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Need Analysis for the Development of E-LKPD on Temperature and Heat Based on PBL Using Google Sites Integrated with Local Wisdom to Improve Students' Problem-Solving Skills

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ABSTRACT

Problem-solving skills are among the essential 21st-century competencies that students must develop in physics learning. The results of a preliminary test administered to Grade XI students at SMAN 1 Batang Anai revealed that their problem-solving skills were still at a low level. These findings were supported by interviews with physics teachers, student questionnaires, and document analysis, which indicated that the student worksheets (LKPD) currently used were not optimally integrated with technology, structured Problem-Based Learning (PBL) activities, or local wisdom-based contextual learning. Therefore, this study aimed to analyze the needs for developing a Problem-Based Learning (PBL)-based Electronic Student Worksheet (E-LKPD) on temperature and heat using Google Sites integrated with local wisdom. This study employed a descriptive research method with both quantitative and qualitative approaches to analyze the needs for the proposed initial design of the E-LKPD. The research participants consisted of two physics teachers and Grade XI Phase F students at SMAN 1 Batang Anai. Data were collected through a problem-solving skills test, teacher interviews, student characteristics questionnaires, and document analysis. The findings revealed that students' problem-solving skills were relatively low, the implementation of PBL had not fully reflected all stages of the learning process, and students showed greater interest in interactive and contextual digital learning media. The novelty of this study lies in its comprehensive needs analysis, which integrates the identification of students' problem-solving skills, learning conditions, student characteristics, and teachers' needs as the basis for developing a PBL-based E-LKPD using Google Sites integrated with local wisdom for the topic of temperature and heat. The findings provide an empirical foundation for the subsequent development of the proposed E-LKPD; however, they are not intended to draw conclusions regarding the effectiveness of the proposed product.

Keywords :E-LKPD, Temperature and Heat, PBL, Google Sites, Local Wisdom, Problem-Solving Skills.

I. INTRODUCTION

Education in the twenty-first century requires students to possess four essential competencies: critical thinking and problem-solving, communication, creativity and innovation, and collaboration [1]. These competencies are essential components of the learning process, as they prepare students to face the rapid advancement of science, technology, and an increasingly competitive workforce. The transformation of global education has shifted the focus of learning from merely transferring knowledge to fostering higher-order thinking skills that can be effectively applied in real-life situations [2]. In the context of science education, particularly physics, these demands are even more significant due to the nature of the subject, which involves numerous abstract concepts and natural phenomena that require systematic reasoning skills. Therefore, problem-solving skills have become one of the essential competencies that should be developed through physics education.

Problem-solving skills refer to students' ability to identify, analyze, and solve problems systematically, as well as to apply the solutions obtained across various contexts [3]. In physics education, these skills involve not only mastering formulas but also developing a deep conceptual understanding and the ability to relate scientific

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concepts to real-world phenomena [4]. Students who possess a strong conceptual understanding are more likely to formulate logical and systematic strategies for solving problems [5]. Therefore, developing students' problem-solving skills not only contributes to success in learning physics but also fosters a critical, logical, and systematic scientific mindset for addressing a wide range of problems [6].

In line with these demands, the Indonesian government, through the implementation of the Merdeka Curriculum, emphasizes competency-based learning that encourages students to think critically, creatively, and solve contextual problems [7]. Problem-solving skills are also an integral component of higher-order thinking skills, as they integrate conceptual and procedural knowledge to solve complex problems. Through these skills, students are expected not only to solve problems but also to transfer their knowledge to various new situations in an appropriate and meaningful manner. Furthermore, strengthening literacy and higher-order thinking skills contributes to students' readiness to face a wide range of challenges in both academic and non-academic contexts [8].

Problem-solving skills are demonstrated through students' ability to understand problems, formulate solution strategies, implement the selected strategies, and evaluate the resulting solutions. Furthermore, students are expected to relate physics concepts to various real-world phenomena in a flexible and adaptive manner. Problem-solving skills encompass not only conceptual understanding but also analytical, evaluative, and decision-making abilities required to solve problems effectively [9]. Furthermore, well-developed problem-solving skills enable students to solve complex physics problems through logical and systematic thinking processes [10].

Developing problem-solving skills requires learning experiences that actively engage students in the learning process [11]. Learning activities should provide students with opportunities to analyze and solve problems systematically [12]. Active student engagement in the learning process also contributes to the development of higher-order thinking skills [13]. One of the instructional materials that can support active student engagement is the Electronic Student Worksheet (E-LKPD).

Numerous previous studies have reported the development of E-LKPDs for various learning topics. Nevertheless, most of these studies have primarily focused on the product development process and its effectiveness, while studies specifically examining needs analysis as the foundation for E-LKPD development remain relatively limited. Furthermore, several studies have shown that existing E-LKPDs tend to emphasize the presentation of learning materials and practice exercises, thereby not fully facilitating the development of students' higher-order thinking skills, particularly problem-solving skills. In addition, the integration of digital technology into many E-LKPDs has not yet been optimized, resulting in learning experiences that remain largely passive and provide limited opportunities for active student engagement in the learning process [14]. An Electronic Student Worksheet (E-LKPD) is a digital learning worksheet that can be flexibly accessed via computers, laptops, and smartphones to facilitate students' understanding of the learning materials [15].

One of the instructional models widely used to develop students' problem-solving skills is Problem-Based Learning (PBL). This model places contextual problems at the center of the learning process, encouraging students to think critically, conduct investigations, and develop solutions systematically [16], In physics education, PBL has been shown to help students develop conceptual understanding through the processes of problem identification, strategy formulation, and evaluation of the proposed solutions [17]. These characteristics make PBL well suited to integration with digital technology to support learning that promotes the development of problem-solving skills.

In addition to instructional models, the integration of digital technology has become another essential aspect of twenty-first-century education. One of the widely used platforms is Google Sites, a web-based service that enables teachers to develop digital learning media without requiring programming skills while supporting the integration of various multimedia resources [18]. This platform also allows teachers to provide discussion forums, quizzes, and diverse learning resources within a single website that is easily accessible to students [19]. The use of Google Sites has been shown to contribute positively to students' learning outcomes due to its interactive and flexible features [20]. Furthermore, the integration of Google Sites into the learning process enhances student collaboration. In addition to the use of digital technology, the integration of local wisdom is another essential aspect of creating contextual learning experiences [21]. Local wisdom enables students to relate physics concepts to their everyday experiences, thereby making learning more meaningful [22]. Furthermore, local wisdom-based learning contributes to strengthening students' character, fostering cultural identity, and enhancing the relevance of learning materials to students' real-life contexts [23].

Although numerous studies have investigated the development of E-LKPDs, the implementation of Problem-Based Learning (PBL), the use of Google Sites, and the integration of local wisdom in learning, studies that specifically employ needs analysis as the foundation for E-LKPD development remain relatively limited. Nevertheless, needs analysis constitutes a crucial stage in identifying learning conditions, student characteristics, and teachers' needs, thereby ensuring that the developed instructional materials are aligned with actual classroom needs. Therefore, conducting a needs analysis is essential as a foundation for designing an E-LKPD that is consistent with the characteristics of the learning process and capable of supporting the development of students' problem-solving skills

Based on the foregoing discussion, a comprehensive needs analysis is required as the foundation for developing an E-LKPD on the topic of temperature and heat. This needs analysis encompasses the identification of students' problem-solving skills, student characteristics, learning conditions, the instructional materials currently in use, and teachers' needs for digital instructional materials that support the implementation of Problem-Based Learning (PBL), the use of Google Sites, and the integration of local wisdom. The findings of the needs analysis are expected to serve as the basis for determining the specifications of the E-LKPD to be developed in accordance with the actual conditions of the school. Therefore, this study aims to analyze the needs for developing a PBL-based E-LKPD on the topic of temperature and heat using Google Sites integrated with local wisdom. The needs analysis was conducted by identifying students' problem-solving skills, student characteristics, learning conditions, and teachers' needs for digital instructional materials as the basis for the subsequent development of the E-LKPD. The findings of this study are expected to provide valuable insights for physics teachers in designing digital instructional materials that are better aligned with students' characteristics and learning needs.

II. METHOD

This study employed a descriptive research method using quantitative and qualitative approaches to analyze the needs for developing a Problem-Based Learning (PBL)-based E-LKPD on the topic of temperature and heat using Google Sites integrated with local wisdom. A descriptive quantitative–qualitative approach was selected because the study focused on identifying the needs and preferences of teachers and students in physics education, particularly on the topic of temperature and heat, as well as examining how digital technology and local wisdom can be utilized to support the learning process. This approach enabled the researchers to obtain a comprehensive understanding by integrating quantitative data derived from questionnaires and problem-solving tests with qualitative data collected through teacher interviews and document analysis. A similar approach was adopted by [24] in conducting a needs analysis for the development of a differentiated learning E-LKPD, which identified student characteristics, teachers' needs, and learning conditions as the basis for product development. Likewise, [25] employed a needs analysis in developing a Problem-Based Learning (PBL)-based E-LKPD by identifying students' problem-solving skills, student characteristics, and learning needs as the foundation for product development. Similarly, [26] used a descriptive approach to analyze the needs for developing Project-Based Learning-integrated digital physics instructional materials with a STEM approach by examining student characteristics, the instructional materials currently in use, and the learning process, thereby generating product specifications that were aligned with actual classroom needs.

The study population comprised all Grade XI Phase F students at SMAN 1 Batang Anai and the physics teachers responsible for teaching these classes. The research sample consisted of two physics teachers and 32 Grade XI Phase F students from SMAN 1 Batang Anai, who were selected using purposive sampling, a sampling technique in which participants are selected based on specific criteria aligned with the objectives of the study. Prior to data collection, permission was obtained from the school administration, and informed consent was obtained from all participating teachers and students. The teachers were selected because they were directly involved in teaching the topic of temperature and heat, whereas the students were selected because they had completed the relevant topic and were considered representative of the learning context that constituted the focus of the needs analysis. In this study, the two physics teachers served as interview participants and as sources of data for classroom implementation observations and document analysis, while the 32 students participated as respondents to the student characteristics questionnaire, completed the problem-solving skills test, and were observed during the implementation of the learning process.

The research instruments consisted of a teacher interview protocol, a student characteristics questionnaire, a problem-solving skills test, a classroom implementation observation sheet, and a document analysis instrument in the form of an analysis checklist for the student worksheets (LKPD) used by the teachers. The teacher interview instrument was developed as a semi-structured interview protocol to obtain information regarding the learning process, instructional models, and instructional materials used in physics teaching. The student characteristics instrument was a Likert-scale questionnaire comprising eight indicators: learning interest, attitudes, motivation, learning styles, digital learning habits, learning facilities, collaborative learning habits, and students' learning difficulties. The problem-solving skills test consisted of essay questions designed based on the stages of the problem-solving process [11]. The classroom implementation observation sheet was used to evaluate the extent to which classroom instruction was implemented in accordance with the syntax of the adopted instructional model, including the introductory, core, and closing activities. The document analysis instrument, in the form of a checklist, was used to evaluate the LKPD employed by the teachers based on its alignment with the instructional model syntax, the relevance of the learning materials to real-world contexts, and the availability of activities that promote students' problem-solving skills.

The results of the problem-solving skills test were analyzed by calculating the mean score and subsequently categorized according to the levels of problem-solving skills. The scores were calculated using the following formula, and the resulting values were classified based on the criteria presented in Table 1.

$$NP = \frac{R}{SM} \times 100 \quad (1)$$

Description:
NP = Expected percentage score
R = Student's raw score
SM = Maximum possible score
100 = Constant

Table 1. Criteria for Problem-Solving Skills Percentage

Percentage (%)	Criteria
81-100	Very High (VH)
61-80	High (H)
41-60	Enough (E)
21-40	Low (L)
1-20	Very Low (VL)

(Source: Ref[12])

The data obtained from the student characteristics questionnaire were analyzed by calculating the percentage score for each indicator using the following equation:

$$P = \frac{\sum x}{\sum xi} \times 100\% \quad (2)$$

Description:

P = Percentage score
X = Total score obtained for each indicator
Xi = Total number of respondents

Table 2. Criteria for Analyzing Student Needs

Score (%)	Category
81-100	Very High
61-80	High
41-60	Enough
21-40	Low
0-20	Very Low

(Source: Ref[27])

The data obtained from the document analysis checklist were analyzed by calculating the percentage score for each indicator using the following equation:

$$P = \frac{\sum x}{\sum xi} \times 100\% \quad (3)$$

Description:

P = Percentage score
X = Total score obtained from respondents' responses for each item
Xi = Maximum possible score for each item

Table 3. Criteria for Interpreting the Percentage of LKPD Document Suitability

No.	Achievement Level	Qualification	Description
1	81-100%	Excellent	Highly Feasible / Highly Valid / No Revision Required
2	61-80%	Good	Feasible / Valid / No Revision Required
3	41-60%	Fairly Good	Less Feasible / Less Valid / Revision Required
4	21-40%	Poor	Not Feasible / Not Valid / Revision Required
5	>20%	Very Poor	Highly Infeasible / Highly Invalid / Revision Required

(Source: Ref[28])

III. RESULTS AND DISCUSSION

Results

The preliminary study findings were obtained through four data collection techniques: a preliminary problem-solving skills test, document analysis, student characteristics analysis, and interviews with physics teachers at SMAN 1 Batang Anai. These data collection techniques were employed to obtain an initial overview of the conditions of physics learning on the topic of temperature and heat, including students' problem-solving skills, student characteristics, learning conditions, and the instructional materials used. The problem-solving skills test was administered to Grade XI F9 students to assess their ability to solve problems based on the problem-solving indicators proposed by [11], namely understanding the problem, devising a solution plan, implementing the solution plan, and reviewing the solution. The test results were analyzed to determine the students' level of problem-solving skills and to identify the difficulties encountered at each stage of the problem-solving process. The findings revealed that the students' problem-solving skills were still at a low level, with the highest achievement observed in the understanding the problem indicator (40%) and the lowest achievement in the reviewing the solution indicator (25%), as presented in Figure 1

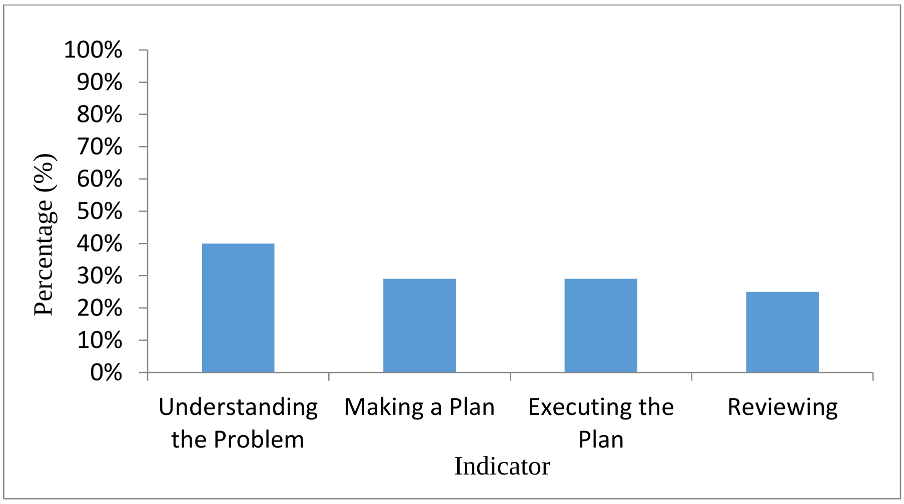

Fig. 1. Graph of Problem-Solving Ability Results

As shown in Figure 1, students' achievement on each problem-solving indicator remained below 50%, with the highest achievement observed in the understanding the problem indicator (40%) and the lowest in the reviewing the solution indicator (25%). Overall, the students' mean problem-solving skills score was categorized as **low**, with an average percentage of 30.83%. This result indicates that most students still experience difficulties in solving physics problems systematically by following the stages of the problem-solving process. For example, in a problem involving heat mixing, most students provided only the final answer without identifying the given information, formulating a solution strategy, or performing calculations based on the principle of thermal equilibrium (Black's principle). In addition, they did not review or verify the correctness of their solutions. These findings suggest that the students' abilities to understand problems, devise solution strategies, implement those strategies, and evaluate the resulting solutions have not yet been fully developed. These results are consistent with the findings of [9] , who reported that problem-solving skills encompass not only conceptual understanding but also analytical, evaluative, and decision-making abilities, which many students have not yet mastered. Similarly, [4] found that students tend to memorize solution procedures without understanding the underlying physical concepts, making it difficult for them to solve problems presented in different contexts. These findings highlight the need to further develop students' problem-solving skills, particularly in devising solution strategies, implementing appropriate solution procedures, and reviewing the correctness of their solutions.

The interview findings from the two physics teachers at SMAN 1 Batang Anai revealed that both Problem-Based Learning (PBL) and Discovery Learning had been implemented; however, their implementation did not fully adhere to the prescribed instructional syntax. Classroom instruction remained primarily focused on concept explanation and theoretical discussion, whereas the investigation phase, which requires active student engagement through experimental activities, had not been optimally implemented due to limited laboratory facilities. Consequently, the learning process placed greater emphasis on conceptual understanding than on procedural understanding, resulting in students assuming a predominantly passive role as recipients of information rather than actively participating in the inquiry process. The teachers also indicated that limited instructional time was one of the major challenges preventing the complete implementation of all PBL stages in a systematic manner. One of the teachers stated, *"The main challenge in the learning process is the limited instructional time, which prevents all stages of problem-based learning from being implemented optimally."* (Physics Teacher 1). These interview findings provide qualitative evidence of the challenges associated with implementing PBL in classroom practice. This evidence is further supported by the quantitative results of the classroom implementation observations presented below. Data on classroom implementation were obtained using an observation sheet that assessed three components of the learning process: the introductory activities, the core activities, and the closing activities, as presented in Figure 2.

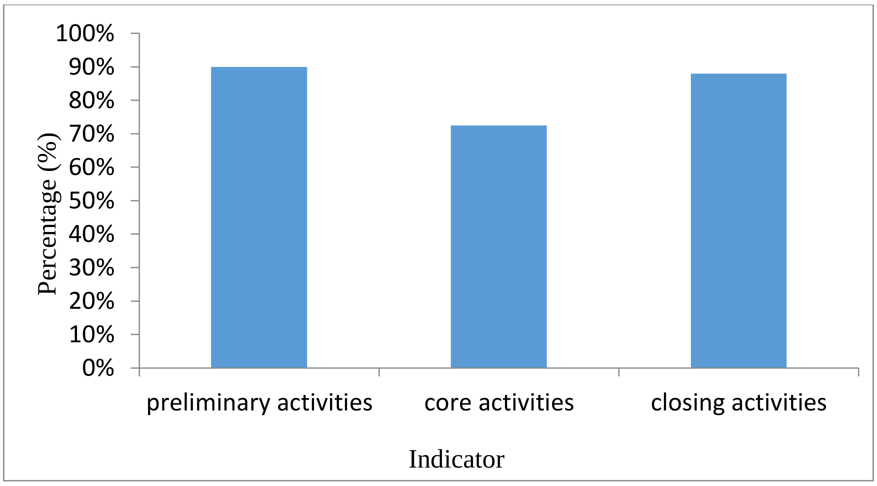

Fig. 2. Percentage Implementation Graph of Learning

As shown in Figure 2, the classroom implementation observation revealed that the introductory activities achieved 95.83%, which was categorized as excellent, while the closing activities achieved 87.50%, also categorized as excellent. In contrast, the core activities achieved only 72.50%, which fell into the good category and represented the lowest score among the three instructional components. The relatively lower achievement in the core activities was primarily attributed to the implementation of the instructional model, as the teachers did not fully implement the core and closing stages of the PBL syntax in a systematic sequence. Consequently, several observation indicators for these stages were rated only as fair. These quantitative findings corroborate the interview results, which indicated that the investigation phase of the PBL syntax had not been optimally implemented because classroom instruction remained predominantly teacher-centered and focused on concept explanation. In addition, the subcomponent related to student participation and engagement also showed less-than-optimal performance, with most indicators falling into the fair category, suggesting that students were not yet actively involved in investigative activities and group discussions. In contrast, the subcomponents assessing the teacher's role as a facilitator and the utilization of learning resources and technology demonstrated relatively higher levels of implementation, indicating the teachers' commitment to supporting the learning process despite the incomplete implementation of the PBL syntax. These findings provide empirical evidence supporting the need to develop a PBL-based E-LKPD explicitly designed to guide both teachers and students in implementing each stage of the instructional syntax systematically and consistently. Therefore, the shortcomings identified in the implementation of the core instructional activities constitute an important consideration in determining the specifications of the E-LKPD to be developed in the subsequent stage of this research.

The results of the document analysis of the student worksheets (LKPD) used by the teachers for the topic of temperature and heat are presented in Table 4, which shows the percentage achievement for each document suitability indicator based on the interpretation criteria presented in Table 3.

Table 4. Results of the Document Analysis of the Student Worksheets (LKPD)

Indicator	Percentage	Category
Alignment of the LKPD with Student Characteristics	75%	Good
Alignment of the LKPD with Learning Outcomes and Learning Objectives	50%	Fairly Good
Relevance of the LKPD Content to Real-World Contexts	25%	Poor
Alignment of the LKPD with the Instructional Model	50%	Fairly Good
Support of the LKPD for Developing Problem-Solving Skills	25%	Poor
Alignment of the LKPD with Learning Assessment	25%	Poor
Overall Average	**41.67%**	**Fairly Good**

The data presented in Table 4 indicate that the indicator assessing the alignment of the LKPD with student characteristics achieved the highest percentage (75%), which was categorized as Good. This finding suggests that the LKPD used in the classroom has adequately accommodated students' general characteristics. The indicators assessing the alignment of the LKPD with the learning outcomes and learning objectives, as well as its alignment with the instructional model, each obtained a percentage of 50%, which was categorized as Fairly Good, indicating that the alignment between the LKPD activities, the intended learning outcomes, and the instructional model syntax has not yet been fully optimized. In contrast, the remaining three indicators, namely the relevance of the LKPD content to real-world contexts, the support provided by the LKPD for developing students' problem-solving skills, and the alignment of the LKPD with learning assessment, each obtained only 25%, which was categorized as Poor. Although the overall average document alignment score was 41.67%, corresponding to the Fairly Good category, according to the document feasibility criteria presented in Table 3, the LKPD was still considered less feasible and therefore required revision.

The document analysis of the LKPD used by the teachers indicated that the instructional material met the fundamental requirements of a student worksheet, including the inclusion of learning outcomes, learning objectives, a summary of the subject matter, and practice exercises. However, several limitations were identified. For example, the learning activities did not begin with contextual problems that could encourage students to identify problems independently. In addition, the exercises were predominantly focused on formula application and therefore did not explicitly foster students' problem-solving skills. The learning materials were also not sufficiently connected to real-world phenomena or local wisdom relevant to the topic of temperature and heat. These findings are consistent with the classroom implementation observations, which revealed that the instructional model syntax was not implemented systematically across all stages. Consequently, the LKPD was not able to effectively guide either teachers or students through each stage of problem-based learning in a structured manner. These findings are consistent with [13], who reported that LKPDs not systematically designed to facilitate higher-order thinking processes tend to be less effective in developing students' problem-solving skills. Therefore, instructional materials are needed that explicitly integrate both the instructional model syntax and the stages of the problem-solving process into each learning activity in a structured manner. Such instructional materials should also be designed to promote active student engagement and establish stronger connections between the learning content, real-world contexts, and relevant local wisdom.

The results of the student characteristics questionnaire administered to 32 Grade XI F9 students at SMAN 1 Batang Anai are presented in Figure 3.

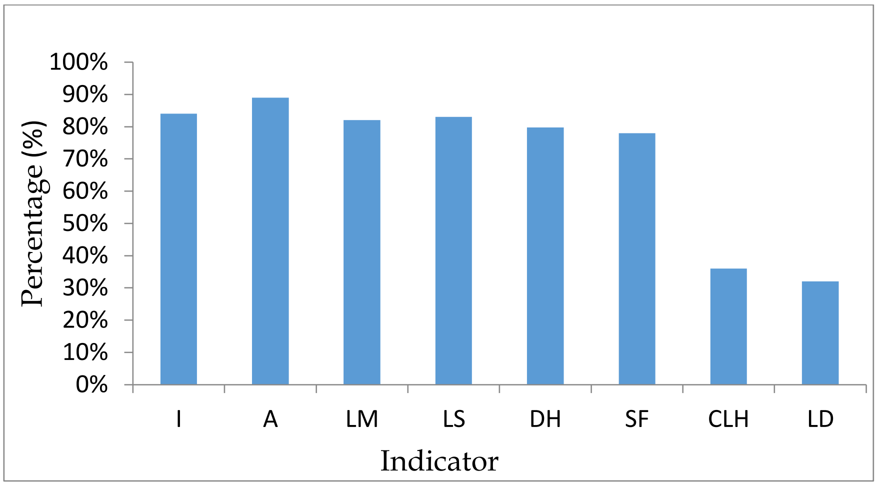

Fig. 3. Graph of Student Characteristics Assessment Results

As shown in Figure 3, the results indicate that students generally demonstrated positive attitudes (89.3%), high learning interest (84.0%), strong learning motivation (82.4%), and appropriate learning styles (83.0%). In addition, the indicators related to technology utilization, including digital learning habits (79.8%) and learning facilities (78.0%), suggest that students possess adequate resources to support digital learning. However, the indicators of collaborative learning habits (36.5%) and learning difficulties (32.2%) yielded substantially lower percentages than the other indicators, indicating that students' collaborative learning practices and the learning difficulties experienced by some students require greater attention. The low percentage of collaborative learning habits is also consistent with the classroom implementation findings regarding student engagement, which likewise indicated that student participation had not yet reached an optimal level. Together, these findings reinforce the need for instructional materials that promote collaboration among students. Overall, the analysis of student characteristics suggests that the proposed E-LKPD should be designed to be interactive, collaborative, and context-based in order to accommodate students' learning needs and preferences.

Discussion

The needs analysis revealed that students' low problem-solving skills were not solely attributable to their insufficient understanding of physics concepts but were also associated with a learning process that had not fully facilitated students in carrying out all stages of problem solving systematically. Many students still tended to solve problems procedurally without understanding the scientific rationale underlying each step of the solution process. This finding indicates that effective problem-solving requires not only conceptual understanding but also analytical, evaluative, and decision-making skills throughout the problem-solving process [9]. Therefore, the learning process should be designed to provide students with opportunities to develop their own problem-solving strategies through meaningful learning experiences.

These findings are further supported by the classroom implementation analysis, which revealed that the PBL syntax, particularly during the core learning activities, had not been implemented optimally. The investigation phase, which constitutes the core component of PBL, did not fully provide students with opportunities to identify problems, gather relevant information, conduct investigations, and develop solutions independently. Consequently, classroom instruction remained predominantly focused on concept explanation, limiting students' opportunities to engage in meaningful learning experiences that foster higher-order thinking skills. These findings suggest that the effective implementation of PBL requires instructional materials capable of guiding both teachers and students through each stage of the instructional process in a systematic and consistent manner.

The document analysis revealed that the LKPD used by the teachers did not yet fully support the development of students' problem-solving skills. The worksheets were still predominantly focused on presenting learning materials and practice exercises, with learning activities that did not explicitly engage students in conducting investigations, developing solution strategies, or reflecting on the solutions they obtained. These findings are consistent with previous studies reporting that many E-LKPDs remain oriented toward content delivery and practice exercises, and therefore have not yet effectively facilitated the development of higher-order thinking skills [14]. Therefore, the development of an E-LKPD should explicitly integrate the PBL syntax and the stages of the problem-solving process into each learning activity in a structured and systematic manner.

In addition to the learning conditions and instructional materials, the analysis of student characteristics revealed that students showed a strong interest in using digital learning media. This finding provided the rationale for selecting Google Sites as the platform for developing the E-LKPD, as it enables the integration of various multimedia resources, including images, instructional videos, virtual simulations, learning resource links, and interactive assessments, within a single website that can be easily accessed via computers and smartphones [18]. Beyond serving as a platform for presenting instructional content, Google Sites has the potential to support the systematic implementation of the PBL syntax by facilitating the presentation of contextual problems, inquiry-based learning activities, digital learning resources, and formative assessments within an integrated learning environment. Its accessibility and flexibility allow each stage of the PBL process to be delivered in a more structured and coherent manner, thereby providing students with more active and interactive learning experiences. These findings are consistent with previous research reporting that Google Sites–based E-LKPDs received positive responses from students and contributed to improving conceptual understanding through more engaging and accessible learning materials [29].

In addition to the use of digital technology, the integration of local wisdom constitutes another important consideration in the development of the E-LKPD. Local wisdom provides learning contexts that are closely related to students' daily lives, enabling concepts of temperature and heat to be explored through phenomena that students encounter in their everyday experiences. By connecting learning activities with the local environment and cultural practices, the learning process becomes more meaningful while helping students understand the application of physics concepts in real-world situations. These findings are consistent with previous studies suggesting that local wisdom should be integrated into the learning process to enhance the meaningfulness of learning experiences for students [30]. Furthermore, [31] emphasized that local wisdom embodies cultural values that can serve as authentic contexts for science learning, thereby strengthening students' conceptual understanding, whereas [32] highlighted the importance of incorporating local cultural values into the teaching and learning process.

Based on the overall results of the needs analysis, this study provides an empirical foundation for the development of a PBL-based E-LKPD on temperature and heat using Google Sites integrated with local wisdom. Nevertheless, this study has several limitations. The research was conducted only at the needs analysis stage as the initial phase of E-LKPD development; therefore, it did not include the product development process, expert validation, practicality testing, or effectiveness testing. Consequently, the proposed E-LKPD cannot yet be stated as effective in improving students' problem-solving skills, but rather remains a design developed based on the identified learning needs. Further research should continue through the stages of development, validation, implementation, and effectiveness testing to obtain empirical evidence regarding the feasibility and effectiveness of the E-LKPD in enhancing students' problem-solving skills.

IV. CONCLUSION

The results of the needs analysis indicate that the problem-solving skills of eleventh-grade students at SMAN 1 Batang Anai are still relatively low. In addition, physics learning has not fully provided opportunities for students to actively engage in the inquiry process, while the LKPD currently used has not been integrated with digital technology, has not accommodated contextual learning, and has not comprehensively facilitated the development of problem-solving skills. On the other hand, the analysis of students' characteristics reveals that students have good interest and readiness toward the use of interactive digital learning media that are contextualized with local wisdom. These findings indicate the need for digital learning materials that can support more interactive, contextual, and problem-solving-oriented physics learning. Therefore, the results of this needs analysis serve as an empirical foundation for the development of a PBL-based E-LKPD on temperature and heat using Google Sites integrated with local wisdom. The development of this E-LKPD has the potential to support the improvement of students' problem-solving skills; however, this potential still needs to be confirmed through further research involving the stages of product development, validation, and testing.

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