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Integration of Gamification in Physics Learning: A Development Study of FISIPOLY Using the Genially Platform for 10th Grade High School Students

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Abstract. Physics is often perceived as a challenging subject due to its abstract nature and reliance on advanced mathematical skills, leading to students' difficulties in grasping core concepts. Gamification in education has been proven to enhance motivation and engagement in learning. This study aims to develop a Genially-based learning media, FISIPOLY, focused on Global Warming for 10th-grade senior high school students. The research employed the 4D model (Define, Design, Develop, Disseminate). Validation was conducted by material and media experts, followed by product trials involving 10th-grade students. Results demonstrated that FISIPOLY met valid criteria and was deemed suitable for physics instruction. Student trials revealed very good for both content and media aspects. Thus, the gamified genially based FISIPOLY proves feasible for enhancing physics education

Keywords: Game-Based Learning, Gamification, Genially, Physics Education.

INTRODUCTION

Education is a deliberate effort to pass down culture from one generation to another. It not only focuses on the transfer of knowledge but also on the development of skills, values, and habits that enable individuals to grow throughout their lives (Rahman et al., 2023) . In the context of science education, particularly physics, one of the biggest challenges students face is its abstract nature and strong mathematical foundation. Physics concepts are often difficult to understand due to their limited connection to real-life experiences (Daun et al., 2020). As a result, many students struggle to grasp the material, which ultimately leads to low learning motivation (Bouchée et al., 2022).

The dominance of lecture-based methods in physics learning is another key factor contributing to the lack of student engagement in the learning process. Previous research has shown that this method is often perceived as monotonous and less effective in fostering students' conceptual understanding (Anggraeni et al., 2024) Additionally, students often perceive physics as a difficult subject due to its heavy reliance on mathematical calculations, leading to the misconception that physics is merely a collection of formulas to be memorized rather than concepts to be deeply understood (Pribadi et al., 2023). Another factor contributing to students' low interest in physics is the

lack of supportive learning facilities and the limited availability of interactive learning media (Harwanto, 2019).

In addressing this challenge, an innovative approach to Physics education is required to enhance student engagement and motivation. One applicable solution is the implementation of gamification in learning. Gamification is a learning strategy that integrates game elements to improve student engagement and learning experiences (Albina et al., 2022) This approach has been widely adopted in various educational fields and proven effective in improving learning outcomes, particularly in subjects perceived as challenging, such as Physics (Asyafah, 2019). As a form of gamification, Game-Based Learning (GBL) has rapidly evolved and is increasingly applied in education. This model enables students to learn more actively by confronting challenges and solving problems within an interactive game-based environment (Dewi & Suyanta, 2018).

Various studies have shown that game-based learning can enhance students' conceptual understanding, train problem-solving skills, and reduce anxiety levels in learning (Oktavia, 2022) . Therefore, this research developed FISIPOLY, a Genially-based learning medium that adapts the Monopoly game concept for Physics education. FISIPOLY is designed to help students understand Global Warming material through a more engaging and interactive approach. The Genially platform was chosen for development due to its provision of multimedia features such as animations, quizzes, and visual elements that can enhance students' learning experiences (Ni'mah & Hermiati, 2022) . Additionally, the primary advantage of FISIPOLY is its ability to deliver game-based learning experiences that increase student motivation and help them grasp Physics concepts more deeply.

Building on this background, this study aims to develop FISIPOLY, a Genially-based learning media focused on Global Warming material for 10th-grade high school students. The research emphasizes three main aspects (1) The specifications of the developed learning media, (2) The validation results from content and media experts, and (3) the evaluation results of the learning media by students and educators. The findings are expected to contribute to the development of game-based learning tools in Physics education and serve as a reference for teachers in implementing more innovative and engaging teaching methods. Additionally, this research aims to promote the integration of digital technology in education to improve the quality of Physics instruction on a broader scale.

METHOD

The research method employed in this study is a development research method adopting the 4D stages (Define, Design, Develop, Disseminate) with a mixed quantitative-qualitative approach. The research was conducted at Sebelas Maret University (UNS) and State Senior High School 2 Karanganyar, involving 10th-grade students who had studied the Global Warming topic. The collected data comprised quantitative data obtained through a media feasibility validation questionnaire using a Likert scale, and qualitative data gathered through open interviews with educators and students.

The interview was conducted in the initial phase, specifically the definition phase, with two physics teachers from the tenth grade and ten students to explore the learning needs and the characteristics of suitable media. A definition questionnaire was also distributed to two classes, namely X-E2 and X-E4, to gather additional information for the definition phase of the learning media needs. The defining aspects in this research encompass both material and media aspects. The distribution of the material aspect includes learning, content, and benefits, while the media aspect encompasses audio, text, and visual elements, as well as the utilization of media.

Following the definition phase, the next step is the design phase of the learning media. The selection of media is based on a needs analysis that takes into account the characteristics of the content as well as the learning resources accessible to both students and educators. Once the design of the learning media is complete, the subsequent phase is the development phase. This phase consists of several stages, including evaluation by media and content experts, assessment by educators, and a trial phase. Media and content experts evaluate the feasibility of the media based on aspects such as readability, content relevance, visual design, and effectiveness in supporting learning. Educators also provide assessments based on their teaching experience and the alignment of the media with the needs

of the students. This evaluation aims to ensure that the learning media meet the established standards before proceeding to further trials.

The learning media that have been evaluated by educators and experts will be tested with students through three main stages of trials: preliminary trials, small-scale trials, and field trials. The preliminary trials are conducted with three students from class X or phase E, who receive draft product 1 and provide feedback through an evaluation form. The qualitative data obtained is used to assess the strengths and weaknesses of the product before proceeding to the next stage. The small-scale trials involve seven students from class X phase E, who receive draft product 2 and provide qualitative evaluations through a form. The operation of the media is conducted under the guidance of the developer, and students offer revision suggestions if any shortcomings are identified in the content and media aspects. The field trial is conducted in two classes, X-E3 and X-E2, at State Senior High School 2 Karanganyar. The assessment data is analyzed based on a criteria table used to evaluate the quality of the learning media..

The final stage is the dissemination phase, during which the learning media are distributed through the creation of a scientific journal. The FISIPOLY learning media is documented in the form of a scientific journal and published to serve as a reference for other researchers and educators interested in developing game-based learning. The flow of the FISIPOLY learning media development method, which adopts the 4D development process, can be seen in Table 1.

Table 1. Stages of FISIPOLY Learning Media Development

Development Stage	Description
Definition Phase	Analyzing learning needs through interviews with teachers and students, as well as literature review, to determine the objectives of media development.
Design Phase	Designing the learning media by determining the format, structure of the content, learning approach, and visual design elements to be used.
Development Phase	Creating the learning media based on the designed plan, validating the media with experts, and assessing its feasibility through preliminary trials, small-scale trials, and field trials
Dissemination Phase	Distributing the developed learning media through the publication of a scientific journal and digital distribution to ensure accessibility for a wide range of users

Table 2. Assessment Categories for FISIPOLY Learning Media by Experts

FISIPOLY Assessment Score Interval	Category
$84 < x$	Very Good
$70 < x \leq 84$	Good
$56 < x \leq 70$	Good Enough
$42 < x \leq 56$	Not Good
$x \leq 42$	Very Not Good

Table 3. Evaluation Categories for Learning Media by Educators

FISIPOLY Assessment Score Interval	Category
$87 < x$	Very Good
$73 < x \leq 87$	Good
$59 < x \leq 73$	Good Enough
$45 < x \leq 59$	Not Good
$x \leq 45$	Very Not Good

Table 4. Evaluation Categories for Learning Media by Students

FISIPOLY Assessment Score Interval	Category
$84 < x$	Very Good
$70 < x \leq 84$	Good
$56 < x \leq 70$	Good Enough
$42 < x \leq 56$	Not Good
$x \leq 42$	Very Not Good

RESULT AND DISCUSSION

Result

This research consists of four development stages based on the 4D model: Define, Design, Develop, and Disseminate. The definition stage was conducted to identify the needs and issues in physics learning through interviews with two physics teachers and a questionnaire distributed to 67 tenth-grade students. The analysis results indicate that 100% of the students consider the importance of presenting material in a systematic manner with engaging visual support, while 98% of the students desire access to flexible and user-friendly learning media. The physics teachers expressed that the learning material needs to be more structured to support deeper understanding and requires more effective illustrations. Therefore, the FISIPOLY learning media was developed with a game-based approach to enhance student engagement in the learning process.

The design stage includes the selection of media, presentation format, and content structure. The primary media used is Genially, supported by other platforms such as Canva for visual design, PhET Colorado for interactive simulations, and Live Worksheets for filling out student worksheets. The content structure consists of three main sections: the impacts of global warming, the causes of global warming, and mitigation solutions. The primary colors chosen are Equator and Medium Carmine, along with Indonesian cultural ornaments, to support local identity. A Game-Based Learning (GBL) approach is implemented through quizzes and challenges in Genially, allowing students to engage in a more interactive learning experience. The results of the developed media can be seen in Figure 1 and Figure 2.

Figure 1. FISIPOLY Learning Media Homepage Screen Display

Figure 2. Game Board Display of FISIPOLY Learning Media

The development stage was carried out through validation by media experts, content experts, and educators. The validation results indicate that the FISIPOLY learning media meets the criteria of "very good" with a score above 84. The assessment results by content and media experts can be seen in Table 5. The evaluation results by educators also provide an "very good" rating with a score above 87, as shown in Table 6.

Table 5. Summary of Expert Assessment Results

Respondent	Aspect	Assessment Score	Criteria
Expert	Material	55	Very Good
	Media	42	Very Good
Total		97	

Table 6. Summary of Educator Assessment Results

Respondent	Aspect	Assessment Score	Total Score	Criteria
Educator 1	Material	56	98	Very Good
	Media	42		
Educator 2	Material	52	92	Very Good
	Media	43		

Subsequently, trials were conducted in three main stages: preliminary trial, small-scale trials, and field trial to evaluate the feasibility of the learning media. The preliminary trial involved 3 students who provided feedback to add material before the student worksheets. The small-scale trials were conducted with 7 students who stated that the flow of material presentation was clear, but the layout of the LKPD needed improvement. The field trial was conducted in two classes with a total of 67 respondents from tenth-grade students at State Senior High School 2 Karanganyar. The results showed that 56 students rated the media as "very good," 7 students rated it as "good," 1 student rated it as "good enough," and 3 students rated it as "very not good." The average score across all aspects, both material and media, was 93, indicating that this learning media is highly suitable for use.

The dissemination stage was carried out by implementing the media in physics learning at State Senior High School 2 Karanganyar, which received positive feedback from both educators and students. Additionally, this media was published in a scientific journal as a reference for educators and researchers interested in developing game-based learning methods. The media was also distributed through the digital platform Genially to reach a wider audience.

Discussion

This research resulted in a product in the form of FISIPOLY learning media, which can be accessed through a link and integrated into the Genially platform for the topic of Global Warming in the tenth grade of high school, Phase E. This learning media consists of several main pages, including the homepage, rules page, game page, material page, as well as reference and student worksheet pages. Each page has a function designed to facilitate students' understanding of the concept of global warming in a systematic and interactive manner. The game page consists of 27 interactive area squares, with various symbols that present challenges and opportunities for students to explore the material in greater depth.

The use of Game-Based Learning in the development of FISIPOLY aligns with the research by (Nakatsu et al., 2016) which states that game-based learning can enhance student motivation and engagement, particularly in subjects that require conceptual understanding, such as physics. dditionally, research by (Castillo-Cuesta, 2022) indicates that this method can help reduce student anxiety in understanding complex concepts and increase their active participation in the learning process.

Digital platforms like Genially play a crucial role in creating interactive learning experiences. According to research by (Ni'mah & Hermiati, 2022) the use of Genially in physics education has proven effective in presenting learning media that helps students better understand the material through features such as animations, quizzes, and simulations.i. Furthermore, (Haleem et al., 2022) emphasize that the application of technology in education can enhance the efficiency of time and effort in the learning process, allowing educators to focus more on directly guiding students. In the context of physics education, global warming is often perceived as an easy topic because most students view it merely as a collection of theories without complex calculations or practical applications. Global warming is generally taught in the form of information regarding its causes, impacts, and solutions, leading students to tend to memorize concepts without deeply understanding the scientific mechanisms behind them. However, global warming involves various physics concepts such as heat transfer, the greenhouse effect, and energy balance in the Earth's atmosphere. Without a strong understanding of how these factors interact, students often struggle to connect these concepts with real-world phenomena in their environment.

Game-Based Learning (GBL) approach based on Genially, students can be more active in exploring the material through challenges and games that are systematically designed. Barz et al. (2024) state that game-based learning can enhance student engagement in the learning process, as games provide a more enjoyable interactive experience. Additionally, Dahalan et al. (2024) explain that game-based learning can eliminate student boredom and help them focus more on understanding the learning material.. Today's youth, known as the digital generation or the gaming generation, tend to learn through technology-based and game-based approaches. The use of games in education can increase motivation and enable students to develop understanding through exploration and hands-on experiences. In a global context, game-based learning not only helps students become more interested in the material but also aids them in understanding the cause-and-effect relationships between human activities and environmental changes in a more concrete manner.

The validation results from experts and educators indicate that the FISIPOLY learning media has very high quality. Based on the expert assessment, the material aspect received a score of 55, while the media aspect received a score of 42, resulting in a total score of 97, which meets the "very good" criteria with a score above 84. Additionally, the evaluation by educators showed that Educator 1 gave a score of 56 for the material aspect and 42 for the media aspect, resulting in a total score of 98. Meanwhile, Educator 2 provided a score of 52 for the material aspect and 43 for the media aspect, resulting in a total score of 95. Overall, the assessments from educators rated the media as "very good" with scores greater than 89. These results demonstrate that the FISIPOLY learning media has met the very high quality standards and is suitable for use in the learning process.

Subsequently, a preliminary trial was conducted with three students from the tenth grade, Phase E, to identify the strengths and weaknesses of the product. The results of the preliminary trial indicated that the learning media had met good standards in terms of topic relevance, material accuracy, and ease of understanding. However, it was found that the supporting material before filling out the

student worksheets was insufficient, leading to revisions that included adding content in each area to provide students with a foundational understanding before they attempted the exercises. Additionally, revisions were made to the visual and textual aspects to make them more engaging and easier to comprehend.

In the small-scale trial, which involved seven tenth-grade students, it was found that the learning aspect had been well-structured. Students evaluated the material accuracy, topic relevance, and delivery flow as clear and easy to understand. However, they suggested that the worksheet design should be more visually appealing and less monotonous. Therefore, revisions were made by adjusting the layout, improving color usage to be more dynamic, and adding variety to the question formats to enhance student engagement during learning. Additionally, a user feedback feature was added to allow students to provide opinions or suggest improvements directly through the platform.

During the field trial, which involved two classes of tenth-grade Phase E students at Public Senior High School 2 Karanganyar, an analysis was conducted on students' assessments of the learning media. Among the 67 students who completed the assessment, the majority provided a "very good" rating, with 56 students giving the highest rating, seven students rating it as "good," one student also rating it as "good" (possibly a redundancy in the original data), and three students rating it as "not good". Therefore, it can be concluded that the FISIPOLY learning media has met the "very good" criteria in both material and media aspects and is suitable for use as an interactive learning medium. However, further developments may still be needed to refine the learning media.

CONCLUSION

The development of the FISIPOLY learning media using the Genially platform for Global Warming material in Grade X of Senior High School (Phase E) has demonstrated outstanding effectiveness. Designed as an interactive educational tool, this media incorporates various key components, including a homepage, user manual, game rules, game board, cards, references, student worksheets (LKPD), and instructional materials. These elements allow students to navigate the content in an engaging and structured manner. Additionally, the inclusion of symbolic cues such as light bulbs, eyes, warnings, question marks, and keys enhances cognitive engagement by introducing challenges and fostering deeper exploration, ultimately creating a more dynamic learning experience.

Empirical evaluations conducted with students indicate that FISIPOLY meets the highest standards for interactive learning media. Based on student feedback, 84% rated the media as very good 10% as good, 1.5% as not good, and 4.5% as very not good. These findings highlight the platform’s capacity to significantly enhance student engagement and comprehension of Global Warming concepts. However, a minor percentage of students may require additional instructional support to fully grasp certain concepts presented in the game.

Furthermore, validation by subject matter experts and educators confirms that FISIPOLY meets exemplary criteria in both content quality and media design. By leveraging a game-based learning approach through the Genially platform, this media successfully delivers an engaging, interactive, and contextually relevant learning experience. These results affirm that FISIPOLY not only adheres to rigorous educational media standards but also serves as an innovative tool in enhancing conceptual understanding through gamified learning strategies.

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