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Needs Analysis for the Development of Blended Learning Media Based on PBL to Improve Critical Thinking Skills

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Abstract: This study aims to analyze the requirements for blended learning based PBL learning materials to enhance students' critical thinking skills when solving physics learning challenges, particularly those about rotational dynamics and equilibrium. This research was survey research as a first step in developing blended learning media based on PBL. The subjects used in this study were junior high school students with a total sample of 105 students and five physics teachers in Pekanbaru and Kampar Regency. The research instrument used in this research was a closed questionnaire developed based on indicators of critical thinking skills and the distribution of critical thinking ability tests. The questionnaire response scores were analyzed using a quantitative descriptive analysis method. The research results showed that learning media was needed to support online and offline learning. The learning media must contain learning materials, videos, and student activities to increase learning effectiveness and train students' critical thinking skills. Therefore, it is necessary to develop PBL-based blended learning media to improve the critical thinking skills of students and teachers.

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Introduction

Education has undergone a significant transformation over the past few decades. Social, economic, and technological changes have exerted a profound influence in creating new paradigms in learning. Information and communication technology advancements have altered how humans' access and comprehend information. In the modern era of education, the demand for active learner engagement is paramount. One of the foundational learning theories supporting this active engagement is the theory of constructivism (Sugrah, 2019).

Constructivism is a paradigm of learning that highlights how students actively create their understanding (Sudarsana, 2018). This theory posits that knowledge is not passively transmitted from educators to students but is understood as a mental construction that occurs within an individual's mind through reflection, meaning making, and linking new information to previously acquired knowledge. Learners are encouraged to seek their meaning through reflection and personal interpretation of the material learned based on the theory of constructivism. Consequently, critical thinking skills can be fostered (Almulla, 2023).

The ability to think critically involves actively and critically analyzing, assessing, and interpreting information (Agoestanto et al., 2016). The capacity to think critically is an essential component of learning and academic growth for students. Constructivist learning methods help students gain the ability to critically analyze data, assess claims and theories, and get a profound understanding of topics. However, based on the results of the PISA report, learners in Indonesia have only been capable of achieving a low level of critical thinking in

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solving the given problems (Sani & Prayitno, 2020). It indicates the continued low level of critical thinking abilities among learners in Indonesia. The following data results can be seen in Figure 1.

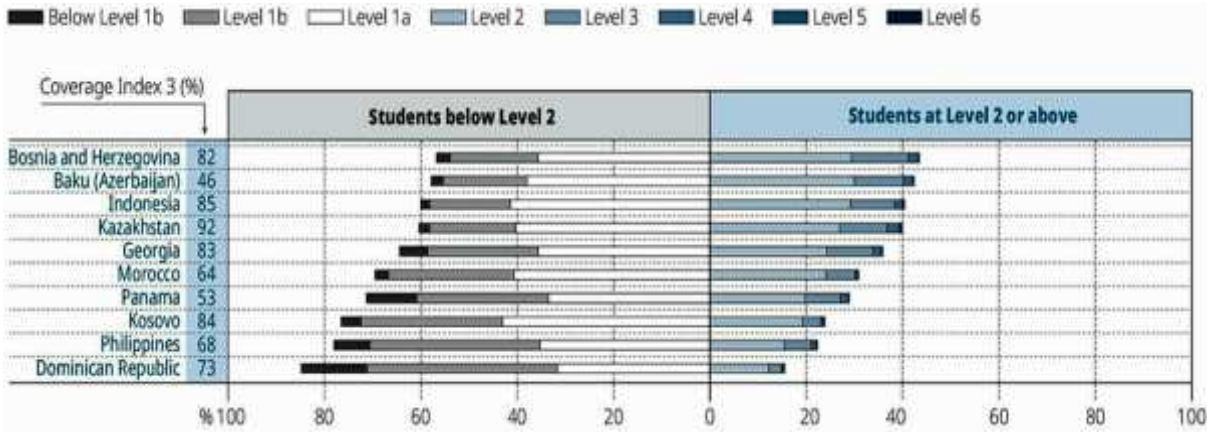

Figure 1. PISA results in 2018 (OECD PISA, 2018)

Several previous studies indicate that the critical thinking abilities of students in Indonesia remain low due to teaching methods that do not encourage critical thinking (Parwati et al., 2020) and an unsupportive learning environment. Learners' motivation also plays a significant role in developing their critical thinking abilities (Fajari et al., 2020). High learning motivation can drive students to enhance their critical thinking skills, while low motivation can hinder the development of critical thinking abilities (Chen & Wu, 2023).

The blended learning approach in educational media can effectively enhance learners' critical thinking abilities (Sunubi & Bachtiar, 2022) and learning motivation (Sunardi et al., 2021). Educational media serve as tools to deliver instructional messages to learners, stimulating their thought processes (Rohima, 2023). The rapid growth of web-based technology in recent years has radically transformed the learning environment (Haleem et al., 2022), consequently driving the rapid development of e-learning educational media (Dineva, 2021). Using blended learning, educational media can integrate face-to-face classroom learning (real-time) with asynchronous or online discussion formats, thus optimizing face-to-face learning effectively (Purnomo et al., 2022; Mintii, 2023). Cao (2023) did a meta-analysis that revealed that the use of blended learning educational media amalgamates the benefits of both in-person and virtual learning, thereby augmenting the efficacy of the learning process.

Blended learning educational media can be packaged by presenting applicable and relevant problems related to everyday situations (Han et al., 2023). These problems can encourage learners to engage in discussions and independently or collaboratively solve issues. Furthermore, educational media can be supplemented with questions that guide learners to relate the learning material to real-life situations. Using this instructional material would improve students' motivation and capacity for critical thought (Gusti & Yasmini, 2021; Fardani et al., 2022).

The use of blended learning educational media based on the Problem-Based Learning (PBL) model can be under consideration as an alternative to improve students' critical thinking skills, which are crucial to developing in physics education, given the benefits and successes of using these materials in the classroom and the importance of a learning model where students actively engage in problem-solving. However, an initial analysis is required to assess the necessity for blended learning educational media based on PBL. Evaluating the necessity for the development of educational media is crucial as it leads to creating media

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suitable for the situation and characteristics of the students. Needs analysis can be conducted when the instructional program designer performs a series of analyses related to the needs of students and teachers. This study aims to analyze the requirements for blended learning-based PBL learning materials to enhance students' critical thinking skills when solving physics learning challenges, particularly those about rotational dynamics and equilibrium.

Research Method

The research approach employed in this study was qualitative research using a survey method. Seventy-five high school students and five Kampar Regency and Pekanbaru physics instructors participated in the cluster sampling approach. The population was calculated using pre-established population regions. The plan shown in Figure 2 below visually represents the research process.

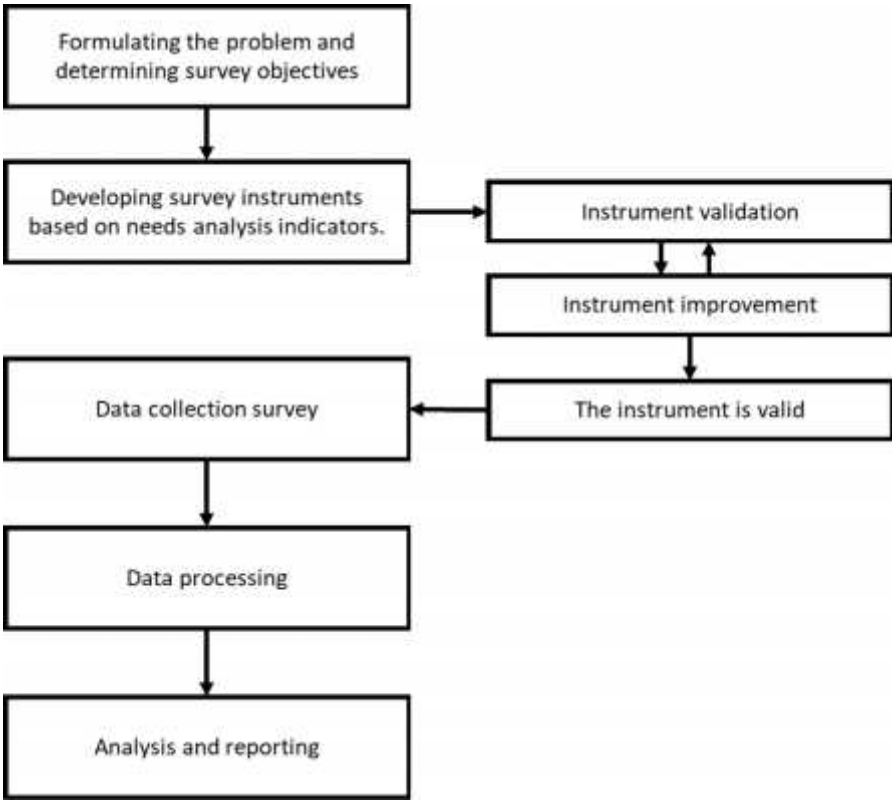

Figure 2. Research Flowchart

In this research, the instrument used was a closed questionnaire structured based on the indicators for analyzing the development needs of blended learning educational media based on PBL to enhance learners' critical thinking abilities. The developed questionnaire consists of 18 questions for students and 19 for teachers, based on five developed indicators. Both student and teacher questionnaires encompass multiple indicators, each having a varying number of items. The number of items for each indicator can be observed in Table 1.

In measuring critical thinking abilities, questions assessing critical thinking abilities were provided, sourced from the Physics-related questions in the 2018 PISA test at a manageable level. These questions were based on five critical thinking indicators, according to Ennis (2006), which include elementary clarification, essential support, inference, advance clarification, and managing strategies and tactics.

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Table 1. Questionnaire Indicators for Students' and Teachers' Needs

Needs Analysis Indicators	Number of Question Items	
	Students	Teachers
Blended learning teaching methods and media	6	9
Constructivism theory	3	4
PBL learning model	5	5
Critical Thinking Skills	5	6
Learning Motivation	3	2

Based on the five identified needs aspects, the researcher developed several indicators and questions for the questionnaire. The data obtained from the questionnaire were then analyzed using predefined assessment criteria, as presented in Table 2. Expert faculty members validated the questionnaire.

Table 2. Likert Scale Assessment

Description	Score			
	1	2	3	4
Answer Options	Never	Rarely	Sometimes	Very Often

The questionnaire response scores were analyzed using a quantitative descriptive analysis method. The scores from each question item within an indicator were processed to determine the averages. These average scores were used as benchmarks to categorize the analysis of the level of need for developing blended learning educational media based on PBL to enhance critical thinking abilities, as depicted in Table 3.

Table 3. Category Analysis of Needs

No	Range of Average Scores	Category	Decision
1	$3,25 < X < 4$	Very High	Requires
2	$2,5 < X < 3,25$	High	Requires
3	$1,75 < x < 2,5$	Low	Not Required
4	$1 < X < 1,75$	Very Low	Not Required

(Fathiyah et al., 2023)

Results and Discussion

The needs analysis in this research is reviewed from analytical methods and blended learning media, constructivist learning theory, PBL learning models, learning motivation, and critical thinking skills. Based on the five learning needs analysis, the level of need for developing PBL-based blended learning media to improve students' critical thinking skills can be explained as a solution to meeting physics learning needs. Based on needs analysis data provided by distributing questionnaires to teachers and students using Google Forms, it was found that there are various problems in learning physics. One of them is that the material on rotational dynamics and equilibrium is considered a lesson difficult for students to understand. It can be seen in Figure 3.

Figure 3. Learning Media Needs Based on Subject Matter

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One scope of physics subjects that emphasizes natural phenomena and their measurement with the expansion of abstract concepts is the topic of rotational dynamics (Handayani et al., 2019). Based on the results of interviews with teachers at SMAN 1 Perhentian Raja, it was found that the material on rotational dynamics and equilibrium was difficult because it combined the concepts of rectilinear motion and circular motion. Students who have trouble understanding rectilinear motion material will have greater difficulty understanding rotational dynamics and equilibrium material. Students tend only to be able to apply formulas without analyzing the problems given. Critical thinking skills are critical in understanding abstract and complex concepts and solving physics problems related to rotational dynamics (Nainggolan et al., 2023; Widodo et al., 2019).

The results of the student critical thinking ability test at SMAN 1 Perhentian Raja based on five aspects of critical thinking ability show that making inferences is mastered mainly by students with a correct percentage of 77%. Meanwhile, the lowest percentage was for further explanation, namely 2.8%. It can be seen in Figure 4. On a scale of 100, the overall average score of the critical thinking ability test results is 49, with four students scoring above 60. It shows that the student's critical thinking ability at SMAN 1 Perhentian Raja is still low.

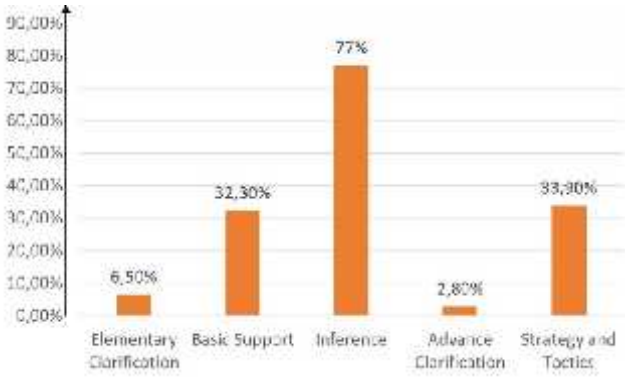
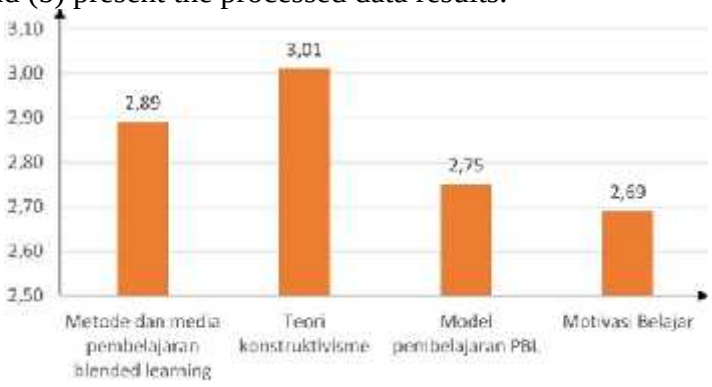


Figure 4. Percentage of Students Answering Critical Thinking Questions Correctly

To address these challenges, a teaching strategy that enhances students' critical thinking skills is required. Therefore, developing instructional media, presenting information traditionally, and fostering and cultivating students' critical thinking skills are essential (Foo & Quek, 2019). Based on the data analysis, this research indicates the students' needs regarding blended learning educational media based on PBL for each indicator of the needs analysis. Figures 5 (a) and (b) present the processed data results.



(a)

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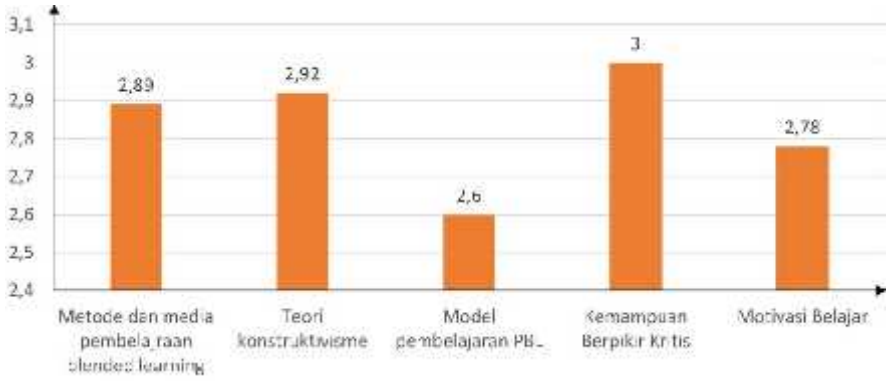

(b)

Figure 5. Needs Analysis Results (a) for students and (b) for teachers in blended learning educational media based on PBL

This research has found that problem-solving is a primary necessity in learning. Asrizal et al.'s study (2017) discovered that problem-solving can prevent gaps in understanding among students. Students aspire for more interactive learning experiences, not merely passive listening and writing. They also concur that they are uninterested in theoretical explanations without problem-solving activities. Some students even prefer seeking and solving problems independently. Therefore, an interactive and participatory learning model, such as the Problem-Based Learning (PBL) approach, may serve as an apt solution to fulfill students' needs for problem-solving in education (Simamora et al., 2017)

Apart from that, the results of the questionnaire showed that 85.7% of the five physics teachers in the Pekanbaru and Kampar areas predominantly applied the question-and-answer method, and 59.2% of the 105 senior high schools in the Pekanbaru and Kampar areas stated that In physics learning, teachers predominantly use books or e-books in physics learning. The question-and-answer method often used in the physics learning process means that 54% of the 75 students at SMA Negeri 1 Perhentian Raja rarely conduct experiments. It can be seen in Figure 6. It shows that the PBL model, especially at SMA Negeri 1 Perhentian Raja, has not been implemented optimally, especially in the third syntax, guiding individual and group investigations.

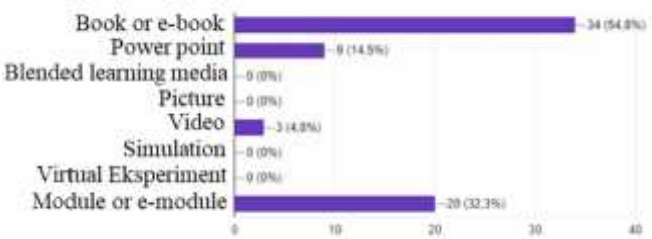

Figure 6. Source or media lessons that are often used in schools

Focusing on solving real problems or complex case scenarios in the PBL learning model can train students to collaborate to identify, analyze, and solve problems (Ariyanto, 2019). It can encourage using various critical thinking skills, such as analysis, evaluation, and synthesis (Abdulah, 2021). The questionnaire results showed that 40.3% of students stated that the teacher often presented a problem at the beginning of learning. However, as many as 40.3% of students said they rarely did, and 12.9% said they never gave opinions based on problems given by the teacher. It shows that this gap is an important point to improve the implementation of the PBL learning model. It can be seen in Figure 7.

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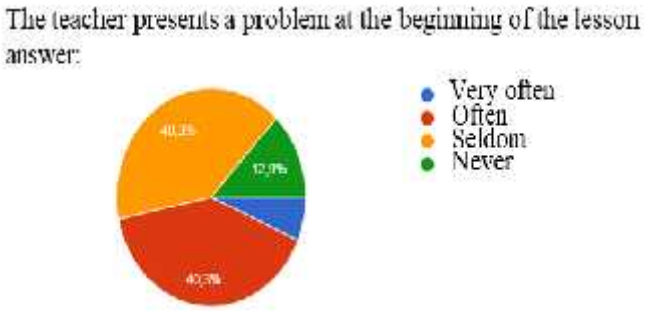

Figure 7. One of the answers to questions from the student questionnaire

Apart from the results of the needs analysis, previous research also stated that several factors cause problems in physics learning, especially in rotational dynamics material. First, teachers often focus on basic concepts or factual knowledge rather than training students' critical thinking activities in the learning process (Rahardhian, 2022; Widodo, 2016). Second, conventional methods, namely lectures and questions and answers, tend to train low-dimensional cognitive abilities such as remembering and understanding (Hamilton, 2020). Third, using appropriate learning media can support and train students' critical thinking skills to maintain consistent student learning motivation (Nurhayati & Angraeni, 2017).

The right solution is the key to overcoming every problem in the physics learning process. Previous research states that with a blended learning approach, teachers have more time and flexibility to provide more in-depth explanations of complex material (Perdana, 2020). Moreover, it can expand opportunities for direct exploration and understanding of concepts through various activities (Lalima, 2017). Integrating blended learning principles in creating learning media allows the development of more adaptive and interactive solutions to support students' understanding of physics learning (Hairida, 2019). Therefore, the development of PBL-based blended learning media using Edunext Openedx is needed to improve student's critical thinking skills and learning motivation, especially in the rotational dynamics and equilibrium material.

Referring to Figure 5 (a), it is observed that the indicator for blended learning instructional media received a score of 2.89, indicating that students agree with the positive questions provided. Approximately 96.8% of the student’s express interest in learning through an educational media platform that offers subject materials in an online format with diverse interactive content such as videos, animations, and simulations. Blended learning media can serve as an effective solution to address challenges in education. It is due to several advantages inherent in blended learning instructional media, such as its ability to present material interactively and engagingly (Dika et al., 2018), enhance learning motivation (Islam et al., 2018), and provide opportunities for exploration and self-discovery aligned with the principles of constructivist learning theory (Pribadi & Ichwan, 2022).

Based on Figure 5 (b), it is observed that the level of demand among teachers for the utilization of blended learning instructional media falls within the average score range of 2.6 - 3.0. This information indicates that teachers' opinions align with positive statements in the questionnaire regarding the need for PBL-based blended learning instructional media to enhance critical thinking skills, as previously mentioned. This aligns with the concept that educational quality improvement can be attained through learning (Suwardi & Farnisa, 2018). Teachers should actively solve instructional issues to find appropriate solutions that positively impact students' skill enhancement (Wang, 2021).

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Conclusion

The conclusion obtained from the results of this study is that the needs analysis for developing PBL-based blended learning instructional media to enhance critical thinking skills is grounded in five indicators: teaching methods and models, constructivist theory, PBL learning models, learning motivation, and critical thinking abilities. Through a holistic evaluation of these aspects, it can be concluded that within the context of physics education, particularly concerning topics like rotational dynamics and equilibrium, there is a need for developing PBL-based blended learning instructional media to enhance students' and teachers' critical thinking skills.

Recommendation

Based on these findings, it is necessary to develop a learning media that integrates PBL-based Blended Learning principles with a focus on aspects of critical thinking skills in rotation and balance dynamics material. This blended learning media is designed to facilitate students' active interaction with the material, integrate relevant case studies, and provide adequate resources to support the development of their critical thinking skills in a physics context. It can include interactive simulations, case studies based on realistic physics problems, and access to in-depth learning content to support problem-solving in rotational dynamics and rigid body equilibrium.

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