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DEVELOPMENT OF PROBLEM-BASED LEARNING MULTIMEDIA USING GENIALLY TO FOSTER CRITICAL THINKING SKILLS AND PHYSICS LEARNING INTEREST OF GRADE XI SENIOR HIGH SCHOOL STUDENTS

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ABSTRACT

This research addresses the problem of students' low critical thinking skills and limited interest in physics, which stem from outcome-oriented teaching and a lack of diverse learning materials. To overcome this, the research develops multimedia learning tools for kinematics using the Genially platform, based on Problem-Based Learning (PBL). The research employs the ADDIE model and a Posttest-Only Control Design with experimental and control groups at SMA Negeri 5 Tapung. Results show the multimedia is valid (average score 3.60), highly practical according to teachers and students, and effective—significantly improving critical thinking and learning interest compared to the control group. Thus, the developed multimedia is feasible and beneficial for physics education. This study utilized the ADDIE framework within a Research and Development (R&D) methodology, integrating a Posttest-Only Control Design specifically for the implementation phase, with experimental and control classes at SMA Negeri 5 Tapung. Data were collected through questionnaires and tests, and analyzed for validity, practicality, and effectiveness using both descriptive and inferential techniques. The results indicate that the developed multimedia is valid, with an average score of 3.60, and practical, with a very high category based on evaluations from teachers and students. Effectiveness testing further revealed significant differences in critical thinking skills and learning interest between the experimental and control classes, with a significance value of < 0.05, thus confirming that the developed multimedia is feasible and effective for use in physics learning.

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1. INTRODUCTION

Education plays a crucial role in various aspects of life as it has a positive impact on the quality of human resources. Therefore, improving the quality of education, particularly the quality of learning, has become a primary concern in line with the demands of the times. One fundamental aspect that determines the progress of the education system is the curriculum, which

serves as a guideline in organizing learning to achieve educational goals (Hudaidah & Ananda, 2021). Curriculum changes represent a form of continuous development carried out to align the education system with contemporary needs and global challenges (Dhomiri, 2023).

As an integral component of the Merdeka Belajar policy, the Merdeka Curriculum was introduced by Indonesia's Ministry of Education, Culture, Research, and Technology., aiming to realize the Pancasila Student Profile, which encompasses both cognitive and non-cognitive competencies such as literacy, numeracy, and character strengthening. The implementation of the Merdeka Curriculum began with the Sekolah Penggerak program, which focuses on strengthening human resources, particularly school principals and teachers (Yantoro & Suratno, 2022). This curriculum requires student-centered learnin g that considers students' readiness, talents, interests, and individual characteristics, while also granting teachers the freedom to innovate in determining appropriate strategies and learning models (Hutabarat et al., 2022).

Nevertheless, the application of student-centered learning is not without challenges. Teachers continue to face difficulties in implementing the Merdeka Curriculum, especially in adapting learning to the diverse characteristics and needs of students. The implementation of this curriculum emphasizes not only the achievement of competencies but also the holistic development of students' character and potential (Idhartono, 2022). Furthermore, the Merdeka Curriculum is closely related to the reinforcement of 21st-century skills, including critical thinking, creativity, communication, and collaboration (Indarta et al., 2022; Jayadi et al., 2020)

Physics learning is one of the subjects that plays an important role in fostering 21st-century skills, particularly critical thinking. Critical thinking in physics learning is essential for analyzing natural phenomena, solving problems, and connecting physics concepts with everyday life (Jayadi et al., 2020). However, various studies have shown that students' critical thinking skills in physics remain relatively low. Students tend to be able to perform mathematical calculations but struggle to understand the meaning of concepts and to explain problem-solving logically in their own words (Benyamin et al., 2021). This condition is further supported by initial needs analysis results, which indicate that most students are not confident in their critical thinking abilities, particularly in providing simple explanations as one of the indicators of critical thinking (Zakaria, 2020).

One factor influencing the low level of students' critical thinking skills is the learning model used. A learning model is a series of activities designed by educators to facilitate the teaching and learning process effectively and systematically (Istarani, 2011; Ariani, 2020). Selecting the right learning model not only helps teachers achieve learning objectives but also creates an engaging, challenging, and meaningful learning atmosphere for students. The Problem-Based Learning (PBL) model is one such approach, oriented toward solving real-world problems and encouraging students to actively analyze, evaluate, and construct knowledge independently. This model has been proven effective in fostering students' critical thinking skills as it requires active involvement in the learning process (Batubara et al., 2010; Rinesti et al., 2019).

The success of implementing PBL in physics learning is also strongly influenced by students' learning interest. Learning interest is a key factor that determines student engagement in the learning process, including in physics, which is often perceived as difficult and abstract (Safitri et al., 2022). Physics, as a branch of science, studies natural phenomena and their interactions, requiring strong conceptual understanding (Wea et al., 2022). In the topic of

kinematics, although it has many real-life applications, many students still struggle to understand the concepts and relate them to real phenomena (Ruspitasari et al., 2022). These difficulties are caused by internal factors such as low interest and motivation, as well as external factors such as limited variety in learning and inadequate facilities (Baser, 2006; Taqwa et al., 2020).

Low conceptual understanding and students' tendency to focus on mathematical problem-solving without deeper analysis lead to reduced enthusiasm and interest in learning physics (Magfira et al., 2021; Oktaviana, 2016; Aldila et al., 2020). Therefore, innovation in physics learning is needed through the use of digital technology as a supporting medium. Technology can help present abstract physics concepts in a more concrete and comprehensible way for students (Illahi, 2018; Sastradewi, 2022).

The development of digital technology in the 21st-century globalization era offers great opportunities to improve the quality of learning. The use of technology in education can support learning facilities and infrastructure while enhancing the effectiveness of teaching and learning processes (Maritsa et al., 2021; Nurillahwaty, 2022). One form of technology utilization in physics learning is the use of multimedia, which integrates text, images, videos, animations, and interactive features into a single unit. Multimedia learning has been proven to increase students' learning interest and critical thinking skills (Socrates & Mufit, 2022).

However, the use of multimedia learning in schools remains relatively low and lacks variety. Teachers tend to rely more on textbooks and worksheets, while the use of media such as videos, interactive presentations, and web-based multimedia is still limited (Novisya & Desnita, 2020). Initial needs analysis also shows that only a small number of teachers use multimedia learning, while most students express interest and motivation when physics learning involves interactive and varied media.

Despite the recognized potential of multimedia learning, a significant gap remains in its systematic integration. Previous studies on physics multimedia, such as those relying on traditional presentation software (e.g., PowerPoint) or standalone offline media (e.g., Flash-based modules), often presented content passively and lacked unified interactive components. Unlike these legacy platforms, genially serves as a cloud-based, centralized ecosystem that seamlessly consolidates diverse interactive tools such as embedded videos, PhET virtual simulations, and automated Google Forms assessments into a single web-based interface accessible via QR codes. Furthermore, while earlier research applied Problem-Based Learning (PBL) through conventional static worksheets, this study distinctively embeds each phase of the PBL framework directly into Genially's interactive features. This synergy transforms problem-solving from traditional paper-based tasks into an active, contextual digital experience, directly addressing students' difficulties in mastering abstract physics concepts like kinematics. This clear distinction underscores the need to empirically validate and evaluate such structured, platform-driven PBL multimedia in secondary physics education.

Based on these conditions, the development of multimedia learning based on Problem-Based Learning using the Genially platform is considered a relevant solution to improve students' critical thinking skills and learning interest in the topic of kinematics. Genially, as a web-based platform, provides various interactive features that allow the integration of multiple learning resources into an engaging medium. Therefore, this study aims to develop PBL-based physics learning multimedia using Genially and to examine its validity, practicality, and

effectiveness in fostering critical thinking skills and enhancing the learning interest of Grade XI senior high school students.

2. METHOD

Utilizing a Research and Development (R&D) design, this study focuses on designing a Genially-powered physics learning multimedia embedded with PBL. It further evaluates the product's validity, feasibility, and efficiency in enhancing students' critical thinking capabilities and motivation to learn. The development model employed was the ADDIE model, consisting of five main stages: analysis, design, development, implementation, and evaluation (Sugiyono, 2017; Branch, 2009). The ADDIE model was chosen because it provides systematic and interconnected stages that are suitable for the development of technology-based learning products. Figure 1 presents the stages of the ADDIE development model.

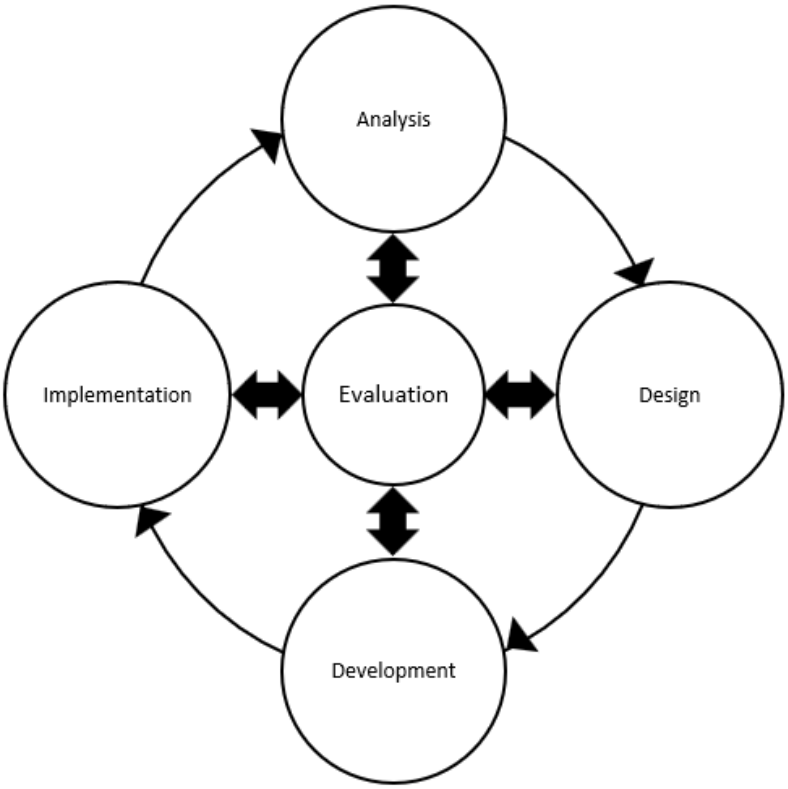


Figure 1. ADDIE Development Model (Branch, 2009)

The analysis stage was conducted to identify problems in physics learning at schools and to examine teachers' and students' needs for learning media. This stage involved distributing questionnaires to teachers and students, conducting initial classroom observations, and reviewing relevant literature. The results revealed that physics learning was still dominated by conventional methods with limited use of media, which negatively impacted students' learning interest and critical thinking skills. Therefore, innovative and interactive multimedia development was deemed necessary to support physics learning, particularly in the topic of kinematics. In addition to needs analysis, concept and material analysis were also carried out, aligned with the Learning Outcomes (CP) and Learning Objectives (TP) of physics in the Merdeka Curriculum.

The design stage involved planning the structure and interface of the PBL-based physics learning multimedia. The design included interface layout, color selection, navigation, and the arrangement of learning flow based on PBL syntax. The presentation of materials was systematically organized to help students understand physics concepts through contextual problems, simulations, practice questions, and integrated evaluations. This stage aimed to produce a product design that is engaging, user-friendly, and aligned with students' characteristics.

The development stage was the realization of the design into a multimedia product using Genially. At this stage, the multimedia was developed according to the planned design and then validated by subject matter experts, media experts, and pedagogical experts. Validation was conducted to assess content feasibility, interface design, language, and the alignment of multimedia with PBL principles. The validation process used a Likert scale, commonly applied to measure perceptions and opinions of validators regarding the quality of learning products (Riduwan, 2013; Sugiyono, 2017). The product was revised based on feedback and suggestions from validators until it was declared valid and feasible for use in learning.

The implementation stage was carried out through field trials to determine the effectiveness of the PBL-based physics learning multimedia using Genially. This study employed a quasi-experimental design in the form of a posttest-only control design (Hastjarjo, 2019). The research subjects consisted of an experimental class that used the multimedia and a control class that received conventional instruction. The population included all Grade XI science students at SMAN 5 Tapung, with samples selected using simple random sampling to ensure equal opportunity for each class to be chosen. The sample for this study comprised two Grade XI classes at SMAN 5 Tapung, with class XI A1 serving as the experimental group and class XI A2 as the control group. The sample included a total of 50 students, with 25 students in each class. This study builds upon the preliminary analysis phase. Specifically, the assessment of learning resource needs revealed that a significant majority of students (87.2%) affirmed that incorporating diverse instructional multimedia markedly enhances their active engagement and conceptual mastery in physics.

Data collection utilized several instruments, including expert validation sheets, practicality questionnaires, critical thinking tests, and student learning interest questionnaires. The learning interest questionnaire was constructed based on indicators of enjoyment, curiosity, involvement, and attention in learning (Apriyani et al., 2022).

The research incorporated a dual-phase evaluation framework consisting of formative and summative assessments. Formative measures were applied dynamically during development through validity-based revisions and small-scale testing; summatively, the impact on student learning interest and higher-order thinking skills was determined using posttest performance and self-reported questionnaire data. Data analysis was performed both descriptively and inferentially. Descriptive analysis was used to describe levels of validity, practicality, critical thinking skills, and learning interest. Inferential analysis was conducted to test research hypotheses using normality and homogeneity tests as prerequisites for statistical analysis (Rangkuti, 2017; Mustafa, 2022).

If the data were normally distributed and homogeneous, hypothesis testing was conducted using MANOVA to determine differences in critical thinking skills and learning interest between the experimental and control classes. However, if the data did not meet normality or homogeneity assumptions, the nonparametric Mann–Whitney test was used as an alternative, since it does not require normally distributed data (Adinurani, 2022; Amiliyah et al., 2022). All statistical tests were performed at a significance level of 0.05 using SPSS software.

3. RESULTS AND DISCUSSION

This research is development research focusing on physics learning multimedia based on Problem-Based Learning (PBL) using Genially for kinematics material with the ADDIE model. The multimedia was developed to foster students' critical thinking skills and learning interest, validated by experts, tested for practicality, and implemented through field trials.

Development and Application of Learning Multimedia

3.1. Analysis

The purpose of the research analysis was to identify the needs of teachers and students, review relevant literature, and examine physics concepts as the foundation for developing multimedia learning that is relevant and aligned with the Merdeka Curriculum. Condition of Students' Critical Thinking Skills and Learning Interest The questionnaire results revealed that most students were still hesitant to explain physics problems in their own words, draw conclusions, and determine problem-solving strategies. In addition, more than half of the students had not shown serious engagement in physics learning, indicating low learning interest. Gap Between Students' Needs and Classroom Practices As many as 87.2% of students stated that they enjoyed and were interested in using multimedia learning, yet classroom practices remained dominated by textbooks and worksheets. The use of physics learning multimedia was relatively low, both among students and teachers, so students' learning needs were not optimally facilitated. The Need for Multimedia Development as a Solution for Physics Learning Based on the analysis of teachers' and students' needs, multimedia learning was considered essential to improve student engagement, conceptual understanding, learning interest, and critical thinking skills. Therefore, the development of PBL-based physics learning multimedia was regarded as a relevant and innovative solution for physics instruction.

3.2. Design

The development of PBL-based physics learning multimedia in this study was carried out using Genially, a web-based digital platform, as the primary medium for product design and development. Genially was chosen for its ability to integrate various types of media—such as text, images, videos, simulations, and interactive links—into a unified learning environment. The use of this platform was expected to support the development of physics multimedia on kinematics material, oriented toward fostering critical thinking skills and enhancing students' learning interest.

The design process began with the preparation of the multimedia interface, including the opening page, content layout, and learning activities on each page. The multimedia design was arranged systematically and attractively by utilizing templates available in Genially, then adapted to the needs of physics learning. The visual aspects of the multimedia adhered to instructional design quality standards, such as consistency in font type and size, color combinations, and other aesthetic elements. Consistency in design was considered essential to maintain visual quality and improve learning effectiveness, as Ghai & Tandon (2022)

emphasized that uniformity in layout, terminology, and design enhances students' comfort and comprehension.

In the advanced design stage, the multimedia was structured not only in terms of visuals but also in terms of content organization and learning activity packaging. A storyboard was prepared to illustrate the overall flow and structure of the multimedia, consisting of three main parts: introduction, content, and conclusion. The introduction included the opening page, main menu, and usage instructions, which helped students understand the learning flow and activities provided. The presence of usage instructions was crucial to ensure that students could utilize the multimedia independently and optimally.

Learning activities within the multimedia were designed according to the syntax of the PBL model. Activities began with the presentation of contextual problems related to everyday life, supported by video media as an initial stimulus. This stage was followed by group formation, experimental or virtual simulation activities, group discussions, and communication of results through presentations. These activities were designed to encourage active student engagement in the learning process while training critical thinking skills through analysis, problem-solving, and decision-making.

The final section of the multimedia included supporting menus such as conclusions, evaluations, references, developer profiles, and a closing page. The evaluation menu was designed to measure the achievement of learning objectives and students' critical thinking skills after completing all learning activities. Overall, the design of PBL-based physics learning multimedia was documented in a development storyboard that illustrated the integration of content, learning activities, and visual design.

The content section, or the core component of the multimedia, included an introduction to the material and structured learning activities, covering learning competencies, learning outcomes, sequence of learning objectives, learning indicators, and the kinematics teaching module. A concept map was also provided to give an overview of kinematics material, helping students understand the interrelationships among concepts. The material was presented in four subtopics or sessions, each accompanied by PBL-based learning activities, sample problems, practice exercises, and a glossary to support the understanding of physics terminology.

The presentation of materials in the multimedia was designed to be contextual and student-centered, in line with the PBL model. The learning objectives and indicators guiding the material development were aligned with the focus of fostering critical thinking skills and increasing students' interest in physics. Therefore, the structure of the material was arranged to encourage students to analyze problems, apply scientific reasoning, and reflect through evaluation questions provided at the end of the learning process. Furthermore, the use of various supporting media—such as images, videos, simulations, interactive links, and diverse practice exercises—was expected to create physics learning that is more engaging, meaningful, and student-centered through the utilization of digital technology in PBL-based multimedia.

3.3. Development

The development stage aimed to realize the design into PBL-based physics learning multimedia ready for testing. The content was developed using Genially, validated by experts,

and revised according to feedback. This process was supported by applications such as Microsoft Word, Canva, and Google Form to produce a product suitable for use.

3.3.1. Product Development

Structure and Navigation of Learning Multimedia. The PBL-based physics learning multimedia was systematically developed into three main parts: introduction, content, and conclusion. The introduction served as an entry point, containing the opening page, menu list, and usage instructions to facilitate navigation and understanding of the learning flow. (1) Presentation of Problem-Based Learning (PBL) Materials. The core section presented kinematics material aligned with the competencies of the Merdeka Curriculum and PBL syntax. The material was delivered contextually and interactively through concept maps, problem-based activities, simulations, videos, sample problems, and practice exercises to train students' critical thinking skills. (2) Reflection and Closing Functions. The final section reinforced understanding and reflection through conclusions, evaluations, and references. Additionally, the inclusion of developer profiles and a closing page provided academic completeness and marked the end of the learning process in a structured manner.

3.3.2. Validation Results

At the development stage, the PBL-based physics learning multimedia created with Genially underwent validation as an initial evaluation. The validation aimed to assess product feasibility before classroom implementation. The process involved three expert validators: a subject matter expert, a pedagogical expert, and a media expert. Supporting instruments were also prepared, including teacher and student response questionnaires, learning motivation questionnaires, and critical thinking tests for use in field trials.

The validation results showed that the developed multimedia met feasibility criteria across all assessed aspects. The material aspect obtained an average score of 3.53, the media aspect 3.67, and the pedagogical aspect 3.61. The overall average score was 3.60, categorized as valid. This indicates that in terms of content, media presentation, and pedagogical alignment, the PBL-based physics learning multimedia was deemed feasible for use in physics instruction.

Although declared valid, the validators provided constructive suggestions, particularly regarding the completeness of the learning structure, such as adding a conclusion menu at the end of each session as part of the closing stage. All feedback was used as the basis for product revision. These revisions aimed to improve the quality of the multimedia to be more systematic, comprehensive, and aligned with the characteristics of PBL before proceeding to trials and implementation.

3.3.3. Small-Group Trial

Teacher Practicality. The small-group trial involving two physics teachers showed that the PBL-based physics learning multimedia had a very high level of practicality. Assessments of usability, time efficiency, and benefits yielded an average score of 3.86. This indicates that the multimedia was easy to use, efficient in supporting the learning process, and beneficial as

instructional material for kinematics. Student Practicality. Trials conducted with 25 students also revealed highly positive responses to the PBL-based physics learning multimedia. The average practicality score was 3.33, categorized as very high, indicating that students felt supported, interested, and found it easy to understand the material through the developed multimedia. These results suggest that the product is feasible for use and can enhance student engagement in physics learning.

3.4. Implementation

The implementation stage was carried out through field testing after the multimedia was declared valid and practical. Samples were randomly selected and tested for normality and homogeneity. The learning process employed a quasi-experimental design, with the experimental class applying PBL-based multimedia and the control class using conventional instruction.

3.4.1. Descriptive Analysis

Results of Critical Thinking Skills (CTS). Higher critical thinking abilities were demonstrated by the experimental class relative to the control class. The posttest results highlighted a notable distinction, with the experimental group averaging 77.6 (classified as high) and the control group averaging 69.3 (classified as moderate). These findings indicate that PBL-based physics learning multimedia is effective in fostering students' critical thinking skills. (1) Providing Simple Explanations. The experimental class demonstrated lower achievement compared to the control class. This was influenced by students' adaptation process to PBL-based multimedia, which required problem exploration and visualization, so the ability to provide simple explanations had not yet developed optimally at the initial stage. (2) Building Basic Skills. The experimental class obtained higher scores than the control class. PBL-based multimedia encouraged students to follow systematic investigation procedures through interactive simulations, although conventional learning also remained effective in training basic skills. (3) Drawing Conclusions. The ability to draw conclusions in the experimental class was better than in the control class. The stages of PBL and the use of interactive simulations helped students connect physics variables and draw logical conclusions based on the data obtained. (4) Providing Further Explanations. The very high scores in the experimental class indicated that PBL-based multimedia was effective in training students to develop deeper explanations. The integration of visualization and data analysis strengthened students' critical thinking skills. (5) Organizing Strategies and Tactics. The experimental class excelled in designing problem-solving strategies. PBL-based interactive multimedia helped students plan, test, and evaluate strategies in a structured manner through simulations and visualization of physics concepts.

Results of Students' Learning Interest Data Analysis Students'. Student interest in learning was assessed descriptively using questionnaire feedback from 50 respondents across both research groups. Following exposure to the PBL-based physics multimedia on the Genially platform, the experimental class consistently outperformed the control class across every indicator. (1) Enjoyment. The percentage of students' enjoyment in the experimental class was higher than in the control class. This indicates that PBL-based physics learning multimedia with Genially effectively increased students' enjoyment and enthusiasm for learning. (2) Students'

Interest. Students' learning interest in the experimental class was categorized as high and superior to that of the control class. Problem-based investigation activities and interactive simulations created engaging and meaningful learning experiences for students. (3) Learning Engagement. Students' engagement in the experimental class was higher due to the application of PBL, which required active participation through discussions, simulations, and problem-solving. Interactive multimedia supported students' cognitive and social engagement during learning. (4) Attention During Learning. Students' attention in the experimental class was slightly higher than in the control class. Although both were categorized as high, PBL-based multimedia contributed positively to maintaining students' focus and attention throughout the learning process.

3.4.2. Inferential Analysis

Hypothesis testing was conducted on data related to students' critical thinking skills and learning interest. Prior to inferential testing, posttest data were analyzed using normality and homogeneity tests as prerequisites for parametric statistics. All inferential analyses were performed with the assistance of SPSS software to determine differences between groups. (1) Normality Test. The results of the Kolmogorov–Smirnov test indicated that the data on critical thinking skills were not fully normally distributed, as the experimental class had a significance value of < 0.05, while the data on students' learning interest in both classes were normally distributed. This finding influenced the selection of subsequent statistical analysis techniques. (2) Mann–Whitney Test as a Nonparametric Alternative. A Mann–Whitney test was executed due to a violation of the normality assumption. A notable disparity in learning interest and critical thinking skills emerged between the control and experimental groups, thereby validating the impact of implementing PBL-integrated physics instructional media via Genially. (3) MANOVA Test and the Effect of PBL Multimedia. The MANOVA test demonstrated that PBL-based learning multimedia had a significant effect on students' critical thinking skills and learning interest. The R^2 values indicated a contribution of 25% to critical thinking skills and 18.5% to learning interest, thereby proving that multimedia-based learning is more effective than conventional instruction.

3.5. Evaluation

The development of physics learning multimedia based on Problem-Based Learning (PBL) using Genially was carried out systematically through the ADDIE model, with formative and summative evaluations conducted at each stage. The analysis results indicated the need for innovation in learning, as kinematics is considered a difficult topic and students' interest and critical thinking skills remain low. The multimedia was designed with an attractive visual interface, interactive features, and alignment with PBL syntax, then validated by experts and revised according to their feedback. Practicality testing revealed highly positive responses from both teachers and students. Classroom implementation demonstrated that the multimedia was effective in significantly improving students' learning interest and critical thinking skills compared to conventional instruction.

These findings are consistent with prior studies showing that multimedia integration can enhance engagement and higher-order thinking in science education. However, earlier research often focused on general multimedia applications without systematically embedding them in structured instructional design models or problem-based learning contexts. By employing the ADDIE framework and leveraging Genially's interactive features, this study extends previous work and provides stronger empirical evidence that well-designed multimedia can address persistent challenges in physics learning, particularly in fostering critical thinking and sustaining student interest.

Research by Isnaini & Pujianto (2025) further demonstrates that visual appeal, appropriate color schemes, interactive simulations, and structured learning frameworks significantly facilitate media usability and student comprehension. To operationalize these elements, the product workflow was systematically mapped through initial design blueprints and storyboard development. Similarly, the empirical analysis by Al-Fajri & Ariani (2025) underscores the essential role of Problem-Based Learning (PBL) in enhancing students' interest and learning outcomes in physics.

3.6. Strengths and Limitation

Previous research on instructional multimedia development by Maslakhah et al (2024) reveals that physics instruction is not limited to a single medium, as the strategic integration of diverse learning media plays a crucial role in enhancing students' conceptual understanding. In line with these findings, Cahyani et al. (2023) demonstrated that implementing the Problem-Based Learning (PBL) model in teaching sound waves significantly improves students' critical thinking skills. Building upon these foundations, physics learning multimedia based on Problem-Based Learning (PBL) developed via Genially offers a comprehensive solution. It integrates key strengths such as seamless accessibility, device flexibility, and various interactive media—including animations, videos, PhET simulations, and Google Forms—to support contextual, interactive, and collaborative learning that effectively fosters critical thinking skills and sparks student interest. Furthermore, barcode-based access enhances practical usability in the classroom. However, certain limitations remain, particularly its reliance on stable internet connectivity and the feature constraints of the free platform version. Consequently, teacher guidance remains essential to ensure optimal utilization and equitable engagement across all students.

4. CONCLUSION

In conclusion, the development of a Genially-powered physics instructional media integrated with Problem-Based Learning (PBL) has been achieved. The evidence demonstrates that this interactive resource effectively promotes critical thinking skills alongside student interest in learning physics. Guided by the five ADDIE phases—analysis, design, development, implementation, and evaluation—the creation process incorporated Problem-Based Learning (PBL) steps through learning activities including problem orientation, student organization, guided investigation both individually and in groups, presentation of results, and evaluation of the problem-solving process. These activities trained students to identify problems, formulate

hypotheses, test concepts, and draw conclusions based on the data obtained. Validation results from experts and practicality tests conducted by teachers and students indicated that the multimedia met the criteria of being valid and practical, making it feasible for use in teaching kinematics in Grade XI senior high school. Classroom implementation demonstrated that students' critical thinking skills and learning interest were categorized as high, and inferential analysis using the Mann–Whitney test confirmed significant differences between the experimental and control classes. In line with the decision criteria of the Mann–Whitney test, the alternative hypothesis (Ha) was accepted because the significance value was below 0.05, thereby proving that the developed PBL-based multimedia is effective.

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