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Development of Blended Learning Media Based on Openedx Integrated PBL on Rotational Dynamics Material

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Abstract: Learning physics, especially rotational dynamics, is often difficult for many students because of the complexity of the concepts and abstract approach. In situations like this, conventional physics learning often encounters obstacles to providing in-depth understanding to students. Transformation in the world of education is becoming increasingly important, significantly increasing student motivation in studying physics so that it can improve students' performance. To address this issue, open-source blended learning materials that include problem-based learning (PBL) in the Rotational Dynamics curriculum must be developed. The goals of this study are to identify the phases involved in the creation of learning media; identify appropriate standards for learning media; and assess the usefulness of the learning media under development. The development model known as ADDIE is the process utilized for development. Four experts validated the blended learning media developed and underwent revisions to obtain suitable results. This research shows that: the learning materials created have been deemed legitimate and fit for use in the educational process, with a very high category; The application of the learning materials created is user-friendly and practical, also with a very high category.

Keywords: Blended Learning Media; Openedx, Problem-Based Learning

Introduction

The advent of the Industrial Era 4.0 has resulted in substantial alterations across different spheres of life, notably in education (Bonfield et al., 2020; Utami & Amaliyah, 2022). This shift necessitates inventive approaches to learning. The evolution within the educational landscape is gaining paramount importance, particularly concerning the elevation of student engagement in physics education. Learning physics is often difficult for many students because of the complexity of the concepts and abstract approach (Ma'ruf et al., 2020; Nabilah & Jumadi, 2022; Sapriyadin et al., 2023). In this situation, conventional physics learning often faces obstacles to providing in-depth understanding to students (Azizah et al., 2023; Saad et al., 2019; Subagiyo, 2023). One of the physics learning topics considered difficult is the topic of rotational dynamics (Kurniawati et al., 2021).

Learning rotational dynamics requires theoretical understanding and a strong understanding through experimentation and application of concepts in real situations (Ledezma-Ramírez, 2023). However, the density of the material makes it difficult for teachers to provide meaningful learning to students (Amalia et al., 2022; Nainggolan et al., 2023). Conventional learning on the topic of rotational dynamics often experiences obstacles in providing students with in-depth understanding due to the material's abstract nature and complexity (Mulyastuti et al., 2016). Learning rotational dynamics requires theoretical understanding and a strong understanding through experimentation and application of concepts in real situations. However, the density of the material makes it difficult for teachers to provide meaningful learning to students (Hassan, 2023).

In the rotational dynamics material, the application of the PBL learning model allows students to explore physics concepts through solving real problems, such as applying the law of conservation of angular momentum

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in situations of object rotation or analyzing the moment of inertia of objects in everyday life. In this way, students not only passively understand the theory but also apply it in practical situations (Shinta, 2019; Widodo et al., 2019). Technological progress has fostered a more interconnected world digitally. With the creation of educational media, students not only grasp the subject matter but also gain proficiency in utilizing technology as part of their learning experience (Amaliyah, 2023).

Hence, employing learning media can enhance the effectiveness of implementing the Blended Learning method (Feranie et al., 2023; Susilawati et al., 2022). By combining online and in-person learning, this integration leverages the strengths of each approach, ultimately enriching students' learning journeys (Bartoszewicz et al., 2020). Experts highlight that limitations in conventional learning can be optimized using Blended Learning (Morton et al., 2016). Blended Learning enables more efficient use of resources and creates an adaptive learning environment, allowing students to learn independently while still having access to guidance and social interaction (Alvarez Jr, 2020).

Integrating Blended Learning into a learning medium is essential in comprehensively presenting material. Several blended learning media can be used, such as utilizing LMS learning systems, including Moodle, Schoology, Edmodo, and others (Kavani & Amjadiparvar, 2018). Expanding the widespread utilization of Learning Management Systems (LMS) can be achieved by adopting Massive Open Online Courses (MOOCs). MOOCs adhere to the principle of openness and leverage advanced technology to facilitate the engagement of extensive participant numbers, making them accessible to the public (Badali et al., 2022; Bettiol et al., 2022; Ebben & Murphy, 2014).

One open-source platform that can be used is Edunext Openedx (Fajrillah et al., 2020). Edunext Openedx is an online platform for creating, delivering, and analyzing online courses (Giang, 2022) with its use, it can display most of the basic and advanced functionality in LMS and e-commerce applications that are open to experience from the learner's perspective (Annamalai et al., 2021). Using the Edunext Openedx platform can be used as a blended learning medium. Using blended learning media allows students to gain new knowledge independently (Rimbawati & Muchlas, 2015). Based on the background mentioned, this writing aims to produce blended learning media based on Openedx integrated PBL on valid rotational dynamics material. The integration of PBL in blended learning media on platforms such as Edunext Openedx will provide a holistic learning experience.

Method

This investigation aligns with the Development Research or Research and Development (R&D) methodology, employing the ADDIE development model. The study will encompass consecutive stages of analysis, design, development, implementation, and evaluation, as detailed by Wicaksana et al. (2021). The focus of this research involves creating PBL-based blended learning media utilizing Edunext OpenEdX. This educational tool aims to enhance students' motivation and critical thinking skills in the realms of equilibrium and rotational dynamics. The visual representation of the product development process is illustrated in Figure 1.

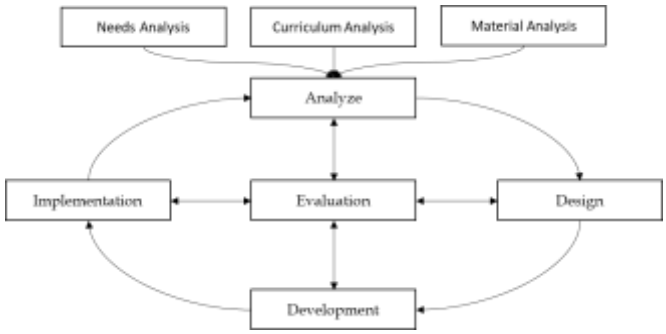


Figure 1. Media development flow design

According to the diagram, the research will implement the ADDIE model's development procedure in the following manner:

Analysis

Within this research, the analysis phase encompasses various activities, including needs analysis, curriculum assessment, and scrutiny of learning materials (Amirudin et al., 2017; Maudiarti, 2018; Rahmatina, 2019). The specific needs analysis in this study aims to explore prevalent methods and models utilized in the learning process, along with discerning the requirements of both teachers and students regarding learning media. This investigation particularly focuses on the necessity for blended learning media concerning material on rotational dynamics. Meanwhile, the curriculum analysis and material analysis referred to in this research aim to determine the competencies that must be achieved by students and their depth.

Design

The design of this learning media uses LMS design steps. According to Listiawan (2016), there are two development activities in designing an LMS, namely reference analysis and LMS design. Reference analysis involves the exploration and study of literature or

resources related to the diverse requirements in Learning Management System (LMS) development derived from the outcomes of the analysis phase. The design of the LMS will rely on the creation of historical boards and storyboards as foundational elements (Veliu & Selimi, 2011).

Development

The development phase follows a predetermined design, utilizing the design outcomes as a reference. This stage involves translating the design into the creation of blended learning media utilizing the integrated PBL approach within Edunext Open. The developed media then undergoes validation testing by expert validators to assess its validity. The data obtained from the validity test of the blended learning media underwent analysis, focusing on qualitative assessment criteria for each aspect. This assessment involved examining several indicators within each aspect to evaluate its effectiveness and quality. The qualitative data that has been obtained is changed into quantitative data and presented on a Likert scale, namely 1-4. Based on quantitative data, the validity value is determined using Aiken's V formula 1 (Hidayah & Muhtarom, 2023).

$$V = \frac{\Sigma s}{n\,(c-1)} \quad (1)$$

Data from the practicality test of blended learning media, which was originally qualitative, was analyzed based on several indicators on a 1-4 Likert Scale after being converted to quantitative format. The next step involves determining the practicality value using the following equation.

$$Practicality = \frac{Number\ of\ scores}{Maximum\ Score} \quad (2)$$

Implementation

At this implementation stage, the product that had been created was carried out on a small-scale trial in the form of a practicality test on 3 teachers and 15 students at SMAN 1 Perhentian Raja.

Evaluation

The concluding phase involves conducting a formative evaluation. This ongoing evaluation gathers data at each stage, utilized for continual improvement. It targets experts at each stage, aiming to collect data that aids in refining the development of blended learning media (Zulqadri et al., 2023).

Result and Discussion

The development of blended learning media, integrating Openedx and PBL, was structured according to the ADDIE instructional design model, delineated as follows.

Analysis

In this research, the analysis phase comprises three key activities: needs analysis, curriculum analysis, and material analysis. The outcomes of these analyses are presented in Table 1.

Table 1. Results of media development in the analysis stage

Analysis	Results
Needs Analysis	1. The dominant learning resource used by students is books 2. The dominant learning method applied by teachers is lecture and question-and-answer 3. Students do not understand the concept of rectilinear motion dynamics as a basic concept in understanding rotational dynamics material 4. Teachers still have difficulty creating or displaying simulations related to rotational dynamics material 5. The distance teacher invites students to carry out experiments 6. Rotational dynamics material is complex and abstract material 7. PBL-integrated blended learning media is needed to overcome students' problems in understanding rotation dynamics material
Curriculum Analysis	1. The 2013 curriculum is the curriculum used 2. Media development is based on core competencies and basic competencies according to material on the dynamics of class XI high school rotation 3. The learning design is integrated with the use of blended learning media
Material Analysis	1. The rotation dynamics material is divided into 4 meetings 2. Indicators and learning objectives for each meeting are adjusted to core competencies and basic competencies

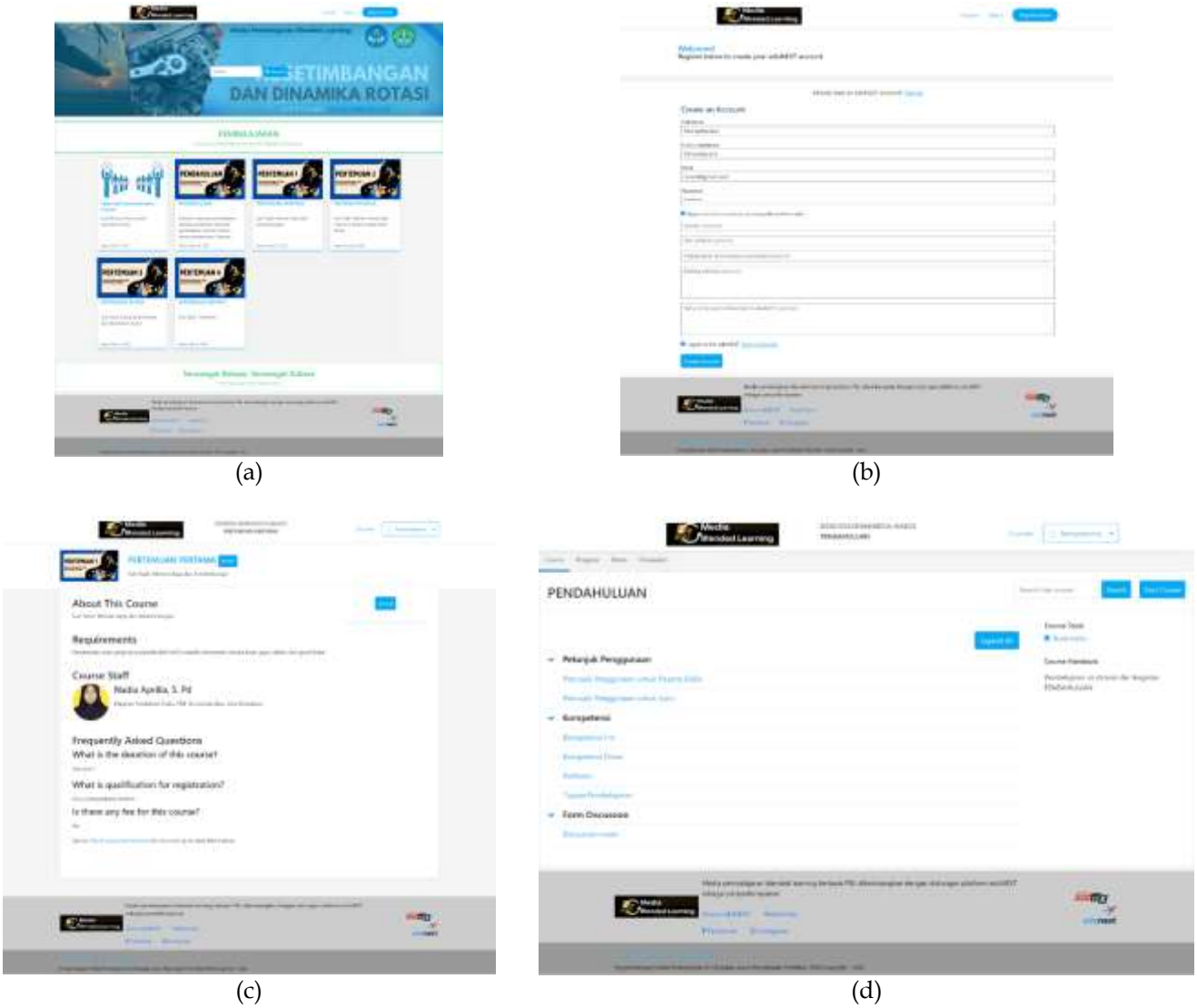
Based on the needs analysis, learning rotation dynamics material in class XI SMA shows several obstacles. Conventional learning methods are not effective enough in conveying a deep understanding of the material. To overcome this, it is necessary to use blended learning media with the PBL approach.

PBL integration will encourage students to learn by solving case-based problems and applying concepts in real-world contexts. Thus, it is hoped that this solution

can provide a more interactive learning experience and increase the effectiveness of understanding rotational dynamics material.

Design

The blended learning media design process consists of 2 steps, namely designing a history board and storyboard. Based on the results of the history board, a storyboard is developed for each section. Following are some of the results and explanations of the media developed, which can be seen in Figure 1.



(a) (b) (c) (d)

Figure 1. Media display: (a) Branda of LMS; (b) Display of account registration; (c) First page after registration; (d) Display of material

This section is the home screen of the blended learning media LMS being developed. On the main page (homepage), there are 3 buttons in the header, 2 buttons in the footer, and 6 menus in the main content section. Each meeting is made into a separate course. Users can start learning by registering first. If you have registered, users can immediately start learning by logging in to the media. This section is the account registration display on blended learning media. Registration is carried out to make it easier for developers to track users. This section is the initial page display when the user wants to register for the meeting course provided on the media. This section is a display of the course homepage for the first meeting. This page consists of 3 main menus in the main content section, namely instructions for use (with 2 submenus), competencies (with 4 submenus), and discussion form (with 1 submenu). In the header section, there are 4 buttons provided by Edunext Opened, namely course (to display the main page), dates (to see assignment deadline dates or notifications), and

discussion (to access the discussion column). The blended learning media logo will direct users to the course they have registered for. Each footer section of the course has a help center button to make it easier for users. This section is a submenu display that helps investigate activity groups 1. In this section, users carry out virtual experimental activities in groups. In this section, component development involves incorporating text by adding live links to the worksheet page. Meanwhile, the problem analysis section utilizes Raw HTML for its implementation. Apart from that, in the conclusion section, add a blank problem comment. This activity is carried out to build inference skills to improve critical thinking abilities

The blended learning media that has been developed is then validated. The validity test was carried out by giving a validity assessment sheet to 4 validators (Tselios et al., 2011). This learning media is validated based on 3 criteria aspects, namely media material and pedagogy along with explanations.

Assessment of the suitability of learning media in terms of media is carried out by lecturers who specialize in developing e-learning-based learning media. Assessment indicators in this aspect include appearance, interactivity, and programs. The validation results can be seen in Figure 2.

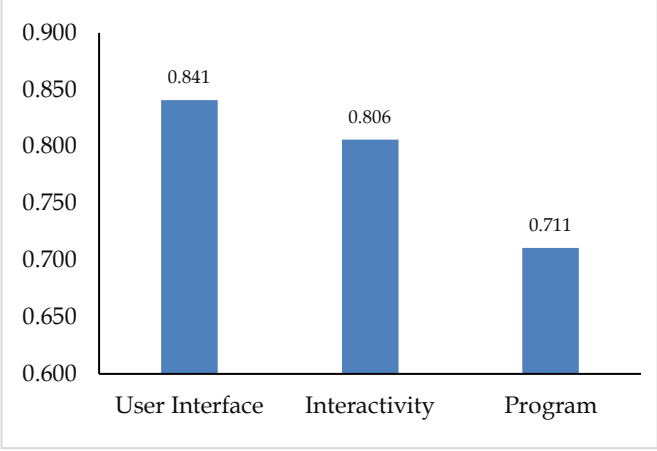


Figure 2. Media Aspect Average Score

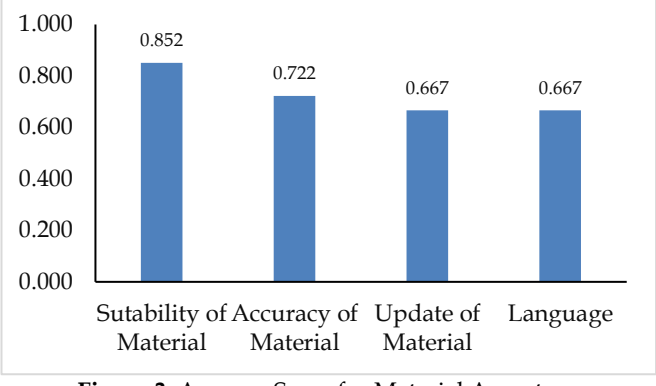


Figure 3. Average Score for Material Aspects

Assessment of the suitability of learning media in terms of material is carried out by the lecturer who has abilities or fields of study related to learning material. Assessment indicators in this aspect include Material Suitability, Material Accuracy, Material Update, and Language. The validation results can be seen in Figure 3.

Assessment of the suitability of learning media in terms of pedagogy is carried out by lecturers who have abilities or fields of study related to educational pedagogy. Assessment indicators in this aspect include the presentation and PBL model. The validation results can be seen in Figure 4.

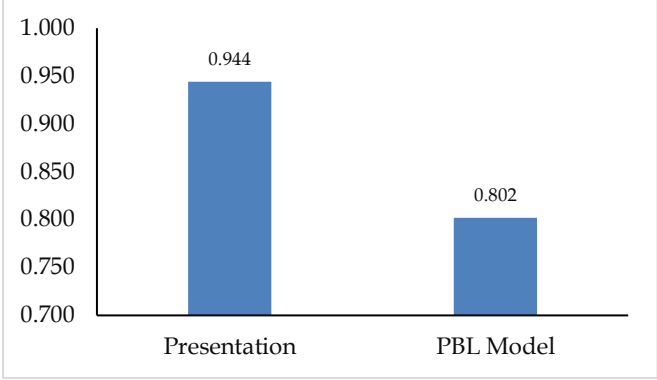


Figure 4. Average Score of Pedagogical Aspects

Overall, the results of the validation criteria for each aspect can be seen in Table 3

Table 3. Results of validity test of blended learning media

Assessment Aspects	V	Validation Category	Category
Media	0.79	Valid	Very high
Material	0.79	Valid	Very high
Pedagogy	0.84	Valid	Very high
Average	0.81	Valid	Very high

Based on Table 3, the results of the validity test of blended learning media tested by 4 validators obtained an average Aiken validity index of 0.81 with very high criteria.

Implementation

The implementation phase carried out in this research was in the form of small-scale trials and field trials. Small-scale trials were given to 3 physics teachers and 20 students at SMAN 1 Perhentian Raja. Practicality test results by the teacher and students are shown respectively in Table 4 and Table 5.

Table 4 and Table 5 showcase the outcomes of the practicality test for the blended learning media conducted by three physics teachers, resulting in an average score of 3.58 against practical criteria. Similarly, students obtained an average score of 3.76 using the

same practical criteria. From these findings, it can be inferred that, overall, the blended learning media is deemed feasible for practical application within the physics learning process.

Table 4. Test of the practicality of blended learning media by teachers

Assessment Aspects	Average Score	Criteria
Media	3.77	Practical
Material	3.36	Practical
Pedagogy	3.60	Practical
Average	3.58	Practical

Table 5. Test the practicality of blended learning media by students

Assessment Aspects	Average Score	Criteria	Category
Media	3.75	Practical	Very high
Material	3.77	Practical	Very high
Pedagogy	3.78	Practical	Very high
Average	3.76	Practical	Very high

Evaluation

This research was evaluated at the analysis, design, development, and implementation stages. The results of the analysis stage show that rotational dynamics material is one of the physics learning materials that students consider difficult. Therefore, the development of blended learning media based on Openedx integrated PBL is needed in physics learning (Aprilia et al., 2024). Based on suggestions from supervisors, examiners, and validators, there are several improvements to the learning media being developed. The blended learning media developed has several advantages, namely wide accessibility and integration, flexibility, can be used anytime and anywhere, easy to use, can help users to measure understanding independently; teachers can adjust content and classes. However, behind its advantages, this media has a disadvantage, namely that it requires an internet network.

Conclusion

The research findings indicate that the integration of OpenEdX-based Blended Learning media with PBL on Rotational Dynamics material has demonstrated suitability for application in physics education. The validation process and its practicality have been tested using the ADDIE-type Instructional Design procedure, including analysis, design, development, implementation, and evaluation.

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Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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