

Analysis of the Needs for the Development of Digital Teaching Materials Based on Multiple Learning Materials Objects in Elementary Schools

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Abstract:

This study aims to analyze the needs of elementary school students and teachers for the development of digital teaching materials based on Multiple Learning Materials Object (MLMO) on energy transformation materials. The background of this research is based on the low level of science literacy among students and the limitations of conventional teaching materials, which are less interactive and not yet contextualized with daily life. The research used a mixed methods approach with a sequential explanatory design, starting with the collection of quantitative data through questionnaires completed by 60 grade IV students, then continuing with semi-structured interviews with four science subject teachers. Data were analyzed using descriptive statistics and thematic analysis. The results of the study show that students have a high preference for visual and interactive learning media, such as videos, digital quizzes, and simulations, which facilitate the understanding of abstract concepts. Meanwhile, teachers emphasized the importance of digital teaching materials that are lightweight, accessible, and relevant to the socio-cultural context of students. Based on these findings, the development of MLMO-based digital teaching materials is considered to have the potential to increase learning motivation, conceptual understanding, and science literacy among elementary school students while supporting the implementation of 21st-century learning that is creative, interactive, and oriented towards independent learning.

Keywords: *needs analysis; digital teaching materials; MLMO; science literacy; elementary school.*

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Introduction

21st century learning requires students to master a variety of essential skills, such as critical and creative thinking, collaboration, and effective communication. Basic education plays an important role as a foundation in developing these literacy skills (Khusna & Febrianto, 2024; Sukirman & Dewi, 2021). In the context of the Independent Curriculum, literacy is an aspect that is emphasized in every subject, including Natural and Social Sciences (IPAS). IPAS learning is designed to improve students' intellectual abilities while relating scientific and social concepts to daily life (Silalahi & Budiono, 2023). In line with this, the School Literacy Movement emphasizes that literacy and numeracy are basic competencies that are very important for improving the quality of national education (Adiputra & Heryadi, 2021).

However, various international reports show that the literacy skills of Indonesian students still face serious challenges. The results of the Programme for International Student Assessment (PISA) in 2022 show that only 25% of 15-year-old students reach the minimum standard in reading literacy, far below the Organisation for Economic Co-operation and Development (OECD) country average of 74% (Elvianasti et al., 2021). At the elementary school level, around 40% to 70% of students have not reached the minimum literacy competency (Harahap et al., 2022). This data reflects the need for more innovative learning strategies, especially in the provision of contextual and engaging teaching materials to support the improvement of students' literacy skills (Harahap & Marwiyah, 2023).

One of the main problems in social studies learning is the still dominant use of conventional teaching materials that are oriented towards teachers. The teacher-centered approach and the lack of interactivity in the learning process cause students to have difficulty understanding abstract concepts (Hariyono et al., 2024; Lestari & Rahmawati, 2022). To overcome this, the development of digital teaching materials is a relevant solution. Digital teaching materials are able to increase student engagement and provide flexibility in the learning process according to their respective learning speeds and styles (Suantara et al., 2023). In addition, various studies show that the use of interactive digital teaching materials can significantly increase students' motivation and learning outcomes (Muliadi et al., 2022).

One potential approach in the development of digital teaching materials is the Multiple Learning Materials Object (MLMO). This approach integrates various forms of learning media such as videos, interactive quizzes, simulations, and digital modules to enrich the learners' learning experience. MLMO not only functions as a source of information, but also encourages collaboration, communication, and active participation in learning (Wulandari, 2023). The application of MLMO to energy transformation materials is believed to help students understand the concept of energy in a more in-depth and contextual way, because this material is very close to daily life (Setiawan, 2022). Thus, students can develop critical and creative thinking skills more optimally.

The novelty of this study lies in its focus on the analysis of the need for the development of MLMO-based digital teaching materials on energy transformation materials at the elementary school level, which is still rarely studied in the literature. Most previous research has focused on the development of digital teaching materials in general or at the secondary education level, while the study of specific needs at the elementary school level is still limited (Fanani et al., 2022). Through a systematic needs analysis, this research is expected to contribute to designing learning products that are contextual, varied, and in accordance with the literacy characteristics of elementary school students. This approach is relevant to support the transformation of learning quality in the 21st century education era (Smith et al., 2023). Various studies also show that the application of the right learning model can have a significant effect on the development of students' creative thinking skills. The application of the brainstorming method can significantly increase students' creativity, while the Project-Based Learning (PjBL) model has been proven to be able to foster creative thinking skills innovatively (Nafiah et al., 2023). Therefore, the development of MLMO-based digital teaching materials based on the analysis of students' needs is seen as able to strengthen learning outcomes while increasing their active involvement in the learning process (Bulut et al., 2022; Sukarso et al., 2022).

Overall, these considerations emphasize the urgency and importance of designing interactive digital teaching materials that are appropriate to students' development and based on Multiple Learning Materials Object (MLMO) to teach energy transformation materials in elementary schools. This initiative not only promises to improve students' understanding of science concepts, but also encourages students' critical thinking skills, creativity, and active involvement from an early age. Therefore, this study aims to analyze the need to guide the development of MLMO-based digital teaching materials on energy transformation materials in primary education. Practically, the results of this needs analysis are expected to be a direct guide for teachers and developers in designing digital teaching materials that are more effective, attractive, and in

accordance with the characteristics of elementary school students, so that it can ultimately improve science literacy and student learning outcomes.

RESEARCH METHOD

This study uses a qualitative descriptive design to describe in depth the needs of teachers and students for digital teaching materials based on Multiple Learning Materials Object (MLMO). This approach was chosen because it allows researchers to understand participants' perceptions, experiences, and expectations contextually. The results of the descriptive analysis were used to identify patterns of needs and became the basis for the development of relevant digital teaching materials for elementary school students.

The participants in this study consisted of 60 grade IV students at SDN 1 Sumber Rezeki and SDN 2 Sumber Rezeki. Four science teachers from SDN 1 Sumber Rezeki, SDN 2 Sumber Rezeki, SDN 2 Teluk Kemang and SDN 1 Nusa Serasan. The purposive sampling technique was used to select participants based on their direct involvement in the learning process of energy transformation materials. This approach allows researchers to obtain relevant and in-depth data according to the research objectives.

This research is carried out through three stages, namely preparation, implementation, and analysis. The preparation stage includes the preparation and validation of research instruments in the form of simple questionnaires and interview guides tailored to the research objectives. The implementation stage was carried out by filling out questionnaires by elementary school students to obtain an overview of their learning experience, then followed by in-depth interviews with teachers to further explore the perceptions, needs, and obstacles faced in the learning process. The analysis stage was carried out in a qualitative descriptive manner, where the results of the interviews became the main data, while the findings from the questionnaire were used to complement and strengthen the interpretation of the data. The results of the analysis of the two data sources were integrated to determine the need for digital teaching materials based on Multiple Learning Materials Object (Safitri & Suningsih, 2025; Yanti & Raharjo, 2025)

The data of this study was collected through two techniques, namely questionnaires and semi-structured interviews. The main data were obtained through semi-structured interviews with four elementary school grade IV teachers who were purposively selected to explore in depth their teaching experiences, learning strategies, and needs and expectations for digital teaching materials based on Multiple Learning Materials Object (MLMO). Meanwhile, the questionnaire data is used as supporting data given to elementary school students with a Likert scale covering four aspects, namely learning style, literacy level, effectiveness of teaching materials, and the need for digital media. The results of the questionnaire were used to provide an overview of students' tendencies and needs for digital teaching materials, which were then used to reinforce the findings of the teacher interviews in a qualitative descriptive manner. (Abbasi et al., 2021; Suratmi & Sopandi, 2022; Utomo et al., 2021; Veith & Bitzenbauer, 2022)

The data was analyzed using a qualitative descriptive approach by emphasizing the results of teacher interviews through thematic analysis that included reduction, categorization, and meaning extraction to identify the needs and expectations for digital teaching materials based on Multiple Learning Materials Object (MLMO). The student questionnaire data was analyzed in a simple descriptive manner to show the tendency of learning preferences and digital media needs.

The results of the second analysis were integrated descriptively to find the relationship between the needs of students and teachers as the basis for recommendations for the development of interactive and contextual digital teaching materials. (Mutiarra et al., 2025; Raharjo et al., 2024; Safitri & Suningsih, 2025)

RESULTS AND DISCUSSION

Preparation Stage

The preparation stage begins with determining the focus of research related to the analysis of student and teacher needs for MLMO-based digital teaching materials. The researcher conducted a literature review to formulate research indicators, then compiled two main instruments in the form of student questionnaires and teacher interview guides. Both instruments are designed to explore aspects of learning style, literacy level, and the need for digital media as shown in table 1.

Table 1. Instrument Grille

Aspects	Indicator	No Item
Student Needs Questionnaire		
Learning Style	Identify students' preferences in understanding the material through visual, auditory, and kinesthetic learning styles	1,2,3,4,5,6,7
Student Literacy Level	Measure students' ability to understand, interpret, and relate information from texts or readings to everyday experiences	8,9,10,11,12
The Need for Digital Teaching Materials	Knowing students' needs and interests in digital teaching materials that are engaging, interactive, and easy to use	13,14,15,16,17,18,19,20,21,22
Availability of Teaching Materials	Identify students' perceptions of the availability and quality of teaching materials used in schools	23,24,25,26,27
Interview Guidelines		
Teaching Experience and Learning Context	Identify teachers' experiences in teaching energy transformation materials and obstacles faced in the use of conventional teaching materials.	1,2,3
Pedagogical Needs (Teaching Strategies)	Exploring the needs of teachers related to learning strategies and activities that can help students understand the concept of energy through digital teaching materials.	4,5,6
Technical (Facilities and Infrastructure)	Knowing the condition of facilities and technology support in schools that affect the application of digital teaching materials.	7,8,9
Cognitive Aspects (Understanding and Critical Thinking)	Explore how teachers help students understand energy concepts and develop critical thinking skills through digital learning media.	10,11
Aesthetic Aspects (Design and Media Display)	To find out the teacher's views on the appearance, design, and visual elements of digital teaching materials that are attractive and effective for elementary school students.	12,13
Socio-Cultural Aspects (Learning Context)	Assess the importance of integrating local context and cultural values in digital teaching materials to be relevant to students' lives.	14,15

Aspects	Indicator	No Item
Evaluation Aspects	Identify the evaluation methods that teachers commonly use and their expectations for the automatic evaluation feature in digital teaching materials.	16,17,18
Expectations for the Development of Teaching Materials	Exploring teachers' expectations and preferences for the features, content, and form of digital teaching materials based on <i>Multiple Learning Materials Object (MLMO)</i> .	19,20

Source: Processed by researcher, 2024

Before being used at the data collection stage, the instrument is validated by experts to assess the feasibility of the content, clarity of the item, and the suitability of the indicators for the purpose of the study. The validation results are as shown in table 2 below.

Table 2. Results of instrument validation by experts

Aspects	Questionnaire Assessment Score	Interview Guidelines Assessment Score	Information
Clarity	5	5	Highly Valid
Accuracy of Contents	5	5	Highly Valid
Relevance	5	5	Highly Valid
Content Validity	5	5	Highly Valid
No Bias	5	5	Highly Valid
Language Accuracy	5	5	Highly Valid

Source: Primary data, 2024

Implementation Stage

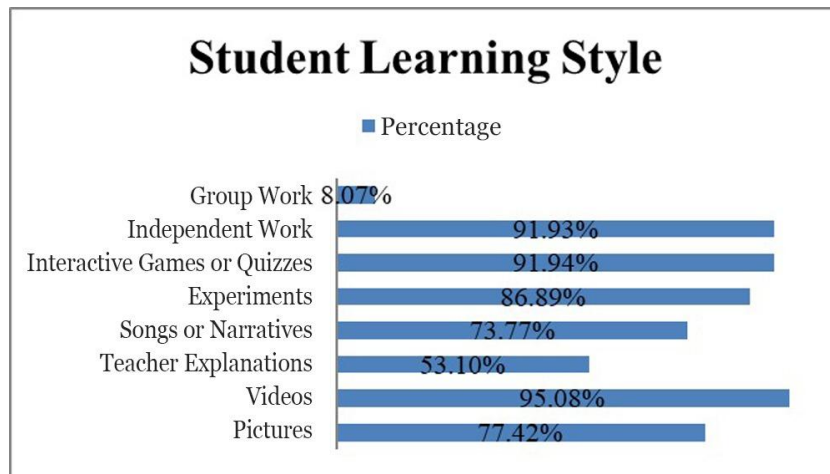
The implementation stage is carried out after the instrument is declared valid by experts. At this stage, the researcher distributed questionnaires to elementary school students to obtain quantitative data on learning styles, literacy levels, and the need for digital teaching materials based on *Multiple Learning Materials Object (MLMO)*. Furthermore, semi-structured interviews were conducted with teachers to explore qualitative information related to teaching experience, learning strategies, and obstacles in the use of digital media. All implementation activities are carried out in a planned and controlled manner so that the data obtained is valid, representative, and in accordance with the research objectives.

Stages of Analysis

Student Needs Analysis Results

The analysis of student needs was carried out to obtain an overview of the real conditions and needs in the learning process in energy transformation materials. This analysis includes four main aspects, namely student learning styles, student literacy levels, teaching materials currently used, and the need for digital teaching materials. These four aspects are interrelated in determining the direction of the development of teaching materials that are in accordance with the characteristics of students. The data collected from the questionnaire results showed a variation in students' learning style preferences as the basis for designing digital teaching materials based on

Multiple Learning Materials Object that is able to accommodate different individual learning methods. The following is presented the results of the analysis of student learning styles as shown in graph 1.

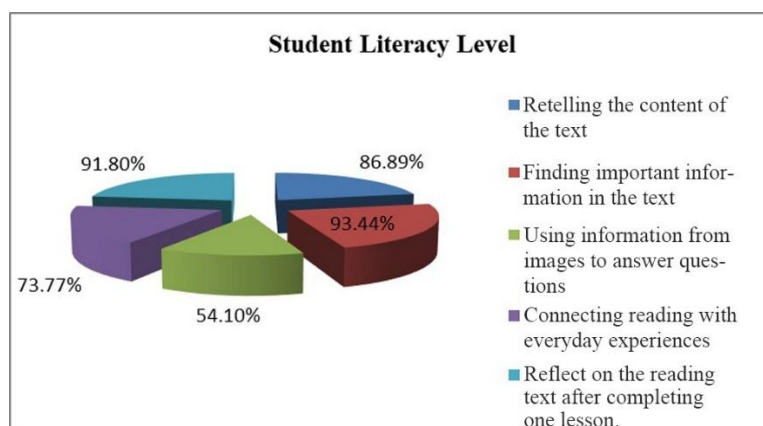


Graph 1. Results of questionnaire analysis of aspects of student learning style

Source: Student questionnaire data (n=60), 2024

Based on the results of the questionnaire, it is known that students have a high tendency towards learning through video (95.08%), games or interactive quizzes (91.94%), and independent learning (91.93%). These findings show that students prefer learning activities that are visual, interactive, and independent (Dewi, 2022; Kailani et al., 2021). In addition, learning styles through experiments (86.89%) and drawings (77.42%) are also in high demand, indicating that students need learning media that allows them to explore and gain concrete learning experiences (Saleh & Solihin, 2023).

In contrast, learning styles with songs or narratives (73.77%) and teacher explanations (53.10%) were at a moderate level, while group work (8.07%) showed the lowest preference. This condition indicates that students tend to be more comfortable learning individually than collaboratively (Hidayah et al., 2022; Pentianasari et al., 2022). Therefore, it is necessary to develop interactive multimedia-based digital teaching materials that can accommodate these various learning styles, so that the learning process becomes more effective in improving concept understanding and energy literacy in elementary school students (Ifliadi et al., 2024). Furthermore, the results of the analysis on the level of student literacy are presented to provide an overview of students' basic abilities in understanding and interpreting information in energy transformation materials.



Graph 2. The results of the questionnaire analysis of aspects of students' literacy level

Source: Student questionnaire data (n=60), 2024

Based on the results of the questionnaire on the aspect of students' literacy level, it was found that the ability to find important information in the text (93.44%) occupied the highest percentage. This shows that students are able to recognize the main ideas and key information in reading well (Maleta Zahra & Mukhlis, 2024; Melia Anggraeni & Muhammad Mukhlis, 2023). In addition, the ability to retell the content of the text (86.89%) and use information from images to answer questions (91.80%) also showed high results. These findings indicate that students are quite skilled in understanding the content of reading and relating it to visual representations, which is an important part of science literacy in elementary schools (Lase et al., 2022; Anggraeni & Mukhlis, 2023).

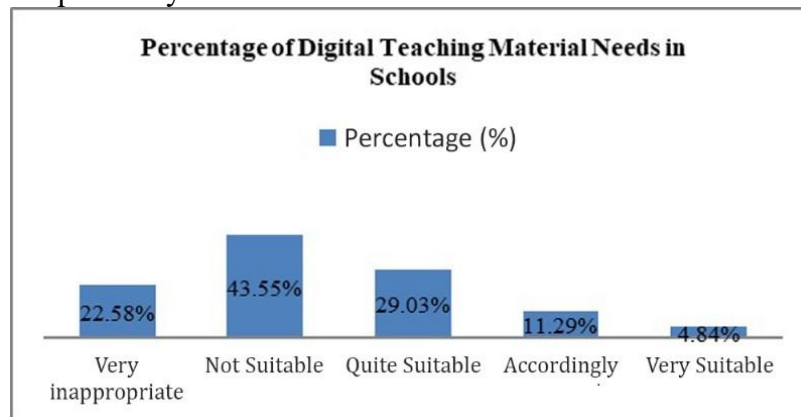
Meanwhile, the ability to relate reading to daily experiences (73.77%) and reflect on reading texts after completing learning (54.10%) was at a moderate to low level. This condition shows that students still need guidance in relating reading materials to real-life contexts and in reflecting on learning content (Perdana & Mukhlis, 2024; Wijayati & Widhiyoga, 2022). These results hint at the need for teaching materials that not only present information, but also encourage students to think critically and reflectively about the material studied. Furthermore, to find out the support of learning resources used in the learning process, a table is presented regarding the availability of teaching materials that are currently used in schools.

Table 3. The results of the questionnaire analysis of the aspect of the availability of teaching materials in schools

Statement	Category	Percentage
The teaching materials used today are good	3 (Sufficiently Suitable)	50,82 %
Existing teaching materials help to understand the material	4 (Suitable)	39,34 %
The existing teaching materials only focus on the material and practice questions	5 (Highly Suitable)	37,70 %
Existing teaching materials use many pictures and videos	3 (Sufficiently Suitable)	39,34 %
Available teaching materials include interactive quizzes and project activities	5 (Highly Suitable)	31,15 %

Source: Student questionnaire data (n=60), 2024

Based on the results of the questionnaire, 50.82% of students stated that the teaching materials currently used are quite appropriate, meaning that the teaching materials have helped learning but have not fully met the needs of students. The statement that teaching materials help understand the material obtained 39.34% (appropriate), indicating that teaching materials are quite effective in supporting concept understanding (Mamuaja et al., 2023). As many as 37.70% of students stated that the teaching materials still focus on material and practice questions, so that the aspects of skills and the application of concepts have not been optimally worked on. The use of images and videos is considered quite appropriate (39.34%), indicating that multimedia elements have not been utilized optimally (Torkos, 2023). Meanwhile, teaching materials containing interactive quizzes and project activities were only 31.15% (very appropriate), indicating that interactive activities were still limited (Mamuaja et al., 2023). These results confirm the need to develop digital teaching materials that are more interactive and contextual so that learning is more engaging and meaningful for elementary school students (Putri & Jayanta, 2023). Furthermore, the results of the analysis on the aspect of digital teaching material needs are presented in graph 3 to illustrate the types and forms of learning media expected by students.



Graph 3. Percentage of digital teaching materials needed in schools

Source: Student questionnaire data (n=60), 2024

Based on the results of the questionnaire, it is known that the use of digital teaching materials in schools is still relatively low. Most of the students stated that they were not appropriate (43.55%) and very inappropriate (22.58%), which shows that the digital teaching materials used have not been effective in supporting the learning process. As many as 29.03% of students assessed it as quite appropriate, while those who assessed it as appropriate (11.29%) and very appropriate (4.84%) were only a small part. These results show that the use of digital teaching materials in schools is not optimal and still needs to be improved in terms of quality, variety, and relevance to students' learning needs (Darwanto & Meilasari, 2022; Trinaldi et al., 2022). Furthermore, to further understand the types and forms of digital teaching materials needed by students, table 4 is presented regarding the need for digital teaching materials in schools.

Table 4. Results of analysis of the need for digital teaching materials

Statement	Frequency	Percentage
Digital teaching materials make it easy to understand lessons about energy transformation	54	87,10 %
Digital teaching materials with pictures and illustrations make it easy to understand lessons on energy transformation	54	87,10 %
Digital teaching materials contain engaging videos and make it easy to understand lessons on energy transformation	52	83,87 %
Digital teaching materials with interactive quizzes make it easy to understand lessons on energy transformation	47	75,81 %
Digital teaching materials contain educational games to make lessons more enjoyable	53	85,48 %
Digital teaching materials are easy to use and not confusing	53	85,48 %
Digital teaching materials can be accessed via mobile phones or tablets making it easier to learn anywhere	53	85,48 %
Digital teaching materials containing practice questions are more interesting to use	51	82,26 %
Teaching materials that provide feedback space help to reflect on learning	48	77,42 %

Source: Student questionnaire data (n=60), 2024

Based on the results of the questionnaire, most of the students responded positively to the use of digital teaching materials in energy transformation materials. As many as 87.10% of students stated that digital teaching materials, including those containing pictures and illustrations, facilitate the understanding of the material. In addition, 83.87% of students found learning videos interesting and helpful in understanding concepts, while 75.81% said that interactive quizzes made the learning process easier. Other features such as educational games, ease of use, and access via mobile devices were also positively rated by 85.48% of students, indicating that flexible and interactive digital teaching materials are preferred. Meanwhile, 82.26% of students found digital practice questions more interesting, and 77.42% felt that feedback helped with learning reflection. Overall, these results show that students need digital teaching materials that are interactive, easy to use, and contextual to improve energy understanding and literacy in elementary schools (Susanti et al., 2022; Maladerita et al., 2023).

Results of Teacher Needs Analysis

The analysis of needs seen from the teacher's perspective is carried out through interviews. The results of the interviews showed that elementary school teachers faced difficulties in teaching abstract concepts while growing student literacy through digital teaching materials. Teachers assessed the limitations of experimental tools and monotonous teaching materials as the main obstacles. As stated, *"Students find it difficult to understand abstract concepts, experimental tools are limited, textbooks are not interesting"* (Respondent 3) and *"Energy transformations are often not directly visible, so students find it difficult to imagine the process"* (Respondent 4). This limitation affects students' ability to understand texts and connect concepts with the context of life (Utomo et al., 2021)

Students' responses to conventional teaching materials are also diverse. *"Student responses were mixed: some were less enthusiastic, bored quickly"* (Respondent 4), but *"Students were very interested and enthusiastic; learning takes place in fun and interactive"* (Respondent 2) when digital media is used. This shows that visualization and interactivity play an important role in strengthening science literacy (abbasi). In addition, learning strategies that are considered effective are experience-based activities such as simulations, experiments, and digital quizzes. *"Learning activities that help students are interactive simulations, experiments, videos, simple quizzes"* (Respondent 3) and *"Simulations and collaborative activities make students actively ask questions"* (Respondent 2). Teachers also show readiness to use digital teaching materials *"as an introduction, exercise, and reinforcement of materials"* (Respondent 1). These findings reinforce the importance of active and technology-based learning in developing students' literacy and critical thinking (utomo).

From a technical perspective, digital facilities in schools still vary. *"The digital facilities are complete and supportive of learning"* (Respondent 2) in contrast to *"Our learning tools are limited and alternate"* (Respondent 3). Therefore, teachers want digital teaching materials that are lightweight, *offline*, and easy to use. This need shows the need for inclusive design so that digital teaching materials can be accessed in various school conditions (Ghaderi, 2023). The teacher also highlighted the importance of visual design in attracting attention and supporting multimodal literacy. *"Bright colors, lots of pictures and animations, pleasant sounds"* (Respondent 3) and *"Visuals make students understand better (99% can with visuals)"* (Respondent 2) illustrate that aesthetic aspects not only strengthen motivation, but also help with the understanding of visual texts (Abbasi et al., 2021; Veith & Bitzenbauer, 2022).

In addition, teachers emphasize the relevance of socio-culture in learning. *"Teaching materials should be close to students' lives"* (Respondent 3) and *"Good if they contain local cultural values"* (Respondent 3). The local context is considered to enrich literacy and foster a sense of pride in regional culture (Wisanti et al., 2021). In terms of evaluation, teachers use a combination of tests and practice, but consider the automatic evaluation feature important to improve efficiency. *"It is important if digital teaching materials have evaluation questions, so that students know the direct results and the teacher is helped"* (Respondent 3). This feature helps measure the ability to read, understand, and apply concepts independently (Abbasi et al., 2021).

Teachers' expectations for digital teaching materials based on *Multimedia Learning Multiple Output (MLMO)* are very large. They want media that is interactive, accessible, and encourages active student engagement. *"Helping students understand abstract energy concepts, increasing student interest, and engagement"* (Respondent 4) and *"Animated videos, interactive simulations, automated quizzes, additional materials at home"* (Respondent 3) show hope for digital teaching materials that are feature-rich, flexible, and relevant to strengthening science literacy (Veith & Bitzenbauer, 2022). It can be concluded that elementary school teachers have a high awareness of the importance of digital teaching materials to strengthen student literacy. The main obstacle lies in the limitations of facilities and less attractive media. The development of teaching materials based on *Multiple Learning Materials Object (MLMO)* with an interactive, visual, and contextual approach is believed to be able to increase the motivation, understanding, and science literacy of elementary school students.

Discussion

The analysis of student needs shows that effective learning on energy transformation materials requires the support of digital teaching materials that are interactive, visual, and encourage independent learning. Students' preference for video-based media, quizzes, and simulations signifies a strong tendency to learn through multisensory experiences. This reinforces the *theory of Cognitive Theory of Multimedia Learning* which asserts that the combination of visual and verbal channels improves the retention and understanding of abstract concepts. Thus, digital teaching materials not only function as an auxiliary medium, but also as a means of strengthening science literacy that helps students read, understand, and interpret scientific information more meaningfully (Kailani et al., 2021; Mutiara et al., 2025). Learning approaches that involve interactivity and visualization have also been shown to increase the focus, motivation, and learning independence of elementary school students (Marita et al., 2025; Safitri & Suningsih, 2025).

Students' literacy skills that still tend to be limited to literal comprehension show that learning has not fully encouraged reflective and applicative thinking processes. Therefore, digital teaching materials need to be designed not only to convey content, but also to stimulate critical and reflective thinking skills through activities based on the context of daily life (Anggraeni & Mukhlis, 2023; Raharjo et al., 2024; Wijayati & Widhiyoga, 2022). The application of the *Multiple Learning Materials Object (MLMO) approach* is considered relevant because it is able to integrate various learning modes such as simulations, contextual videos, and educational games that can strengthen students' energy literacy and 21st century skills (Suratmi & Sopandi, 2022; Yanti & Raharjo, 2025). With an interactive and contextual design, MLMO-based digital teaching materials have the potential to enhance students' ability to analyze, relate concepts, and reflect on the meaning of learning in real life.

From the perspective of teachers, the results of the interviews show that the main need lies in the availability of digital teaching materials that are contextual, flexible, and easy to use in the midst of limited learning facilities. Teachers face difficulties in explaining abstract concepts and fostering students' interest in literacy due to limited media and learning time. They emphasized the importance of teaching materials that are interactive, can be accessed *offline*, and are relevant to the socio-cultural context of students (Raharjo et al., 2024; Utomo et al., 2021; Veith & Bitzenbauer, 2022). Thus, the collaboration between teachers' needs and student preferences is the basis for the development of MLMO-based digital teaching materials that are not only visually appealing, but also functional in strengthening conceptual understanding, science literacy, and independent learning character in elementary school students (Mutiara et al., 2025; Safitri & Suningsih, 2025; Yanti & Raharjo, 2025).

CONCLUSION

The results of the study show that both students and teachers have a strong need for the development of digital teaching materials based on Multiple Learning Materials Object (*MLMO*) for learning IPAS on energy transformation materials. From the student side, interactive, visual, and contextual teaching materials have proven to be more effective in improving concept understanding, science literacy, and learning motivation. Meanwhile, from the teacher's side, the limited facilities and dominance of conventional teaching materials require the presence of digital

learning media that is flexible, easily accessible, and relevant to the socio-cultural context of students. The integration of various forms of media such as videos, simulations, and interactive quizzes in one platform is considered to be able to bridge the gap between student needs and teachers' pedagogical challenges. Therefore, the development of MLMO-based digital teaching materials is a strategic solution to create active, meaningful, and literacy-oriented 21st century learning. Further research is recommended to focus on the development and feasibility testing stages of the product to ensure the effectiveness of digital teaching materials in improving the learning outcomes and energy literacy of elementary school students.

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