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Opportunities to Implement Traditional Games as Contextualized Physics Learning Innovations

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Abstract

One of the main challenges in developing traditional game-based physics learning is that it is not yet known how students perceive the approach. Students' perceptions, interests, and readiness are crucial aspects that need to be mapped before developing a targeted learning strategy. Therefore, this study aims to identify and analyze how students respond to traditional game-based physics learning through science literacy, the level of interest generated, and their readiness to be actively involved in the learning process with this approach. This study uses a descriptive qualitative approach, the study was conducted in one of the high schools in Sidoarjo City, with 100 students in grade XI purposively selected to represent a diversity of academic and social characteristics. Data were collected through observation, questionnaires, and interviews. Most students indicated that they still have difficulties in understanding and linking physics concepts with daily life and technology. The majority of students are interested and motivated to learn physics when learning is packaged in an engaging, creative, and fun way. However, they also expressed higher interest when learning is done through experiments and games, although most students had never experienced physics learning using traditional games, they showed an open and positive attitude towards the approach. The conclusion is idea of physics learning based on traditional games received a positive response from students. This approach can increase interest and motivation to learn and also opens up great opportunities to improve science literacy and active participation of students in a meaningful and contextualized learning process. Although there are some challenges in linking concepts with local cultural contexts, these obstacles can be overcome by designing appropriate learning oriented to students' experiences.

Keywords: *Traditional Game, Local Wisdom, Physics Learning, Science Literacy*

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INTRODUCTION

Science education in the modern era develops by taking an approach that goes beyond the mere transfer of knowledge from teacher to student. The ideal science learning process is for students to be actively involved, foster critical thinking skills, and be able to link scientific concepts with contextual contexts in life (Bao & Koenig, 2019). Students often consider physics subjects complex and abstract due to teaching methods dominated by symbolic, theoretical, and less contextual learning. As a result, many students have difficulty understanding physics concepts that are very close to the phenomena around them (Eliezanatalie & Deta, 2023). To improve this, science literacy becomes one of the main tools in meaningful science learning. Science literacy includes understanding scientific concepts and applying knowledge in evidence-based decision-making and reflective thinking on issues related to science, technology, and society (OECD, 2019). The Merdeka Curriculum implemented in Indonesia directs learning towards a more contextual and relevant direction to students' lives by strengthening the Pancasila learner profile. In this context, the contextual approach plays an important role in helping students understand the relationship of science material to the social and cultural realities they experience daily (Fianti & Neratania, 2024). When students can relate scientific concepts to their environment and personal experiences, learning becomes more meaningful and, therefore, easier to understand and has the potential to improve long-term retention.

A contextual approach that encourages science literacy cannot be separated from the social and cultural environment in which students live. In this case, local culture is not only a learning background but can also be utilized as an authentic and relevant learning resource (Nasution et al., 2023). One form of contextual approach that is increasingly gaining the attention of educators is culture-based learning, which utilizes the values, practices, and culture around the environment as a bridge to understanding scientific concepts (Ogodo, 2023). The integration of local culture in learning, especially in the context of science, is known as the ethnoscience approach. Ethnoscience recognizes that local communities have scientific knowledge and practices reflected in everyday life, such as art, agriculture, and traditional games (Yusof et al., 2024). Culture can act as a link between modern science knowledge and local experiences, not only to improve conceptual understanding but also to shape scientific attitudes, appreciate diversity, and strengthen students' cultural identity.

Indonesia, a country with tremendous cultural wealth, has various traditional games that naturally contain physics principles. Games such as *bekel, engklek, and kekehan*, for example, contain elements of motion, force, momentum, elasticity, and balance (Deta et al., 2024; Rizki et al., 2022; Asra et al., 2021). However, the educational potential of these games is still rarely used optimally in physics learning at school. Research conducted by Khoiri et al. (2023) shows that integrating traditional games in physics learning can be one of the effective strategies for creating a fun, relevant, and meaningful learning experience. In addition, research by Arrafi et al. (2023) also shows that this approach can strengthen science literacy through direct and contextual student experiences. Thus, physics learning becomes easier to understand and more relevant to students' cognitive, emotional, and cultural lives.

In recent years, local culture-based science learning approaches especially through traditional games have become a growing concern in education. Recent research shows that contextual learning that utilizes cultural elements, such as in the ethnoscience approach, can improve concept understanding while strengthening students' cultural identity (Deta et al, 2024). However, most previous studies focused on developing media or culture-based learning models, such a research that has been conduct by Safitri et al. (2023) that not specifically exploring students' perceptions and readiness as learning subjects. In this context, research that addresses students' responses to traditional game-based physics learning is crucial because it provides a new dimension to developing contextual approaches. Research by Putra et al. (2022) and Amelia et al. (2021) have indeed proven the effectiveness of this approach in improving science literacy but have not touched the psycho-pedagogical aspects that include interest, emotional involvement, and student's perceptions of the relationship between cultural games and scientific concepts. Therefore, this study fills the gap by offering a data-driven perspective on students' perceptions, which is indispensable in designing culture-based learning strategies that are more personalized, contextualized, and learner-centered. Thus, this study not only supports the strengthening of science literacy but also contributes to the education movement that is inclusive, socially relevant, and rooted in local cultural values that are unique to Indonesia.

Traditional games have great potential as contextual media in physics learning. Still, this innovation cannot be implemented effectively without a deep understanding of the characteristics of students as learning subjects. One of the main challenges in developing traditional game-based physics learning is that it is not yet known how students perceive the approach. Students' perceptions, interests, and readiness are crucial aspects that need to be mapped before developing a targeted learning strategy. Without paying attention to these aspects, there are various risks that learning will not be aligned with students' needs, expectations, or learning styles. Therefore, this study aims to identify and analyze how students respond to traditional game-based physics learning through science literacy, the level of interest generated, and their readiness to be actively involved in the learning process with this approach. The findings of this study are expected to be a strong basis for designing learning that suits the profile and needs of the students.

METHOD

This study uses a qualitative descriptive approach to explore and describe students' responses to traditional game-based physics learning, especially in the aspects of science literacy, learning interest, and active involvement during the learning process. This approach was chosen so researchers can capture students' experiences and views in depth in innovative and contextualized learning (Alhazmi & Kaufmann, 2022). The research was conducted at SMA Wachid Hasyim 2 Taman in the even semester of the 2024/2025 academic year. The research subjects comprised 100 grade XI students selected by purposive sampling to represent the diversity of academic and social characteristics. The distribution of respondents included three grade XI classes, with the number of students varying between 33-34 people per class.

Figure 1. Research Flowchart

Based on Figure 1, data collection procedures were conducted through three main techniques, namely observation, questionnaires, and interviews. Observation was conducted during the learning session to observe students' behavior, participation in discussion, and response to learning. Questionnaires were administered to capture students' views on their experience, the extent to which the learning aroused their interest and helped them understand physics concepts, and their expectations for future physics learning. Interviews were conducted with student representatives from each class selected based on the diversity of their answers in the questionnaire to strengthen and deepen the understanding of the observation results and questionnaire data. After collecting the data, the researcher conducted a simple data reduction by marking important information and grouping students' answers into common themes such as interest in learning, active engagement, and concept understanding. Information considered less relevant is set aside, so only data directly related to the focus of the research is analyzed further. The next stage was data analysis and synthesis using the thematic analysis approach. The researcher examined students' answers to find patterns and main themes and then linked them to science literacy and contextual learning theory. Interpretation was done by paying attention to the consistency and diversity of student responses.

The final step was formulating conclusions, which were formulated based on data synthesis and interpretation of findings. The conclusion not only answers the research focus but also provides a reflection on the effectiveness of the local culture-based contextual learning approach and recommendations for the development of innovative physics learning methods that are relevant to the student's context.

RESULTS AND DISCUSSION

This study identifies and analyzes how students respond to traditional game-based physics learning through science literacy, the level of interest generated, and their readiness to be actively involved in the learning process with this approach. The results of students' surveys on their physics learning experience are shown in Figure 2.

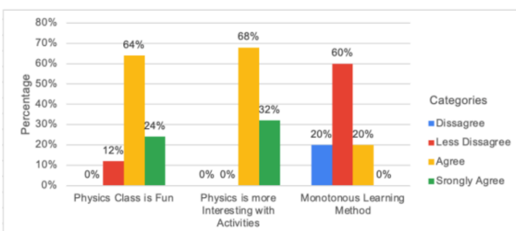

Figure 2. Survey results on student Learning experience

Based on Figure 2, the survey results on students' learning experience show that most students positively perceive physics learning in class. As many as 64% of students agreed, and 24% strongly agreed that physics lessons were fun. Luthfiyati and Widyastuti (2024) state that the classroom atmosphere and the teacher's approach have created an effective learning experience. However, when reviewed through the various learning methods that have been carried out, physics learning is still considered less varied. It can be seen from the data that more than 60% of students disagreed that the learning methods used were interesting enough, with only 20% agreeing. This finding indicates that there is still a gap between the general impression of physics lessons and the assessment of the variety of learning methods applied. Data in Figure 2 shows that students are highly interested in activity-based learning. Based on the data obtained that all respondents (100%) support active learning approaches, such as experiments or activity-based projects. The absence of a disagreeing student indicates that passive, lecture-based learning is no longer effective enough to attract students' interest in learning. This result reinforces the importance of active learning approaches, which allow students to be more directly involved in the learning process. A grade XI student interviewed stated, "*I like physics lessons, but I often get bored when it is just theory. If there is practice or experiment, it will help to understand more quickly and not get sleepy*." This statement shows how physical activity in learning can improve students' attention, understanding, and stimulate students' active thinking and curiosity wich are important components in science learning. This finding shows that the contextual approach cannot be fully applied in learning. Learning linked to students' real experiences is very important to help them link the abstract concepts of physics with the real world (Banda & Nzabahimana, 2021). Overall, the data obtained indicates that although students enjoy learning physics, they expect more active, varied, and relevant methods to everyday life. The results of the students' survey on their science literacy are shown in Figure 3.

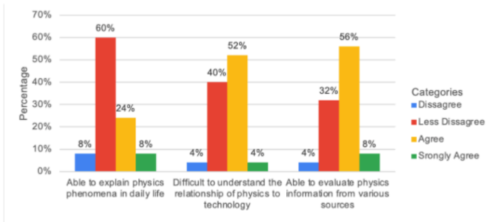

Figure 3. Survey result on student literacy science

One of the most interesting and important data from the survey results in Figure 3 is that 60% of students disagreed, that they could explain physics phenomena in everyday life, and only 8% strongly agreed. This finding suggests that most students have difficulties transferring physics concepts learned in class to real-life contexts, which is one of the cores of science literacy. Science literacy, as emphasized by the OECD, is the ability to understand scientific concepts and use them to explain phenomena and make decisions based on scientific evidence in everyday life. In an interview with a grade XI student, he said, "*I know about force and motion, but I am confused about applying it in real life. Sometimes, I do not realize that falling or moving objects can be explained by physics*." The interview reflects the separation between the school world and students' reality, where physics concepts are learned in the abstract without sufficient linkage to everyday experiences. The funding aligns with the global challenge in science education about transforming students from mere recipients of information-to-information processors and evidence-based problem solvers.

Furthermore, 52% of students agreed that they still have difficulty understanding the connection between physics and technology. This data indicates a lack of integration between physics learning and the applicative and technological aspects very close to students' lives. This condition reduces the relevance of learning and impacts students' low motivation and interest to explore physics in more depth. However, the positive side can be seen from the evaluative aspect, where 56% of students agree and 8% strongly agree that they can evaluate physics information from various sources. The data shows early potential in building literacy skills regarding digital capabilities and critical thinking.

Science literacy has an important role in equipping students as citizens who think scientifically and critically and can make evidence-based decisions (Deta et al., 2025). Understanding the relationship between science, technology, and society is crucial in dealing with global challenges such as climate change, health, and energy use. Sharon and Baram-Tsabari (2020) suggest that without adequate science literacy, students will be vulnerable to misinformation and not have a solid foundation to participate in discussions or decision-making involving aspects of science. Therefore, the low achievement of science literacy identified in the survey data is an important basis for the need for learning innovations that are more contextual, exploratory, and meaningful. Thus, improving science literacy needs to be the main focus in learning for academic purposes and as a provision for facing real life. The results of the students' survey on their study motivation are shown in Figure 4.

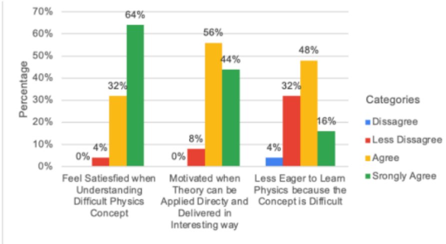

Figure 4. Survey result student study motivation

Figure 4 shows that in the aspect of student learning, motivation is strongly influenced by emotional and pedagogical factors. A total of 64% of students strongly agreed that they feel satisfied when they successfully understand complex physics concepts, which reflects the existence of strong intrinsic motivation in students. This motivation stems from a sense of personal achievement and intellectual satisfaction when they can master previously considered difficult material. The data shows that although physics is often perceived as challenging, students have the potential and desire to conquer it, provided they are given the proper support and learning strategies. Figure 4 illustrates that concept understanding is not only a cognitive matter but also touches deep affective aspects. In addition, the data shows that 56% agree and 36% strongly agree that their motivation increases if the theory can be applied and delivered interestingly. This finding confirms the importance of contextual learning and the use of relevant methods to students' real lives so that the material does not feel abstract and far from everyday life.

However, there are still challenges that cannot be ignored. As many as 48% of students admitted they were less enthusiastic because they found physics concepts difficult, indicating a barrier of perception and confidence in dealing with the material. This fact can hinder motivation if not addressed with the right pedagogical approach. Therefore, teachers need to apply differentiation, scaffolding, and student-centered learning strategies so students feel assisted in facing difficulties, not alone. All of these data suggest that student motivation in physics is determined mainly by personal satisfaction, teacher delivery, and the relevance of the material to real life - three key factors that need to be strengthened in 21st-century learning. The data shows that the conventional approach has not successfully overcome students' affective barriers to physics. This finding indicates that contextual learning is very influential in building students' intrinsic motivation. Masfufah and Chasanah (2023) state that student learning motivation can be increased through creative, creative, relevant learning strategies and encourage confidence in understanding concepts. The results of the students' survey on their experience study with local wisdom are shown in Figure 5.

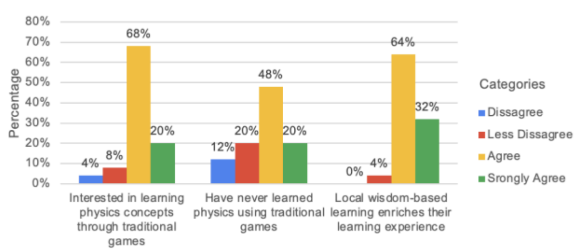

Figure 5. Survey result on student experience study with local wisdom

The data in Figure 5 shows that using traditional games in physics learning is still relatively rare, with more than 68% of students agreed that they are interested in learning physics concepts through traditional games, which shows great enthusiasm for local culture-based learning approaches. Although 48% of students admitted that they have never learned physics using traditional games, the high interest of students opens an excellent opportunity to integrate cultural aspects into science learning, especially physics. This approach bridges physics concepts with real contexts close to students' lives and builds emotional attachment and pride in cultural identity. In an interview, a student stated, "*I used to play bekel as a child, but never thought it could be explained with physics. Maybe I would understand faster if it was explained using games like that*." The interview shows that when science concepts are linked to personal experiences and local culture, students more easily understand them in depth and find learning more relevant. In addition, only 4% of students disagree that local wisdom-based learning enriches their learning experience. Thus, learning physics through traditional games is an alternative and strategic approach that brings together scientific knowledge, cultural context, and local values. It is a real form of contextual education that is holistic and relevant to developing 21st-century science literacy, emphasizing the integration of science, culture, and students' identity. This data suggests that traditional game-based physics learning has very positive implementation opportunities. The high level of interest and recognition of the value of meaningful learning shows that students are cognitively, affectively, and socially ready to be actively involved in the learning process with this approach (Nisa et al., 2024). The data strongly indicates that the local wisdom-based approach is contextually inclusive and effective in increasing engagement, learning motivation, and deeper understanding of physics concepts.

Based on the objectives of the study, which aimed to identify and analyze students' responses to the idea of traditional game-based physics learning through aspects of science literacy, level of interest, and readiness for involvement in the learning process, it can be concluded that students' responses showed a very positive trend towards the approach. First, from the aspect of science literacy, most students indicated that they still have difficulties in understanding and linking physics concepts with daily life and technology. However, they also expressed higher interest when learning is done through experiments and games. Reality suggests that the traditional game-based approach has the potential to be an effective medium for improving science literacy as it provides a more contextual, fun, and applicable learning experience (Hariyono et al., 2023). Second, in terms of interest level, the data shows that the majority of students are interested and motivated to learn physics when learning is packaged in an engaging, creative, and fun way. Traditional games that contain elements of local culture can create a fun learning experience and increase students' learning motivation, especially due to direct involvement in the process of exploring physics concepts (Deta et al., 2021). Third, regarding readiness for active engagement, although most students had never experienced physics learning using traditional games, they showed an open and positive attitude towards the approach. This is reflected in the high percentage of students who agreed or strongly agreed that traditional games can enrich the learning experience, foster cultural pride, and be an effective medium for understanding physics concepts. Thus, students responded positively to the idea of physics learning based on traditional games. This approach can increase interest and motivation to learn and open opportunities to improve science literacy and student active participation in a meaningful and contextualized learning process. This approach deserves further development as an innovative physics learning strategy relevant to local culture and modern era.

CONCLUSION

From the results of the data analysis, the idea of physics learning based on traditional games received a positive response from students. This approach can increase interest and motivation to learn and also opens up great opportunities to improve science literacy and active participation of students in a meaningful and contextualized learning process. Although there are some challenges in linking concepts with local cultural contexts, these obstacles can be overcome by designing appropriate learning oriented to students' experiences. In addition, it is important to continuously develop students' scientific and critical thinking skills through experiments and discussions that encourage in-depth exploration of concepts. Thus, this approach is not only culturally relevant but also effective in supporting the achievement of modern era physics competencies.

AUTHOR CONTRIBUTIONS

Luthfiyaul Laila: Conceptualization, Methodology, Formal Analysis, Data Curation, and Writing - Original Draft; **Ladika Zuhrotul Wardi**: Methodology, Data Curation, Investigation, and Resources; and **Utama Alan Deta**: Supervision, Project Administration, and Writing - Review & Editing

DECLARATION OF COMPETING INTEREST

The authors declare no known financial conflicts of interest or personal relationships that could have influenced the work reported in this manuscript.

DECLARATION OF ETHICS

The authors declare that the research and writing of this manuscript adhere to ethical standards of research and publication, in accordance with scientific principles, and are free from plagiarism.

DECLARATION OF ASSISTIVE TECHNOLOGIES IN THE WRITING PROCESS

The authors declare that generative artificial intelligence (Gen AI) and other AI-assisted tools were used prudently, not excessively, during the research and preparation of this manuscript. Specifically, ChatGPT was used for brainstorming ideas and Grammarly for grammar and style correction. All AI-generated material was reviewed and edited for accuracy, completeness, and compliance with ethical and scholarly standards. The authors accept full responsibility for the final content of the manuscript.

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