted to determine the feasibility level of the teaching materials developed. Meanwhile, the practicality questionnaire is used to assess the level of ease or practicality of teaching materials when used in learning. Practicality questionnaires are given to physics teachers and students as users of teaching materials.

The results of the feasibility test assessment of teaching materials were analyzed using Aiken's V formula (1985) with Eq. (1) as follows [49]:

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

with $r - l_0, s$, the number of validators, n, the highest rating number, c, the lowest rating number, l_0, and the number given by the validator, r.

Aiken's V value will be better if it is close to 1. Aiken's V validity criteria can be seen in Table 1 below [50].

Table 1
Aiken's V validity classification

Score Interval	Validity Interpretation
V > 0.80	High
0.60 ≤ V < 0.80	High enough
0.40 ≤ V < 0.60	Enough
0.00 ≤ V < 0.40	Bad

The analysis results of the V-count are then compared with Aiken's V table. If the V-count value obtained is greater than the V table value, the teaching materials developed are declared valid and suitable for use in learning, and vice versa. After the teaching materials are declared valid through the feasibility test, then the teaching materials can be implemented in learning and tested for practicality.

The practicality test of teaching materials was carried out by distributing practicality questionnaires in the form of a Likert scale to teachers and students. The first practicality test was conducted by physics teachers, along with the feasibility test of teaching materials. The results of the practicality test of teaching materials by teachers were analyzed using the formula from Akbar (2013) in Eq. (2) as follows [51]:

$$V - au = \frac{TSe}{TSh} \times 100\% \quad (2)$$

with individual validation, $V - au$, total empirical score achieved, TSe, and total expected score, TSh.

After being declared practical by the teacher, the practicality test of the teaching materials was then carried out by students along with the small-scale trial. This aims to determine the students' response to the teaching materials developed as an evaluation material for improving teaching materials. The results of the practicality test of teaching materials from students were then analyzed using the following Eq. (3) [52]:

$$Practicality\ Percentage\ (P) = \frac{\sum \text{the score given by the student}}{\sum \text{maximum score}} \times 100\% \quad (3)$$

The results of the practicality test of teaching materials by teachers and students are classified according to the product practicality criteria shown in Table 2 below [53]:

Table 2
Criteria for the practicality of teaching material products

Criteria (%)	Practicality Level
$0 \leq P < 21$	Not practical
$21 \leq P < 41$	Less practical
$41 \leq P < 61$	Practical enough
$61 \leq P < 81$	Practical
$81 \leq P < 100$	Very practical

3. Results and Discussion

The problem analysis in this research was carried out through observation and interview methods conducted at SMA Negeri 6 Semarang, especially in class X. The results of the interview with one of the Xth grade physics teachers mentioned that the learning objectives in the form of analysis and problem solving have not been achieved optimally due to the lack of carrying capacity of the teaching materials used, where the content in the teaching materials does not train students' critical thinking skills. In the observation of the teaching materials used, contextual material has not been presented in it to support the topics of analysis and problem solving. In fact, the existence of phenomena that can be studied theoretically is needed to train critical thinking skills, but the teaching materials provided by schools have not integrated this context. In addition, the assessments presented in the teaching materials also do not integrate the concept of SSI as a stimulus, so they are only problems related to theory and do not refer to solving problems around. The results of interviews with several grade X students show that most of them want differentiated learning with the majority of audio-visual learning styles, so they tend to want learning media with a variety of content variations in it. However, the implementation of the *kurikulum merdeka* at SMA Negeri 6 Semarang, especially in class X, is not supported by the existing learning media which has not been able to meet the needs of the curriculum and the needs of students. The learning that is done is still teacher-centered and has not raised real phenomena that are interesting to learn, so that students feel bored more quickly during learning. In addition, the learning process has not integrated the PBL model. The assignment given is only in the form of solving problems provided by YouTube videos without any discussion process in it, so it does not accommodate students' critical thinking skills. Thus, innovation is needed in the development of PBL-based teaching materials with SSI content accompanied by examples of real phenomena in everyday life to train students' critical thinking skills.

The teaching materials developed are PBL-SSI-based digital teaching materials in the form of flipbooks that contain various variations of content (audio, visual, audio-visual) to facilitate the learning style needs of students, thus supporting differentiated learning. The teaching materials also contain social scientific issues (SSI) to facilitate students' critical thinking skills. At this stage, the systematic content of teaching materials developed based on the results of the analysis of needs and potential problems is formulated. The integration of the use of PBL learning models and SSI content in the content of digital teaching materials is shown in Table 3 below.

Table 3
Application of PBL model and SSI content in digital teaching material content

Syntax of PBL-SSI Model	SSI Content	Aspects of Critical Thinking
Orient students to the SSI problem	An introduction to waterwheels in Rajapolah Subdistrict, Tasikmalaya, which utilize the water of the Citanduy River to overcome drought in rice fields	Simple explanation skills (basic classification)
Organize students to learn, especially in answering the SSI content presented	Identification of the case of the emergence of the Tobelo Tribe in the Kaorahe nickel mining concession area, Halmahera Forest due to mining activities	Building basic skills
Guiding independent and group investigations (there is a group discussion related to social issues about renewable energy material)	Discussion on the impact of PT Freeport's Special Mining Business License (IUPK) extension until 2061	Provide further explanation
Develop and present work	Analyze the relationship between the construction of the giant windmill PLTB Sidrap and the fulfillment of energy needs and make a simple energy-producing device/prototype design through Power Point.	Organize strategies and tactics
Analyze and evaluate the problem-solving process		Conclude (inference)

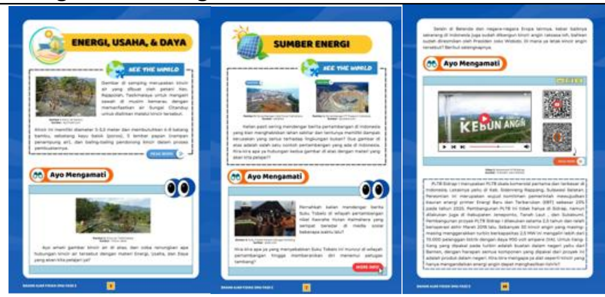
The design of the integration of the PBL learning model with SSI on renewable energy material is then packaged into the design of the developed digital teaching materials. The design of the digital teaching materials developed can be seen through the storyboard listed in Table 4 below.

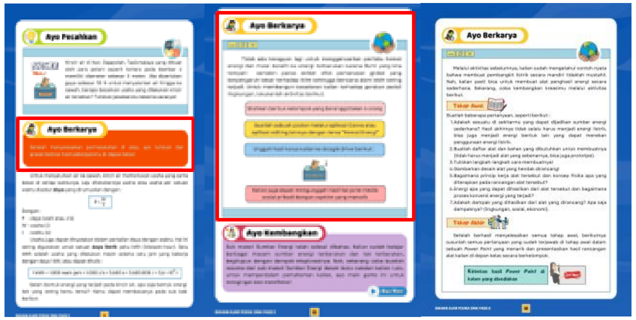
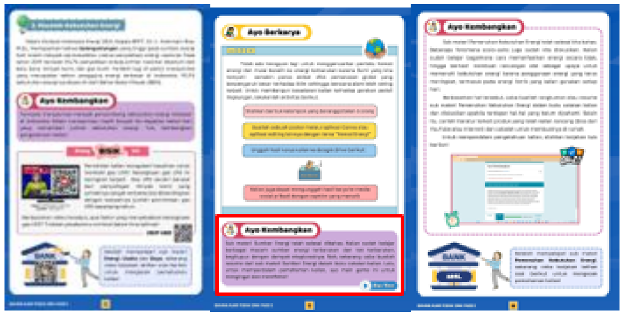
Table 4
Digital teaching material design storyboard

Content	Description
Cover	Contains the title of the material, class (phase), and the author of the digital teaching material.
Table of contents	Contains page information in digital teaching materials
Instructions for use	Contains guidelines for using digital teaching materials with an introduction to available tools
About teaching materials	Contains the parts contained in the teaching material
Content standard	Contains learning' outcomes, elements, and objectives
Concept map	Contains the flow of material to be learned
Ayo mengamati	In the form of the first syntax activity of PBL, namely orienting students to the problem
Ayo berpikir	In the form of the second syntax activity of PBL, namely organizing students to learn
Ayo pecahkan	In the form of the third syntax activity of PBL, namely guiding individual and group investigations.
Ayo berkarya	In the form of the fourth syntax activity of PBL, which is developing and presenting work.
Ayo kembangkan	In the form of the fifth syntax activity of PBL, namely analyzing and evaluating the problem solving process.
Material description	Contains discussion of material with SSI content that is equipped with a variety of content, in the form of news text, images, audio, and learning videos.
See the world	In the form of SSI issues discussed in digital teaching materials
Did you know	Include news articles as additional information to support the SSI issue being discussed.
Question bank	In the form of practice questions that are presented at the end of each sub-learning material
Evaluation questions	In the form of evaluation questions to measure students' understanding at the end of learning
Summary	Summarizes the material that has been discussed
Glossary	Contains a list of important words or terms contained in teaching materials

The final product developed is a digital teaching material based on the PBL learning model and SSI content on renewable energy material. Teaching materials are packaged in the form of flipbooks through Heyzine, so they can be directly used by users in flip form. In this case, users can use it as well as reading printed books in general, but the difference is that this teaching material is digital so that it is easier to use because there are various features that help users in using teaching materials. Teaching materials in the form of flipbooks certainly make it easier for teachers and students in the learning process, because they can be directly used without having to go through any application. Its flexible use allows learning time to be more effective and efficient. The learning activities presented in PBL-based digital teaching materials and SSI content are shown in Table 5 below.

Table 5
Learning activities in PBL-based digital teaching materials with SSI content

PBL-SSI based learning	Activities	Design of teaching materials
Ayo Mengamati	"*Ayo Mengamati*" is the implementation of PBL syntax orienting students to the problem and critical thinking aspects of providing simple explanations (basic classification). In this section, students are asked to answer the triggering questions posed before learning as a form of introduction to the renewable energy material to be discussed, namely related to forms of energy and energy conversion in the process of rotating waterwheels (sub-material energy, work, and power), the impact of exploration of non-renewable energy sources in Kaorahe nickel mining on the lives of surrounding communities (sub-material energy sources), and the working principle of windmills in generating electricity (sub-material fulfillment of energy needs).	
Ayo Berpikir	"*Ayo Berpikir*" is the implementation of PBL syntax organizing students to learn and critical thinking aspects of building basic skills. In this section, students form groups to discuss the problems presented in the teaching materials, so that they exchange ideas and information with each other. The "*Ayo Berpikir*" activity in this teaching material is related to the energy conversion process in the rotation of the waterwheel (energy, work, and power sub-materials), the case of the emergence of the *Tobelo Dalam* Tribe due to the exploration of non-renewable energy sources in the form of nickel (energy source sub-materials), and the background of the PLTB Sidrap construction in South Sulawesi to meet electrical energy needs (energy needs fulfillment sub-materials).	 

Ayo Pecahkan	"*Ayo Pecahkan*" is the implementation of PBL syntax guiding individual and group investigations and critical thinking aspects providing further explanation. In this section, students form discussion groups to solve problems presented in teaching materials by referring to accurate literature sources, so that logical and appropriate solutions are obtained. Students have the freedom to argue in finding the right solution while still being guided by the accuracy of the source. The "*Ayo Pecahkan*" activity in this teaching material is related to the concept of work on a waterwheel (energy, work, and power sub-materials), the impact of extending PT Freeport's business license which explores non-renewable energy sources (energy source sub-materials), and the relationship between the construction of the PLTB Sidrap and the fulfillment of energy needs (energy needs fulfillment sub-materials).	
Ayo Berkarya	"*Ayo Berkarya*" is the implementation of the PBL syntax of developing and presenting work and the SSI aspect of organizing strategies and tactics. In this section, students are asked to present the results of their work in groups and provide responses to each other, thus training the critical thinking skills of students. In the "*Ayo Berkarya*" activity, students are asked to present the results of their discussion related to the concept of work on waterwheels (energy, work, and power sub-materials), create energy-saving theme posters through Canva and upload them on personal Instagram (energy source sub-materials), and design energy-producing devices/prototypes from renewable energy sources and then present them in front through Power Point (energy needs fulfillment sub-materials).	
Ayo Kembangkan	"*Ayo Kembangkan*" is the implementation of the PBL syntax of analyzing and evaluating the problem-solving process and the critical thinking aspect of inference. In this section, it is equipped with a "*Bank Soal*" at the end of each sub-material in the form of a collection of questions as material for evaluating students as well as drawing conclusions from what has been learned. In the "*Ayo Kembangkan*" activity, students are asked to solve analytical problems in the form of LPG gas scarcity issues (energy, work, and power sub-materials) and activities to summarize learning followed by quizzes (energy source sub-materials and energy needs fulfillment sub-materials).	

After developing teaching materials, the next step is to conduct feasibility testing of digital teaching materials to determine the feasibility level of the product. The feasibility test of teaching materials is divided into feasibility tests of material experts and media experts by involving five expert validators consisting of two physics lecturers FMIPA UNNES and three physics teachers. Teaching materials are declared feasible if they obtain a V-count score in the range of 0.80 to 1.00. The results of the feasibility test of PBL-based digital teaching materials with SSI content by material expert validators can be seen in Table 6 below.

Table 6
Material expert validation results of PBL-SSI digital teaching materials

No.	Aspects	V-Count	V-Table	Criteria
1	Content feasibility	0.89	0.8	Valid
2	Material presentation	0.96		Valid
3	Language	0.90		Valid
Average		0.91		Valid

In the material expert validation test, there are three aspects of assessment which include content feasibility, material presentation, and language. Based on the results of the material expert validation test, the average V-count score was 0.91> 0.8 so that the teaching materials developed were declared valid or feasible in the high category. In the aspect of content feasibility, a V-count of 0.89 > 0.8 was obtained and included in the valid criteria. This means that the teaching materials developed have contained material content that is in accordance with the integration of the PBL-SSI model in it, so that it has the potential to improve students' critical thinking skills. In the aspect of material presentation, a V-count of 0.96 > 0.8 was obtained and included in the valid criteria. This means that the teaching materials developed have been arranged coherently and systematically with various variations of content in it. In addition, the teaching materials have also met the completeness of the presentation according to the standards of BSNP (National Education Standards Agency). In the language aspect, a V-count of 0.90 > 0.8 was obtained and included in the valid criteria. This means that the writing in teaching materials has met the standards according to the applicable language rules, both in terms of writing scientific notation, spelling, and sentences used. The results of the feasibility test of PBL-based digital teaching materials with SSI content by media expert validators can be seen in Table 7 below.

Table 7
Media expert validation results of PBL-SSI digital teaching materials

No.	Aspects	V-Count	V-Table	Criteria
1	View	0.96		Valid
2	Graphics	0.91	0.8	Valid
3	Software	0.95		Valid
Average		0.93		Valid

In the media expert validation test, there are three aspects of assessment which include views, graphics, and software (use). Based on the results of the media expert validation test, the average V-count score was 0.93 > 0.8 so that the teaching materials developed were declared valid or feasible in the high category. In the views aspect, a V-count of 0.96 > 0.8 was obtained and included valid criteria. This means that the design of teaching materials developed has an attractive and appropriate color composition and layout, making it comfortable to look at. In addition, teaching materials are also arranged consistently, both in content consistency, layout, and font usage. In the graphics aspect, the V-count is 0.91 > 0.8 and includes valid criteria. This means that the teaching materials have been prepared using the applicable fonts and page formats. In addition, teaching materials have also contained images, audio, and video with good quality and attractive so that they can attract students' interest in learning. In the software aspect, a V-count of 0.95> 0.8 was obtained and included valid criteria. This means that the teaching materials developed have easy access to use because they are supported by various interesting features that help users in using teaching materials.

After the teaching materials are declared feasible to use, then a practicality test is carried out to determine the level of ease of teaching materials when used in learning. The practicality test was carried out by distributing practicality questionnaires to three physics teachers and 36 small-scale trial students. The results of the practicality test of PBL-based digital teaching materials with SSI content by teachers can be seen in Table 8 below.

Table 8
Practicality test results of PBL-SSI digital teaching materials by teachers

No.	Aspects	Percentage (%)	Criteria
1	Learning material	92.2	Very practical
2	Material presentation	89.3	Very practical
3	Use of language	93.3	Very practical
Average		91.28	Very practical

The practicality test of digital teaching materials by teachers is intended to determine the assessment given by the teacher regarding the suitability of the teaching materials developed with the learning design [54]. Teacher assessment is needed to find out how practical the product developed [55]. In the practicality test of teaching materials by teachers, there are three aspects of assessment which include learning material, material presentation, and use of language. Based on the results of the practicality test by the teacher, the average practicality score was 91.28% and included in the very practical criteria. In the aspect of learning materials, the practicality score was 92.2% and included very practical criteria. This means that the material presented in the teaching materials is in accordance with the learning objectives to be achieved [56]. The description of the material is in accordance with the applicable curriculum and is arranged coherently and systematically with a variety of relevant content [57]. In the aspect of material presentation, a practicality score of 89.3% was obtained and included very practical criteria. Interesting content variations equipped with interactive multimedia displays encourage more interest and motivation to learn to students [58,59]. Presentation of material with an attractive appearance makes teaching materials easier to understand [60]. In the aspect of language use, a practicality score of 93.3% was obtained and included very practical criteria. This means that the language and terms used in teaching materials are written with appropriate language rules, so that the information presented can be conveyed well to readers [57]. After testing the practicality of teaching materials by teachers, then testing the practicality of teaching materials by students, the results can be seen in Table 9 below.

Table 9
Practicality test results of PBL-SSI digital teaching materials by students

No.	Aspects	Percentage (%)	Criteria
1	Effectiveness	86.39	Very practical
2	Interactive	85.00	Very practical
3	Efficiency	88.15	Very practical
4	Creativity	86.48	Very practical
Average		86.50	Very practical

The practicality test of teaching materials by students aims to see students' responses to the practicality of the teaching materials developed. In the practicality test by students, there are four aspects of assessment which include effectiveness, interactive, efficiency, and creativity. Based on the results of the practicality test of teaching materials by students, an average practicality score of 86.50% was obtained and included in the very practical criteria. In the effectiveness aspect, the practicality score was 86.39% and included very practical criteria. This means that the teaching materials developed are able to explain the learning material well supported by the appropriate material content in the teaching materials so that it makes it easier for students to understand the material. In the interactive aspect, a practicality score of 85% was obtained and included very practical criteria. This means that activities in teaching materials allow direct feedback between teachers and students so that learning becomes more active. In the efficiency aspect, a practicality score of 84% was obtained and included very practical criteria. This means that teaching materials are flexible (easy to use anytime and anywhere) according to the learning style of students and are also easy to access [61]. In the aspect of creativity, a practicality score of 86.48% was obtained and included very practical criteria. Thus, it means that teaching materials are presented in an attractive appearance so that learning becomes more interactive and not boring [62].

4. Conclusion

Based on the results of the research that has been carried out, it can be concluded that the digital teaching materials for renewable energy materials based on PBL and loaded with SSI are declared feasible to use based on the results of the feasibility test analysis of teaching materials by material experts and media experts. The teaching materials developed are also considered practical and easy to use in learning based on the results of the practicality test analysis of teaching materials by teachers and students. Thus, the teaching materials developed are ready to be implemented in learning for further product development, namely at the implementation and evaluation stages.

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References
[1] Kurniawati, Fitria Nur Auliah. “Meninjau Permasalahan Rendahnya Kualitas Pendidikan di Indonesia dan Solusi.” *Academy of Education Journal* 13, no. 1 (2022): 1–13. https://doi.org/10.47200/aoej.v13i1.765.
[2] Rizkita, Karine, and Achmad Supriyanto. “Komparasi Kepemimpinan Pendidikan di Indonesia dan Malaysia dalam Upaya Peningkatan Mutu Pendidikan.” *Jurnal Akuntabilitas Manajemen Pendidikan* 8, no. 2 (2020): 155–164. https://doi.org/10.21831/jamp.v8i2.32362.
[3] Rahayu, Restu, Rita Rosita, Yayu Sri Rahayuningsih, Asep Herry Hernawan, and Prihantini. “Implementasi Kurikulum Merdeka Belajar di Sekolah Penggerak.” *Jurnal Basicedu* 6, no. 4 (2022): 6313–6319. https://doi.org/10.31004/basicedu.v6i4.3237.
[4] Marta, Yonira Mike Vindi, and Ramli. “Analisis Kebutuhan Pengembangan Modul Pembelajaran Fisika SMA Berbasis Pendekatan STEM.” *JIPFRI (Jurnal Inovasi Pendidikan Fisika dan Riset Ilmiah)* 5, no. 2 (2021): 95–101. https://doi.org/10.30599/jipfri.v5i2.918.
[5] Kosasih, E. “Pengembangan Bahan Ajar.” *Jakarta: Bumi Aksara* (2021).
[6] Anharuddin, Muhammad `Izza Mahendra, and Andi Prastowo. “Pengembangan Bahan Ajar Tematik dengan Media Pembelajaran Lectora Inspire.” *Al-Madrasah: Jurnal Pendidikan Madrasah Ibtidaiyah* 7, no. 1 (2023): 94-108. https://doi.org/10.35931/am.v7i1.1467.
[7] Maulida, Syindi Isna, Trapsilo Prihandono, and Maryani. “Pengembangan Modul Fisika Gelombang Bunyi Berbasis React untuk Kelas XI IPA.” *Jurnal Pembelajaran Fisika* 8, no. 3 (2019): 174–180.

[8] Wahyuni, Sri, and Fauzul Etfita. "Efektivitas Bahan Ajar Berbasis Android terhadap Hasil Belajar." *GERAM (Gerakan Aktif Menulis)* 7, no. 2 (2019): 44–49. https://doi.org/10.25299/geram.2019.vol7(2).4069.

[9] Nuryasana, Endang, and Noviana Desiningrum. "Pengembangan Bahan Ajar Strategi Belajar Mengajar untuk Meningkatkan Motivasi Belajar Mahasiswa." *Jurnal Inovasi Penelitian* 1, no. 5 (2020): 967–974. https://doi.org/10.47492/jip.v1i5.177.

[10] Khulsum, Umi, Yusak Hudiyono, and Endang Dwi Sulistyowati. "Pengembangan Bahan Ajar Menulis Cerpen dengan Media Storyboard pada Siswa Kelas X SMA." *DIGLOSIA: Jurnal Kajian Bahasa, Sastra, dan Pengajarannya* 1, no. 1 (2018): 1–12. https://doi.org/10.30872/diglosia.v1i1.pp1-12.

[11] Nafidah, Rahmatun. "Pengembangan Bahan Ajar Digital Interaktif Berbantuan Adobe Flash pada Mata Pelajaran Korespondensi Kelas X OTKP di SMK YPM 3 Taman." *Jurnal Pendidikan Administrasi Perkantoran (JPAP)* 9, no. 1 (2021): 39–50. https://doi.org/10.26740/jpap.v9n1.p39-50.

[12] Wulandari, Mega, and Ade Iriani. "Pengembangan Modul Pelatihan Pedagogical Content Knowledge (PCK) dalam Meningkatkan Kompetensi Profesional dan Kompetensi Pedagogik Guru Matematika SMP." *Kelola: Jurnal Manajemen Pendidikan* 5, no. 2 (2018): 177–189. https://doi.org/10.24246/j.jk.2018.v5.i2.p177-189.

[13] Salsabila, Unik Hanifah, Anggie Perwitasari, Neysa Salsabila Felasufa Amadea, Khusnul Khasanah, and Bellafia Afisya. "Optimasi Platform Digital sebagai Transformasi Pendidikan Islam Berkemajuan." *IQRO: Journal of Islamic Education* 5, no. 2 (2022): 95–112. https://doi.org/10.24256/iqro.v5i2.3494.

[14] Faisal, Muh., Hotimah, Nurhaedah, Nurfaizah A. P., and Khaerunnisa. "Peningkatan Kompetensi Guru Sekolah Dasar dalam Mengembangkan Bahan Ajar Digital di Kabupaten Gowa." *Publikasi Pendidikan: Jurnal Pemikiran, Penelitian, dan Pengabdian Kepada Masyarakat Bidang Pendidikan* 10, no. 3 (2020): 266–270. http://ojs.unm.ac.id/index.php/pubpend.

[15] Sari, Ni Kadek Bulan Mella Ayunda, I Gusti Agung Ayu Wulandari, and I Wayan Wiarta. "Bahan Ajar Digital Interaktif Berbasis Problem Based Learning Materi Keragaman Budaya." *Jurnal Penelitian dan Pengembangan Pendidikan* 6, no. 1 (2022): 127–136. https://doi.org/10.23887/jppp.v6i1.46368.

[16] Maskur, Ruhban, Sumarno, Yasinta Rahmawati, Kenny Pradana, Muhamad Syazali, Ari Septian, and Endah Kinarya Palupi. "The Effectiveness of Problem Based Learning and Aptitude Treatment Interaction in Improving Mathematical Creative Thinking Skills on Curriculum 2013." *European Journal of Educational Research* 9, no. 1 (2020): 375–383. https://doi.org/10.12973/eu-jer.9.1.375.

[17] Syamsudin. "Problem Based Learning dalam Mengembangkan Kemampuan Berpikir Kritis dan Keterampilan Sosial." *ELSE: Elementary School Education Journal* 4, no. 8 (2020): 81-99. http://dx.doi.org/10.30651/else.v4i2.4610.

[18] Fakhriyah, F. "Penerapan Problem Based Learning dalam Upaya Mengembangkan Kemampuan Berpikir Kritis Mahasiswa." *Jurnal Pendidikan IPA Indonesia* 3, no. 1 (2014): 95–101. https://doi.org/10.15294/jpii.v3i1.2906.

[19] Sulardi, Mohamad Nur, and Wahono Widodo. "Pengembangan Perangkat Pembelajaran Fisika Model Problem Based Learning (PBL) untuk Melatih Keterampilan Berpikir Kritis Siswa." *JPPS (Jurnal Penelitian Pendidikan Sains)* 5, no. 1 (2017): 802-819. https://doi.org/10.26740/jpps.v5n1.p802-810.

[20] Adhani, Milan Sri, Andi Dewi Riang Tati, and Nur Abidah Idrus. "Penerapan Model Problem Based Learning (PBL) untuk Meningkatkan Keaktifan Belajar Siswa pada Kelas IV SD Negeri Panaikang Kabupaten Gowa." *Global Journal Teaching Professional* 1, no. 1 (2022): 38–45. https://doi.org/10.59562/progresif.v1i2.29477.

[21] Noer, Sri Hastuti, and Pentatito Gunowibowo. "Efektivitas Problem Based Learning Ditinjau dari Kemampuan Berpikir Kritis dan Representasi Matematis." *Jurnal Penelitian dan Pembelajaran Matematika* 11, no. 2 (2018): 17-32. https://doi.org/10.30870/jppm.v11i2.3751.

[22] Sismawarni, Wuri Utami Dea, Usman, Nur Hamid, and Pintaka Kusumaningtyas. "Pengaruh Penggunaan Isu Sosiosaintifik dalam Model Pembelajaran Berbasis Masalah terhadap Keterampilan Berpikir Tingkat Tinggi Siswa." *Jambura Journal of Educational Chemistry* 2, no. 1 (2020): 10–17. https://doi.org/10.34312/jjec.v2i1.4265.

[23] Kamaruddin, Andi Nurwasiawati, Andi Asmawati Azis, and A. Mushawwir Taiyeb. "Pengembangan Elektronik Modul (E-Modul) Berbasis Socio Scientific Issues (SSI) Terintegrasi Flip PDF Corporate Edition pada Materi Biologi Kelas XI Sekolah Menengah Atas." *Universitas Negeri Makassar* 3, no. 2 (2021): 1–11.

[24] Rahmayanti, Baiq Fitri, Muntari, and Yayuk Andayani. "Validasi E-Modul IPA Berbasis Socio-Scientific Issue (SSI) untuk Meningkatkan Motivasi Belajar dan Literasi Sains Peserta Didik." *JCAR: Journal of Classroom Action Research* 4, no. 1 (2022): 293–299. https://doi.org/https://doi.org/10.29303/jppipa.v6i1.264.

[25] Alfitriyani, Nia, Indarini Dwi Pursitasari, and Surti Kurniasih. "Biotechnology Module Based on Sociosaintific Issues to Improve Student's Critical Thinking Ability Through Online Learning." *Jurnal Pendidikan Matematika dan IPA* 12, no. 1 (2021): 23–39. https://doi.org/10.26418/jpmipa.v12i1.43179.

[26] Kartika, Ika, Surti Kurniasih, and Indarini Dwi Pursitasari. "Pengembangan Bahan Ajar Berbasis Socio-Scientific Issues pada Materi Bioteknologi untuk Meningkatkan Lietrasi Sains Siswa." *Journal of Science Education and Practice* 3, no. 1 (2019): 1–12. https://doi.org/10.33751/jsep.v3i1.1375.

[27] Rostikawati, Diana Ayu, and Anna Permanasari. "Rekonstruksi Bahan Ajar dengan Konteks Socio-Scientific Issues pada Materi Zat Aditif Makanan untuk Meningkatkan Literasi Sains Siswa." *Jurnal Inovasi Pendidikan IPA* 2, no. 2 (2016): 156-164. https://doi.org/10.21831/jipi.v2i2.8814.

[28] Siska, Wili Triani, Yunita, Yuyun Maryuningsih, and Mujib Ubaidillah. "Penerapan Pembelajaran Berbasis Socio Scientific Issues untuk Meningkatkan Kemampuan Argumentasi Ilmiah." *Edu Sains Jurnal Pendidikan Sains & Matematika* 8, no. 1 (2020): 22–32. https://doi.org/10.23971/eds.v8i1.1490.

[29] Sadler, T. D., William R. L., and Sami T. M. "Learning Science Content Through Sosio-scientific Issue-Based Intruction: A Multi-Level Assessment Study." *International Journal of Science Education* 38, no. 10 (2016): 1622–1635. https://doi.org/https://doi.org/10.1080/09500693.2016.120448.

[30] Wiyarsi, Antuni, and Çalik Muammer. "Revisiting The Scientific Habits of Mind Scale for Socio-Scientific Issues in The Indonesian Context." *International Journal of Science Education* 41, no. 17 (2019): 2430–2447. https://doi.org/10.1080/09500693.2019.1683912.

[31] Selamat, I. N. "Keterampilan Abad ke-21 pada Pembelajaran Sains dengan Konteks Socio-Scientific Issues di Indonesia: Tinjauan Literatur Sistematis." *Jurnal Pendidikan dan Pembelajaran IPA Indonesia* 11, no. 2 (2021): 14–21. https://doi.org/10.23887/jppii.v11i2.60895.

[32] Trilling, Bernie, and Charles Fadel. "21st Century Skills: Learning for Life in Our Times." *United States of Amerika: Jossey-Bass* (2009).

[33] Ayu, Putu Eka Sastrika. "Keterampilan Belajar dan Berinovasi Abad 21 pada Era Revolusi Industri 4.0." *Purwadita: Jurnal Agama dan Budaya* 3, no. 1 (2019): 77–83.

[34] Ennis, Robert H. "The Nature of Critical Thinking: an Outline of Critical Thinking Dispositions and Abilities." *Champaign: University of Illinois* (2011).

[35] Priyadi, Rian, Amin Mustajab, Mohammad Zaky Tatsar, and Sentot Kusairi. "Analisis Kemampuan Berpikir Kritis Siswa SMA Kelas X MIPA dalam Pembelajaran Fisika." *JPFT (Jurnal Pendidikan Fisika Tadulako Online)* 6, no. 1 (2018): 53–55. https://doi.org/10.22487/j25805924.2018.v6.i1.10020.

[36] Munif, Abdul. "Penggunaan Media PhET untuk Meningkatkan Kemampuan Berpikir Kritis dan Literasi Sains Siswa pada Materi Energi dan Perubahannya." *Jurnal Pendidikan dan Konseling* 4, no. 2 (2022): 17–25.

[37] Ariadila, Salsa Novianti, Yessi Feronica Nuryati Silalahi, Firda Hanan Fadiyah, Ujang Jamaludin, Sigit Setiawan. "Analisis Pentingnya Keterampilan Berpikir Kritis terhadap Pembelajaran bagi Siswa." *Jurnal Ilmiah Wahana Pendidikan* 9, no. 20 (2023): 664–669. https://doi.org/10.5281/zenodo.8436970.

[38] Azmi, Rizfanny Rafi'ul, and Titin Sunarti. "Analisis Hasil Riset Model Pembelajaran Kooperatif untuk Meningkatkan Keterampilan Berpikir Kritis." *Inovasi Pendidikan Fisika* 12, no. 3 (2023): 68–74.

[39] Fuadi, Husnul, Annisa Zikri Robbia, Jamaluddin, and Abdul Wahab Jufri. "Analisis Faktor Penyebab Rendahnya Kemampuan Literasi Sains Peserta Didik." *Jurnal Ilmiah Profesi Pendidikan* 5, no. 2 (2020): 108–116. https://doi.org/10.29303/jipp.v5i2.122.

[40] Hayati, Nurul, and Deni Setiawan. "Dampak Rendahnya Kemampuan Berbahasa dan Bernalar terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar." *Jurnal Basicedu* 6, no. 5 (2022): 8517–8528. https://doi.org/10.31004/basicedu.v6i5.3650.

[41] Iskandar, Andi Nur Charisma Putri, Devan Filia Pratama, and Muhamad Muhdar. "Transformasi Energi Indonesia: Konstelasi Geopolitik dan Pengaturan untuk Energi Terbarukan." *Jurnal de Jure* 14, no. 1 (2022): 18–28.

[42] Amelia, Ocha, Putri Dwi Sundari, Fatni Mufit, and Wahyuni Satria Dewi. "Analisis Kebutuhan Pengembangan E-Modul dengan Pendekatan Contextual Teaching and Learning untuk Meningkatkan Pemahaman Konsep pada Materi Energi Terbarukan." *Jurnal Ilmiah Profesi Pendidikan* 9, no. 1 (2024): 34–39. https://doi.org/10.29303/jipp.v9i1.1849.

[43] Pratama, Neng Dyah Surya, Agus Suyudi, Halimatus Sakdiyah, and Faisal Bahar. "Analisis Kesulitan Siswa dalam Memecahkan Masalah Fisika Materi Usaha dan Energi." *Jurnal Riset Pendidikan Fisika* 2, no. 2 (2017): 82–88. http://journal2.um.ac.id/index.php/jrpf/.

[44] Budiarso, Aris Singgih. "Pengembangan Bahan Ajar Berbasis Metode Hypnoteaching untuk Memotivasi Siswa SMP dalam Belajar IPA pada Materi Energi Terbarukan." *Jurnal Pena Sains* 3, no. 2 (2016): 132–141.

[45] Nuraini, Lailatul, Supeno, Sudarti, Sri Astutik, and Shinta Nuriyah Mahbubiyah Royani. "Analisis Kemampuan Penguasaan Konsep IPA Terpadu dan Kepedulian Lingkungan Mahasiswa melalui Penggunaan Bahan Ajar Pengolahan Tebu sebagai Energi Terbarukan." *Jurnal Kumparan Fisika* 5, no. 1 (2022): 15–22. https://doi.org/10.33369/jkf.5.1.15-22.

[46] Sugiyono. "Metode Penelitian Kuantitatif, Kualitatif, dan R&D." *Bandung: CV Alfabeta* (2016).

[47] Sugiyono. "Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D." *Bandung: Alfabeta* (2015).

[48] Safitri, Meilani, and M.Ridwan Aziz. "ADDIE, Sebuah Model untuk Pengembangan Multimedia Learning." *Jurnal Pendidikan Dasar* 3, no. 2 (2022): 50–58. http://jurnal.umpwr.ac.id/index.php/jpd/article/view/2237.

[49] Bashooir, Khoirul, and Supahar. "Validitas dan Reliabilitas Instrumen Asesmen Kinerja Literasi Sains Pelajaran Fisika Berbasis STEM." *Jurnal Penelitian dan Evaluasi Pendidikan* 22, no. 2 (2018): 219–230. https://doi.org/10.21831/pep.v22i2.19590.

[50] Febriandi, Riduan, Agus Susanta, and Wasidi. "Validitas LKS Matematika dengan Pendekatan Saintifik Berbasis Outdoor pada Materi Bangun Datar." *Jurnal Pembelajaran dan Pengajaran Pendidikan Dasar* 3, no. 1 (2019): 148–158. https://doi.org/10.33369/dikdas.v3i1.10612.

[51] Irawan, Ardy, and M. Arif Rahman Hakim. "Kepraktisan Media Pembelajaran Komik Matematika pada Materi Himpunan Kelas VII SMP/MTs." *Pythagoras: Jurnal Program Studi Pendidikan Matematika* 10, no. 1 (2021): 91–100. https://doi.org/10.33373/pythagoras.v10i1.2934.

[52] Oktafiana, Eka, Triani Ratnawuri, and Meyta Pritandhari. "Pengembangan Modul Ekonomi Berbasis Pendekatan Saintifik pada Peserta Didik Kelas XI SMA Negeri 2 Metro." *Edunomia: Jurnal Ilmiah Pendidikan Ekonomi* 1, no. 1 (2020): 1–13. https://doi.org/10.24127/edunomia.v1i1.368.

[53] Prasetya, Ari, Rohana, and Nyiayu Fahriza Fuadiah. "LKPD Materi Garis Singgung Persekutuan Dua Lingkaran Berbantuan Geogebra untuk Kelas VIII." *Jurnal Cendekia : Jurnal Pendidikan Matematika* 7, no. 3 (2023): 2178–2190. https://doi.org/10.31004/cendekia.v7i3.2180.

[54] Yusuf, Rahma Ramadanti, Tirtawaty Abdjul, and Citron S. Payu. "Validitas, Kepraktisan, dan Efektivitas Bahan Ajar Berbantuan Google Sites pada Materi Getaran, Gelombang dan Bunyi." *Ideas: Jurnal Pendidikan, Sosial, dan Budaya* 9, no. 1 (2023): 199–208. https://doi.org/10.32884/ideas.v9i1.1115.

[55] Wahyudi, Nur, and Hisbullah. "Kepraktisan LKPD pada Materi Pencernaan Manusia Berbasis Pembelajaran Interaktif Guru dan Siswa." *Journal of Mathematics Science & Engineering Research* 1, no. 1 (2024): 23–36.

[56] Widyasti, Ni Made Sih, I. G. L. Wiratma, and I. W. Muderawan. "Uji Validasi Pengembangan Lembar Kerja Siswa Berbasis Pendekatan Saintifik." *Jurnal Ilmiah Pendidikan dan Pembelajaran* 4, no. 1 (2020): 79–85.

[57] Wati, Desi Kurnia, Sehatta Saragih, and Atma Murni. "Kevalidan dan Kepraktisan Bahan Ajar Matematika Berbantuan FlipHtml5 untuk Memfasilitasi Kemampuan Pemahaman Matematis Siswa Kelas VIII SMP/MTs pada Materi Koordinat Kartesius." *JURING (Journal for Research in Mathematics Learning)* 5, no. 4 (2022): 287–298. https://doi.org/10.24014/juring.v5i4.16717.

[58] Khamidah, Ngulmi, Winarto, and Vita Ria Mustikasari. "Discovery Learning: Penerapan dalam Pembelajaran IPA Berbantuan Bahan Ajar Digital Interaktif untuk Meningkatkan Prestasi Belajar Siswa." *JIPVA (Jurnal Pendidikan IPA Veteran)* 3, no. 1 (2019): 87–99. https://doi.org/10.31331/jipva.v3i1.770.

[59] Nababan, Salma Tua, and Desy Hanisa Putri. "Analisis Kebutuhan E-LKPD terhadap Pembelajaran Fisika di Masa Pandemi Covid-19." *JIPFRI (Jurnal Inovasi Pendidikan Fisika dan Riset Ilmiah)* 6, no. 1 (2022): 32–40. https://doi.org/10.30599/jipfri.v6i1.1199.

[60] Alwi, Zahra, Ernalida, and Yenni Lidyawati. "Kepraktisan Bahan Ajar Perencanaan Pembelajaran Berbasis Pendidikan Karakter dan Saintifik." *Fon : Jurnal Pendidikan Bahasa dan Sastra Indonesia* 16, no. 1 (2020): 10–21. https://doi.org/10.25134/fjpbsi.v16i1.2312.

[61] Kuncahyono. "Pengembangan E-Modul (Modul Digital) dalam Pembelajaran Tematik di Sekolah Dasar." *JMIE: Journal of Madrasah Ibtidaiyah Education* 2, no. 2 (2018): 219-231. https://doi.org/10.32934/jmie.v2i2.75.

[62] Nahdiyah, Dini, Muhammad Nur Hadi, and Anang Sholekhudin. "Inovasi E-Modul Berbasis MooDis pada Mata Pelajaran Al-Qur'an Hadis dalam Meningkatkan Motivasi Belajar Siswa Kelas X MA Ma'arif Durensewu Pandaan." *Jurnal Dimensi Pendidikan dan Pembelajaran* 12, no. 2 (2024): 169–184. https://doi.org/10.24269/dpp.v12i2.9585.