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# NEEDS ANALYSIS FOR DEVELOPING A STEM-PBL-BASED STUDENT WORKSHEET (LKPD) IN PHYSICS LEARNING ON NEWTON'S SECOND LAW AT THE SENIOR HIGH SCHOOL LEVEL

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**Abstract**

This study aims to analyze the needs for developing a STEM-PBL-based Student Worksheet (LKPD) on Newton's Second Law at the senior high school level. As the initial stage of a research and development process, the needs analysis provides a foundation for producing a modern and effective worksheet aligned with the demands of twenty-first-century learning. A survey method was employed, involving 125 grade XI students selected through purposive sampling, together with several physics teachers in Pontianak. Data were collected using a validated needs-analysis questionnaire distributed via Google Form. The results show that physics learning remained dominated by the lecture method and conventional media such as textbooks and PowerPoint, so that student engagement was not optimal. Nevertheless, most students had positive experiences with worksheets that helped them understand the material, and both students and teachers expressed strong interest in the STEM approach and the Problem-Based Learning (PBL) model, which were perceived as engaging, contextual, and supportive of critical thinking and problem-solving skills. These findings indicate that developing a STEM-PBL-based LKPD is needed as an instructional-material innovation appropriate to the demands of the twenty-first century.

**Keywords:** Student worksheet (LKPD), STEM, Problem-Based Learning, needs analysis, physics, twenty-first-century learning.

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## INTRODUCTION

Education plays an essential role in cultivating students' critical thinking. By implementing active learning strategies such as discussion, problem solving, and case studies, students are trained to analyze, evaluate, and construct arguments logically and reflectively (Ariadila et al., 2023). As stated in Article 3 of Indonesian Law No. 20 of 2003, national education prioritizes the development of competencies, the formation of character, and the advancement of national civilization for the welfare of society. Such competencies enable students to be better prepared to face real-world challenges and to filter information critically so as not to be misled by unaccountable data. Education

oriented toward the cultivation of critical reasoning is therefore highly significant within the dynamics of the twenty-first century.

In line with the characteristics of twenty-first-century learning, students are expected to master the 4C competencies, namely communication, collaboration, critical thinking and problem solving, and creativity and innovation (Mardhiyah et al., 2021). Among these, critical thinking is particularly important because it supports sound decision making and appropriate problem solving (Arnyana, 2019). This ability also trains individuals to distinguish fact from opinion especially in an era of widespread misinformation and can be developed through challenging, contextual learning.

Regulation of the Minister of Education and Culture No. 103 of 2014 emphasizes that one of the main characteristics of twenty-first-century learning is the active role of students in constructing knowledge (student-centered learning). In practice, however, teachers often remain the main source of information while students stay passive, merely receiving knowledge without active engagement (Shabila et al., 2020). As a result, the level of student involvement in learning activities tends to be low.

Learning is an internal process influenced by external factors such as the role of the teacher and the learning environment as well as internal factors such as students' curiosity. Teachers hold a central role in designing varied learning experiences and fostering students' academic engagement. Based on the principle of continuous learning, the main focus lies not solely on final outcomes but on the ongoing process of developing students' understanding and competencies (Herman, 2015).

The literature indicates that limited learning resources including instructional materials and facilities pose a significant challenge during implementation, hindering the development of students' thinking skills and making it difficult for them to adapt to life in the twenty-first century (Winarsih & Nisa, 2024). Instructional materials are defined as tools and media used to convey learning messages in order to support the effectiveness of teaching and learning (Hasan et al., 2021). Learning media serve a strategic function in delivering messages while stimulating students' thoughts, feelings, and attention, thereby optimizing learning outcomes (Septy Nurfadhillah et al., 2021).

Consequently, the development of relevant and adequate instructional materials is crucial, as students require resources that genuinely support the learning process. The availability of good instructional materials also increases students' learning interest and teachers' motivation to teach (Suryaningsih & Nurlita, 2021).

One instructional tool that is effective in developing students' critical thinking is the Student Worksheet (Lembar Kerja Peserta Didik, LKPD) (Nadifatinisa & Sari, 2021). The LKPD is a printed instructional material containing guidance that students can use to develop their competencies (Prastika & Masniladevi, 2021). It is specifically designed to guide students in completing various learning activities, both theoretical such as analyzing concepts and practical such as conducting experiments. In general, the LKPD functions not merely as a complement to learning but also as a resource that directs students toward developing critical thinking skills (Nazira et al., 2024).

To implement such materials effectively, an appropriate learning approach is required (Wati et al., 2022). One alternative for fostering students' critical thinking is the Science, Technology, Engineering, and Mathematics (STEM) approach combined with the Problem-Based Learning (PBL) model.

This study is consistent with prior findings on related topics: (1) the use of LKPD in physics learning improves students' cognitive, affective, and psychomotor outcomes (Rahmatin et al., 2022); (2) STEM-based learning contributes significantly to improving student outcomes, developing critical thinking, strengthening scientific literacy, and enhancing creativity and scientific reasoning (Syarah et al., 2021); (3) the PBL model, when integrated into problem-based learning stages, contributes significantly to improving students' critical thinking, including analysis, synthesis, problem solving, drawing conclusions, and evaluation (Windari & Yanti, 2021); and (4) the

integration of STEM and PBL in the Industry 4.0 era serves as an innovative learning alternative for maximizing students' scientific literacy (Suyidno et al., 2022).

Although studies on LKPD, STEM, and PBL are abundant, few have specifically examined the actual needs of teachers and students as a basis for developing a STEM-PBL-based LKPD on Newton's Second Law at the senior high school level. Accordingly, this study aims to analyze and identify these needs as the initial stage of a research and development effort, so that the resulting worksheet is modern, effective, and aligned with the demands of twenty-first-century learning.

## METHOD

This study employed a survey method at the needs-analysis stage to systematically collect data on learning conditions, media use, and students' responses regarding the proposed LKPD. Survey research is used to gather information about students across various aspects such as attitudes, interests, study habits, and future aspirations (Maidiana, 2021). It is practical and applicable for collecting data across diverse educational fields and problems, and is considered efficient because it can produce valid and reliable data while facilitating data collection from large populations (Kurniawati & Rindrayani, 2025).

The main objective of this study was to analyze and identify the needs for developing a STEM-based LKPD using the Problem-Based Learning (PBL) model in physics learning, focusing on the topic of Newton's Second Law taught in grade XI of senior high school. This study represents the initial stage of a research and development (R&D) process, emphasizing user needs analysis as the basis for designing instructional materials.

The participants were 125 grade XI students, selected through purposive sampling based on a defined criterion: students who had already experienced physics instruction and LKPD use but had not yet been taught the target material, Newton's Second Law, so that their responses would reflect genuine learning needs rather than a post-hoc evaluation of the topic. In addition, several physics teachers in the city of Pontianak were involved. The study was conducted during the 2025/2026 academic year in several senior high schools in Pontianak and the surrounding areas.

Data were collected through a needs-analysis questionnaire designed and distributed via Google Form. The instrument consisted of five statements for students and six statements for teachers, all using a dichotomous Yes/No response format. Prior to distribution, the questionnaire was validated by five validators three lecturers and two physics teachers—to assess the appropriateness of the indicators, clarity of language, and relevance of each item to the research objectives. Suggestions from the validators were used to refine the instrument so that it was suitable for data collection.

Before constructing the instrument, the researchers conducted a preliminary study through semi-structured interviews with physics teachers to identify the conditions of physics learning, the need for innovative instructional materials, and teachers' interest in and experience with the PBL–STEM model. The interview results informed the development of the questionnaire indicators. The data obtained served as the basis for understanding students' actual needs and as a reference for developing instructional materials that are more contextual and aligned with their learning characteristics. The findings are expected to serve as a foundation for developing a STEM-PBL-based LKPD that improves the quality of physics learning in schools.

## RESULTS AND DISCUSSION

The needs-analysis stage for developing the STEM-based LKPD with a PBL approach in physics was carried out through a field study, comprising the distribution of needs questionnaires to students and teachers to obtain empirical data on actual classroom conditions. Data were collected during the 2025/2026 academic year to identify the needs, interests, and perceptions of students regarding an innovative LKPD that integrates STEM principles with a problem-based learning model.

Prior to distributing the questionnaire, the researchers conducted a preliminary study through semi-structured interviews with physics teachers. The teachers reported that physics learning was still

dominated by conventional, teacher-centered, one-way instruction. Although more varied learning models were occasionally applied, their use was not consistent across topics. As a result, some students appeared less enthusiastic because learning activities were dominated by content delivery and problem drills, and the available instructional materials were considered insufficient to encourage active student engagement. These initial findings informed the development of the needs-analysis questionnaire subsequently distributed to teachers and students. The results concerning students' needs in physics learning are presented in Table 1.

**Table 1. Results of the Student Needs Questionnaire**

| No | Statement | Yes (%) | No (%) |
|---|---|---|---|
| | Conditions of physics learning at school | | |
| 1 | Classroom learning still largely uses the lecture method | 78 | 22 |
| 2 | Media frequently used are textbooks, worksheets, and PowerPoint | 82 | 18 |
| | Students' experience with the LKPD | | |
| 3 | Have used a worksheet during learning | 94 | 6 |
| 4 | The worksheets used so far help in understanding the material | 80 | 20 |
| | Interest in and perception of the STEM approach and PBL | | |
| 5 | Interested in STEM-based learning | 87 | 13 |

Based on the analysis of the questionnaire distributed via Google Form, 78% of respondents indicated that classroom learning still relied heavily on the lecture method (teacher-centered learning). This finding suggests that physics learning in most schools remains teacher-oriented, so that opportunities for students to explore concepts, discuss, and solve problems independently are still limited. This condition indicates that student-centered learning has not been fully implemented in accordance with contemporary demands. The finding aligns with Mita Tri Wahyuni et al. (2025), who noted that learning still dominated by conventional methods is unable to develop students' skills particularly critical thinking, communication, collaboration, and creativity. Innovation in learning practice is therefore needed, one form of which is the development of a STEM-PBL-based LKPD that encourages students to actively explore knowledge, identify problems, and find solutions independently through contextual, project-based activities.

Regarding learning media, about 82% of teachers still relied on conventional media such as textbooks, worksheets, and PowerPoint, while only 18% had used interactive media. This dominance of traditional media reflects that classroom learning remained oriented toward one-way information delivery, resulting in low active engagement during exploration and meaningful learning. Conventional media tend to make learning one-directional and provide limited opportunities for students to develop critical thinking through exploratory activities. This finding is supported by Nurnaifah et al. (2023), who stated that the use of insufficiently varied learning media makes students less active during learning. Such materials have not optimally developed active engagement or higher-order thinking such as analysis, evaluation, and creativity. Within the context of twenty-first-century learning, this condition provides a fundamental rationale for innovation through the development of a STEM-PBL-based LKPD designed to be contextual and collaborative, encouraging students to observe, experiment, and solve problems independently.

Concerning students' experience with the LKPD, 94% of students had previously used worksheets in learning, while 6% had not. This high figure indicates that the LKPD is a widely used instructional material and is not unfamiliar to students, so that developing a STEM-PBL-based LKPD has a strong prospect for implementation in schools. However, based on the interviews and needs analysis, the worksheets used to date remained oriented toward problem solving in a narrow sense and had not yet integrated activities that train critical thinking or genuine problem solving. This is

consistent with Darmaji et al. (2022), who found that worksheets receive positive responses because they support the learning process, and that their effectiveness increases when they are designed to be more interactive and contextual.

Students also considered that most worksheets still focused on theoretical explanation and were not connected to real situations or phenomena, making learning feel monotonous and insufficiently challenging. Innovation in worksheet development is therefore needed so that the LKPD serves not only as a practice tool but also as a medium that sparks curiosity while sharpening students' critical thinking and creativity. Developing a STEM-PBL-based LKPD is one relevant alternative, as it enables the integration of multiple disciplines within authentic problem contexts, so that students are not limited to understanding theory but also participate directly in designing, analyzing, and evaluating solutions (Darmaji et al., 2022).

The data further indicate that students had positive experiences with the LKPD and a high interest in the STEM approach and problem-based learning. Most students felt supported when learning through a STEM-based LKPD with a PBL model, suggesting their readiness to follow the full PBL syntax from orientation to a contextual problem, investigation, and presentation of results, through to evaluation. Nonetheless, some students did not yet share this experience; therefore, the worksheet to be developed should include triggering questions at the problem-orientation and investigation stages so that all students can follow a structured learning process. These positive experiences provide a strong basis for designing an innovative STEM-PBL-based LKPD, the intended impact of which is an immersive and meaningful learning process that strengthens motivation, fosters creativity, and builds students' capacity to analyze scientific phenomena comprehensively and applicably. The results of the teacher needs analysis are presented in Table 2.

**Table 2. Results of the Teacher Needs Questionnaire**

| No | Statement | Percentage (%) |
|---|---|---|
| 1 | Difficulty in designing instructional materials/teaching tools | 100 |
| 2 | Students are not active in the learning process | 100 |
| 3 | Students show interest in STEM-PBL-based learning | 80 |
| 4 | Student outcomes are influenced by the learning process | 100 |
| 5 | Development of STEM-based instructional materials is needed | 80 |
| 6 | The LKPD can support the learning process | 100 |

Based on the needs analysis conducted through the teacher questionnaire, several fundamental issues concerning the challenges and opportunities in learning were identified. All teachers (100%) reported difficulty in designing instructional materials aligned with curriculum developments. This challenge appears to correlate with student participation, as all teachers (100%) also observed that students tended to be less active during learning. Despite these challenges, considerable potential emerged: 80% of teachers reported that students showed interest in the STEM-PBL model, indicating readiness for a more contextual and applied approach. This is consistent with the unanimous belief (100%) that student outcomes are strongly influenced by the learning process applied. Accordingly, the majority of teachers (80%) considered it important to develop innovative STEM-based instructional materials. The LKPD was viewed as a feasible solution, as all teachers (100%) believed that worksheets can facilitate a more structured and interactive learning process that encourages active student engagement. These findings implicitly recommend that developing a STEM-PBL-based LKPD is not only necessary but also holds strong potential to address the challenges faced by both teachers and students.

The analysis also revealed students' interest in and positive perception of applying the STEM approach and the PBL model. The high percentages indicate that most students were enthusiastic about exploratory, collaborative, and problem-oriented learning innovations that demand their active involvement. This interest may stem from students' awareness of the benefits of contextual,

challenging learning that is relevant to real life. The STEM approach allows students to understand physics concepts contextually and applicably because learning activities are framed as projects relevant to daily life (Septiyanto et al., 2024).

Through this approach, students are invited not merely to memorize theories or formulas but to understand the application of scientific and technological concepts in solving real problems around them, using learning stages that are more effective in developing critical thinking (Herman et al., 2023). This is consistent with the characteristics of twenty-first-century learning, which emphasizes the four core competencies (4C): critical thinking, creativity, collaboration, and communication. A positive attitude toward STEM-PBL also arises because students seek more active, interactive, and engaging learning. Project- and problem-based learning enables them to work in groups, develop new ideas, and find solutions independently through experimentation or observation.

Such an approach fosters a learning experience different from traditional, teacher-centered methods that tend to be monotonous, such as lectures or problem drills alone. The small proportion of students who did not yet show strong interest were likely constrained by limited direct experience and insufficient initial understanding of how project-based learning operates. This underscores the need for teacher guidance providing direction and concrete examples of the benefits and steps of STEM-PBL so that students can adapt more readily.

Taken together, these data reinforce the importance of developing a STEM-PBL-based LKPD as a learning innovation. A worksheet designed with this approach serves not only as a learning aid but also as a medium that motivates students to explore, experiment, and observe real phenomena, thereby fostering learning motivation, exploratory interest, and critical and creative thinking more optimally.

## CONCLUSION

The needs analysis revealed that physics learning in schools remained teacher-oriented and dominated by conventional media, so that student engagement was not yet optimal. Nevertheless, most students had positive experiences with the Student Worksheet (LKPD) because it facilitated conceptual understanding while encouraging active involvement, and it was considered effective in helping students build understanding through exploratory activities and systematic problem solving. Students also showed interest in and positive perceptions of the STEM approach and the Problem-Based Learning (PBL) model integrated into the worksheet, viewing STEM-PBL learning as more engaging and relevant and capable of developing critical thinking, creativity, and collaborative skills. Teachers likewise reported difficulty in designing instructional materials and low student participation, while affirming the value of an innovative STEM-based LKPD. Accordingly, the development of a STEM-PBL-based LKPD is needed as an innovation in physics instructional materials that aligns with the characteristics and demands of twenty-first-century learning and holds strong potential to improve the quality of the learning process. As a needs-analysis study, this research is limited to identifying user requirements; subsequent stages should address the design, validation, and empirical testing of the worksheet's effectiveness.

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