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Integrating Ethnophysics and Technology in Traditional Egrang Games to Support Sustainable Education and Cultural Preservation

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ABSTRACT

Objective: *This study aims to analyze the physics concepts embedded in the traditional Indonesian game Egrang, using an ethnophysical approach to support sustainable education and cultural preservation (SDGs 4 & 11). Technology integration is explored as a medium to preserve and modernize the game.* ***Method:*** *A descriptive qualitative method combined with field observation and online data collection. The study also incorporates conceptual use of digital tools such as motion simulation and 3D modeling to illustrate physical principles within the game.* ***Results:*** *Findings show that Egrang involves concepts like kinetic and potential energy, pressure, mechanical effort, and equilibrium. Traditionally made from bamboo or wood, modern Egrang is now constructed from metal. Technological enhancements, such as augmented reality or mobile simulations, offer the potential to make Egrang more accessible and engaging for students while preserving cultural values.* ***Novelty:*** *This study uniquely combines ethnophysics with digital technology to revive traditional games as educational tools. The integration supports interactive STEM learning while promoting local cultural heritage, providing a contemporary solution to sustain traditional knowledge in the digital era.*

INTRODUCTION

Traditional games are an element of local culture often found in various parts of the archipelago and are usually preserved in rural communities. Traditional games have many benefits: they can train children's creativity, develop motor skills, promote health, enhance sensitivity, regulate emotional and social intelligence, and connect children with nature (Hariastuti, 2020). However, along with the advancement of technology and globalization, foreign cultures have increasingly entered and triggered a cultural crisis in Indonesia. This phenomenon has led to a shift in public interest away from local traditions and endangered traditional arts' sustainability in many regions.

In addition, technological development has contributed to the erosion of local technological wisdom, as traditional knowledge is often viewed as incompatible with modern science. In reality, traditional practices when viewed through the lens of science can be a rich source of contextual and meaningful learning. For example, many traditional games involve mechanical principles and can be integrated into science curricula using an ethnophysical approach. Integrating such traditional elements with modern educational technology (e.g., simulations, augmented reality, interactive learning media) can revitalize cultural learning and make physics more engaging and accessible to students (Mardikantoro & Supatmi, 2022).

Physics is a branch of science that studies phenomena related to energy and motion, often observable in everyday life. One such context is the traditional game of egrang, originating from West Java and commonly found in rural areas (Supriyono, 2018). Ergo involves values such as tenacity, discipline, and cooperation. Physics includes kinetic and potential energy, pressure, work and energy, and equilibrium in rigid bodies (Hariastuti, 2020).

The concept of physics in traditional games provides teachers with a culturally relevant and relatable entry point for teaching abstract concepts. Ethnophysics, which explores the intersection of local wisdom and physical science, offers a valuable framework for this integration. Ethnophysics presents cultural artifacts and practices in ways that can be empirically tested and scientifically analyzed (Sudarmin, 2014). Through this approach, students learn physics and develop an appreciation and respect for local heritage.

Moreover, educational technology can be key in enhancing the ethnophysics approach. Tools such as augmented reality (AR), gamified learning applications, and virtual simulations can be used to model the physical principles behind traditional games like e.g., (Rahmawati et al., 2021). These tools provide visual and interactive experiences that help accommodate diverse learning styles and bridge traditional and modern educational practices.

Integrating ethnophysics and technology in learning supports the Sustainable Development Goals (SDGs). Specifically, SDG 4 promotes inclusive, equitable, and quality education that is culturally grounded (UNESCO, 2021), while SDG 11 advocates for sustainable cities and communities by preserving local culture (Setiawan et al., 2019). Understanding the physics concepts within EGRANG enriches students' scientific literacy and fosters a sense of cultural identity and environmental responsibility.

Based on this rationale, the present study aims to explore the ethnophysical dimensions of the traditional game egrang by analyzing its structural and cultural components and integrating modern educational technology to enhance learning outcomes. Unlike previous studies that have merely documented traditional games or explored their educational values in isolation, this research introduces a novel framework that bridges ethnophysics with digital innovation. The uniqueness of this study lies in its dual focus: first, in revealing the physics principles implicitly embedded in the design and practice of the egrang game—such as balance, force, energy, and motion—and second, in transforming these traditional elements into interactive and adaptive learning media through the application of augmented reality and digital simulations. This approach enables the creation of culturally grounded physics learning that is accessible to various student learning styles while simultaneously preserving local wisdom. Furthermore, this study supports two key Sustainable Development Goals (SDGs), namely SDG 4 (quality education) by promoting inclusive and context-rich instruction, and SDG 11 (sustainable cities and communities) by revitalizing traditional cultural heritage through technologically enhanced education.

RESEARCH METHOD

This type of research is qualitative descriptive with an ethnographic approach. The ethnophysical approach aims to describe and analyze culture and local wisdom related to physics based on information sources from the internet. The ethnophysical approach in this study is used to describe, explain, and analyze the concepts of physics contained in the 'egrang' game. After obtaining information or data about the relationship between the concept of physics and the local wisdom of 'egrang', the data is then analyzed using descriptive analysis with a literature study method. Activities in qualitative data analysis include five stages as in Figure 1.

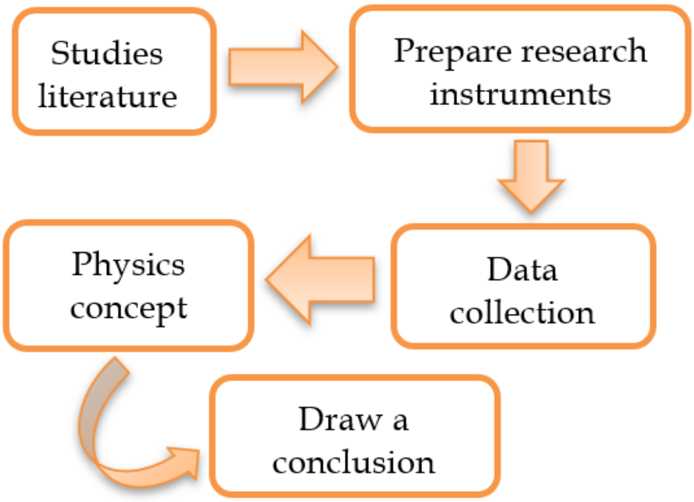

Figure 1. Research stages

This research was conducted through several systematic stages to ensure the validity and depth of the findings related to the ethnophysical exploration of the traditional egrang game. The initial stage involved an extensive literature study, where various scientific journals and relevant publications were reviewed to identify previous studies and theoretical frameworks surrounding traditional games, physics education, and educational technology. This literature provided the foundation for understanding the potential of integrating e-grammar with physics learning in a culturally contextualized way (Creswell, 2014). The second stage was the preparation of research instruments, including observation guidelines and structured group discussion formats. These instruments were designed to guide the field data collection process and ensure that the cultural and physical dimensions of the egrang game could be accurately captured and analyzed (Sugiyono, 2018).

The data collection stage involved both field observations and desk-based research. Field data were gathered through direct interaction with practitioners and community members who still play or preserve the egrang game, while secondary data were obtained from educational and cultural repositories. These data provided insights into the design, materials, and gameplay mechanisms of egrang, as well as its transformation over time, especially with the use of modern materials such as metal or synthetic alternatives, which reflects the influence of technology in cultural adaptation (Setiawan et al., 2019). In the fourth stage, physics concepts were explored by identifying scientific principles embedded in the game, such as potential energy, kinetic energy, equilibrium of rigid bodies, pressure, and work. These concepts were analyzed and presented through short descriptive narratives, charts, and classification diagrams to illustrate the connections between the game's mechanics and physics learning objectives (Sudarmin, 2014; Damayanti, 2017).

Finally, the research concludes by formulating key findings, drawing from empirical data, and conducting theoretical analysis. The conclusion emphasized the pedagogical value of integrating e-graphics into physics education using technological tools such as interactive media or augmented reality simulations. This integration enhances students' conceptual understanding and supports preserving local culture through modern educational frameworks aligned with the Sustainable Development Goals (SDGs 4 and 11) (UNESCO, 2021). Combining cultural content and digital learning tools thus represents a novel approach to fostering scientific literacy and cultural appreciation in the classroom.

RESULTS AND DISCUSSION

Results

Local Wisdom

1) Definition of local wisdom

   Local wisdom is a way and practice developed by a group from a deep understanding of the local environment passed down from generation to generation (Deskarina & Atiqah, 2020). Along with the times and technology, local wisdom begins to fade. It is at risk of being lost because it is considered different from local science and science, even though there are local wisdom lessons that can be emulated and developed into the concept of physics, one of the local wisdoms that can be integrated into the concept of physics with traditional games.

2) Traditional game

   Traditional games are an element of local culture often found in various parts of the archipelago and are common in rural communities. The physics concepts contained in traditional games make it easier for teachers to convey learning to students. This integration can be used in learning. Studying the philosophy, game techniques, and rules that apply first is necessary, but the scientific approach requires students to understand science from the surrounding environment.

   Physics can be expressed very closely in everyday life. Given that traditional games contain many physics concepts that can be analyzed and are by graduate competency standards (SKL), it is necessary to integrate them into learning physics at school. The traditional game of 'egrang' is one of the many traditional games in Indonesia, and it certainly has physics concepts that are useful for understanding students more quickly.

3) Traditional game of 'egrang'

   The traditional game of 'egrang' originated in West Java and is commonly found in rural areas (Supriyono, 2018). The game of 'egrang' has been around since the Dutch era. It was pretty famous in the 1900s and has spread to various regions in Indonesia. The traditional game of 'egrang' includes traditional games that can benefit someone positively. For example, to train courage, perseverance, patience, and physical balance. The traditional game of 'egrang' is shown in Figure 2.

Figure 2. Traditional game of 'egrang'

Ethnophysics

The 'egrang' game is a game that uses a tool with a pair of bamboo sticks and has a footstool. The long bamboo used is 2 meters long, 4 cm in diameter, and of different heights (30 cm, 40 cm, and 50 cm). This game requires leg and hand muscle strength to walk. How to play 'egrang' is as follows:

1) Setting up 'egrang';
2) Upholding the 'egrang' right in front of the player;
3) The position of the 'egrang' is slightly forward;
4) Hold the 'egrang' according to the right player's arm;
5) Lift one leg over the 'egrang', followed by the next leg;
6) Set the balance and start walking to the limit;
7) If you feel you are going to fall, then lower your legs between the 'egrang';
8) Try to play in a wide area.

In the 'egrang' game that is currently in progress, we can analyze that when playing, there are physics concepts, including the following;

1) Work and energy

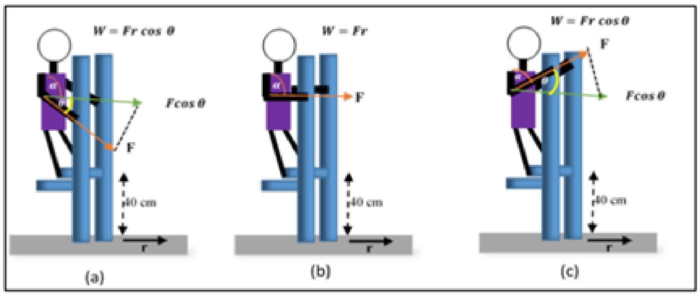

Figure 3. 'Egrang' style illustration
source: JPF (Journal of Physics Education) FKIP UM Metro

Based on Figure 3, we know effort is the work done by the player to get to the 'egrang' and move it from the initial position to the final position. This energy is mechanical energy or the sum of kinetic energy and potential energy. Effort and energy are needed in this game so that the 'egrang' can move and step up to the specified line.

2) Kinetic energy

This analysis is the same as that according to Abdullah (2016), which states that the working force causes the motion of objects. The energy possessed by a moving object is kinetic. Thus, the size of the kinetic energy is indicated by the force exerted by the 'egrang' player, which is interpreted as the speed of the 'egrang'. The concept of kinetic energy that has been described above is described by the equation:

$$E_k = \frac{1}{2} m v^2 \quad (1)$$

Explanation of variables:
E_k= kinetic energy (J)
m= object mass (kg)
v= speed of object (m/s)

3) Potential energy

Potential energy is stored in objects because of their position (Abdullah, 2016). Apart from being influenced by its position, potential energy is also influenced by the gravitational force of the Earth, therefore it can be seen based on the 'egrang' played that the higher the 'egrang', the easier and lighter it is to play, thus proving that the higher the 'egrang', the greater the potential energy because of the greater distance between the 'egrang' and the Earth'sEarth's surface.

Identification of work and energy materials states that potential energy is produced by a force that depends on the position of an object relative to its environment. Lestari (2020) says that the higher the position of an object, the greater the potential energy of that object. Mathematically, potential energy according to the equation:

$$E_p = mgh \quad (2)$$

Explanation of variables:
E_p= Potential energy (J)
m= object mass (kg)
g= acceleration due to gravity (m/s^2)
h=height(h)

4) Mechanical Energy

Mechanical energy is the sum of an object's kinetic and potential energy to do work. In the traditional game of 'egrang', it is clear that there is mechanical energy according to what has been described. It can be seen when the 'egrang' players start the game until it is finished. Mathematically, the mechanical energy according to the equation:

$$EM = EK + EP = \frac{1}{2}mv^2 \quad (3)$$

Explanation of variables:
EM = mechanical energy (J)
E_k= kinetic energy (J)
E_p= Potential energy (J)
m= object mass (kg)
v= speed of object (m/s)

5) Rigid body balance

The game of ‘egrang’ is also related to the balance of rigid bodies. When someone can stand upright on wood with a surface area of no more than 25 square meters, with the accuracy of determining the center of an object, students can play ‘egrang’ easily.

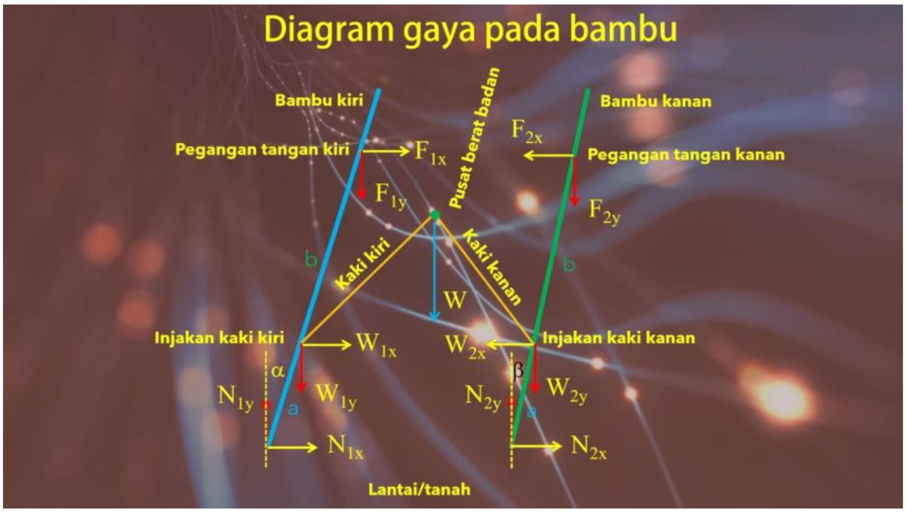

Figure 4. Style diagram on bamboo
Source: YouTube

Left Bamboo:
Style balance

$$N_{1x}+W_{1x}+F_{1x}=0$$
$$N_{1y}+W_{1y}+F_{1y}=0$$

Force moment balance

$$a\sin\alpha\ W_{1y}+(a+b)\sin\alpha\ F_{1y}+a\cos\alpha\ W_{1x}+(a+b)\cos\alpha\ F_{1x}=0 \tag{4}$$

Right Bamboo:
Style balance

$$N_{2x}+W_{2x}+F_{2x}=0$$
$$N_{2y}+W_{2y}+F_{2y}=0$$

Force moment balance

$$a\sin\beta\ W_{2y}+(a+b)\sin\beta\ F_{2y}+a\cos\beta\ W_{2x}+(a+b)\cos\beta\ F_{2x}=0 \tag{5}$$

The balance of forces on the player's body:

$$W_{1y}+W_{2y}+W=0$$

Approximation:
The ‘egrang’ player's feet just press down so that:

$$W_{1x}=W_{2x}=0$$

The ‘egrang’ player's hand just pushes or pulls to the side so that:

$$F_{1y}-F_{2y}=0$$

The equation becomes simple as follows
Left bamboo:
Style balance

$$N_{1x}+F_{1x}=0$$
$$N_{1y}+W_{1y}=0$$

Force moment balance

$$a\sin\alpha\ W_{1y}+(a+b)\cos\alpha\ F_{1x}=0 \tag{6}$$

Right bamboo:
Style balance

$$N_{2x}+F_{2x}=0$$
$$N_{2y}+W_{2y}=0$$

Force moment balance

$$a\sin\beta\ W_{2y}+(a+b)\cos\beta\ F_{2x}=0 \tag{7}$$

Then equation (6) can be written as follows

$$W_{1y}+\frac{a+b}{a}\frac{\cos\alpha}{\sin\alpha}F_{1x}=0 \tag{8}$$

So that equation (7) becomes as follows

$$W-W_{1y}+\frac{a+b}{a}\frac{\cos\beta}{\sin\beta}F_{2x}=0 \tag{9}$$

Then equations (8) and (9) are added up

$$\frac{a+b}{a}\frac{\cos\alpha}{\sin\alpha}F_{1x}+W+\frac{a+b}{a}\frac{\cos\beta}{\sin\beta}F_{2x}=0 \tag{10}$$

Equation (10) is a general equation for producing ‘egrang’ equilibrium. Equation (10) contains four independent variables. The four independent variables must be arranged in such a way that they fulfill equation (10). That is the skill of ‘egrang’ players. So that it can easily adjust these four variables according to equation (10).$\alpha,\beta,F_{1x}F_{1y}$

If there are variables that are not correct and equation (10) is not fulfilled, then the player will fall. So that the following equation can be written.

$$\frac{F_{1x}}{\tan\alpha} + \frac{F_{2x}}{\tan\beta} = -\frac{a+b}{a}\,mg \quad (11)$$

Because and are certain, the term value on the right-hand side is certain. If the position of the bamboo is close to vertical then and so that and $a, b, m, g\alpha \to 0\beta \to 0 \tan\alpha \to 0 \tan\beta \to 0$.

Consequently, the absolute value of each term on the left-hand side approaches infinity (division by zero). This causes the value to be different from the value on the right side (the value on the right side is finite).

In order to remain the same as the value on the right-hand side, one term must be positive and one term negative. Thus, even though the absolute value of each is tremendous, when added up, the results are not large enough to equal the value of the right-hand side.

Thus concluded $\frac{F_{1x}}{\tan\alpha}$ and different sign$\frac{F_{2x}}{\tan\beta}$

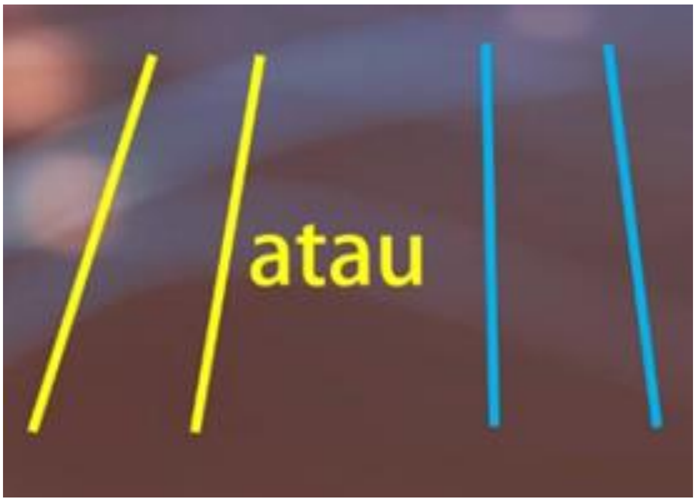

Figure 5. Illustration of 'egrang' with the same slope for each bamboo
Source: YouTube

As a result:

a. If two bamboos have the same slope (same α and β sign) then the player must give and in the opposite direction. Two bamboos are both pulled or pushed together.$F_{1x} F_{2x}$

b. If the bamboo has a different slope (different α and β signs) then the player must give and in the same direction. This means that one bamboo is pulled and one bamboo is pushed.F_{1x} F_{2x}

Figure 6. Illustration of 'egrang' with a different slope for each bamboo
Source: YouTube

If suddenly one of the bamboos changes its angle, the left and right sides of equation (10) are no longer the same. In order to return the same, the player takes action in the following way:

a. Returns the angle.
b. Change the other bamboo corner.
c. Change the value or direction and .$F_{1x} F_{2x}$
d. Do a combination of these methods so that the left and right sides of equation (10) return the same.

The principle of equilibrium of rigid bodies in playing 'egrang' is carried out, so players can use this principle which is often needed when they have a certain angle, in order to maintain balance, a balanced position is needed.

6) Pressure

The quantity in physics that uses force with a surface area is called pressure. Pressure calculated exerted area to which the force is applied.

$$P = \frac{F}{A} \quad (12)$$

If you observe the traces of bamboo 'egrang' and coconut shell 'egrang', they will look different. When the same person wears a different type of 'egrang'. Even though the person's weight is the same, the impact on the ground will also differ. This is influenced by the surface area of the two 'egrang'. The smaller the 'egrang' surface area, the deeper the footprints. The quantity in physics that relates force to surface area is called pressure.

Ethnophysics in learning

Learning is a process provided by the teacher to train students in learning activities and acquire knowledge, skills, and attitudes. Science learning in class should lead students to be literate about science and technology. One of the characteristics of ethnophysics learning is the development of a positive attitude towards science (Pertiwi & Rusyda, 2019). Learning using an ethnophysics approach emphasizes achieving an integrated understanding rather than an in-depth one. This is in line with the opinion of Wahyu (2017), which states that forms of ethnophysics will be more easily identified through educational processes about everyday life that are developed by culture, processes, methods, and content.

Ethnophysics-based learning expects students to conduct direct investigations of a culture, including observations, interviews, and even analysis of literature regarding the native culture of the surrounding community (Indrawati & Qosyim, 2017). For example, community culture is packaged in art forms such as Reog Ponorogo and combines elements of art and sports such as traditional 'egrang' games. Thus, the traditional knowledge that certain indigenous peoples initially owned can be disseminated to the broader community (Hairida, 2010).

The role of education in building regional potential-based learning has not been maximized. The main problem is caused by learning lack of awareness of the region's wealth. According to Wahyudi (2014), some students still do not know their region's potential. The entry of foreign cultures also causes the erosion of the ancestors' cultures. What is worse is that younger generations firmly reject their ancestors' culture (Herimanto & Winarno, 2010). As a result, the government emphasizes that the curriculum must be adjusted to the region's potential. However, learning the area's potential is a special subject in the learning curriculum. These subjects are known generally as local content. The result obtained from high school education is improved life skills. One method that can be done is to develop ethnophysics-based learning.

Discussion

Integrating traditional games, such as e.g., games into physics learning, represents a powerful example of how local wisdom can be revitalized through technological and educational innovations. In line with ethnophysics, which connects cultural practices with scientific principles, the egrang game demonstrates fundamental physics concepts such as mechanical energy, rigid body balance, and pressure (Indrawati & Qosyim, 2017; Abdullah, 2016).

In the era of digital transformation, education increasingly adopts technology-enhanced learning environments. However, technology can also serve as a bridge to preserve and modernize traditional knowledge. For example, augmented reality (AR) or virtual simulation tools could be developed to model the physics behind traditional games, like Jenga, allowing students to visualize forces, energy changes, and equilibrium in an interactive way. Such technological integration enhances understanding and promotes cultural literacy and regional identity among students (Wahyu, 2017).

Moreover, applying physics in traditional games helps demystify abstract scientific concepts by situating them in real-life, culturally meaningful contexts. This approach aligns with the constructivist learning paradigm, where learners actively construct knowledge based on experience. By investigating the egrang game, students develop cognitive understanding and socio-emotional skills such as appreciation for local heritage and critical thinking about technological adaptation (Pertiwi & Rusyda, 2019).

Nevertheless, the inclusion of ethnophysics in mainstream science curricula still faces challenges. These include a lack of teacher training in integrating local culture into scientific content and the tendency to treat local knowledge as peripheral rather than central to scientific discourse (Wahyudi, 2014). Therefore, there is a need for teacher professional development programs and curriculum frameworks that support the blending of ethnoscience with modern science and educational technology.

In conclusion, the traditional game of egrang is more than a cultural artifact—it is a pedagogical tool that embodies physics principles and has the potential to enrich science education through ethnophysics-based approaches. With the aid of technology, local wisdom can be preserved, analyzed, and taught in a way that fosters scientific literacy and cultural awareness in the 21st-century classroom.

CONCLUSION

Fundamental Finding: This study highlights that traditional games, particularly egrang, are not merely cultural heritage but also rich in physical science content. The egrang game applies key physics concepts such as kinetic energy, potential energy, work, and rigid body balance. Through climbing, stepping, and maintaining balance on narrow wooden stilts, players unknowingly engage with principles of mechanics. These interactions provide a real-life context for understanding abstract scientific concepts, making egrang a meaningful tool for physics learning within an ethnophysics framework. **Implication:** Integrating traditional games into science education reinforces the value of local wisdom while promoting scientific literacy. Embedding egrang in classroom activities can improve student engagement, cultural appreciation, and conceptual understanding of physics. Furthermore, such integration supports character development, including perseverance, focus, and sportsmanship, thereby enriching the educational process holistically. This approach also aligns well with constructivist and contextual learning paradigms. **Limitation:** This research is limited to analyzing one traditional game egrang and focuses mainly on qualitative interpretations of its physics content. It does not yet explore how such integration affects students' academic performance or long-term conceptual retention. Moreover, the study is constrained to a specific cultural and geographical context (West Java), which may limit its generalizability. **Future Research:** Future studies should explore the development of instructional models that systematically incorporate various traditional games into the science curriculum. Quantitative investigations are also needed to evaluate the effectiveness of ethnophysics-based learning on student achievement and motivation. Additionally, research can focus on using educational technology, such as augmented reality or simulations, to represent traditional games and enhance their pedagogical value digitally.

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REFERENCES

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.

Damayanti, L. (2017). Pembelajaran fisika berbasis etnosains untuk meningkatkan literasi sains peserta didik. *Jurnal Pendidikan Fisika Indonesia*, 13(2), 71–76.Jurnal Universitas Tidar

Damayanti, C., Rusilowati, A., & Linuwih, S. (2017). Pengembangan model pembelajaran IPA terintegrasi etnosains untuk meningkatkan hasil belajar dan kemampuan berpikir kreatif. *Jurnal Pendidikan Fisika Indonesia*, 13(1), 1–7.jgs.ejournal.unri.ac.id

Deskarina, R., & Atiqah, A. N. (2020). The potential of local wisdom of Bugisan village as an effort to develop tourist attractions to support the Plaosan Temple area. *Journal of Tourism and Culture*, 11(1), 41–49. http://10.31294/khi.v11i1.6906

Hairida. (2010). Utilization of local culture and technology in the framework of science development. *Journal of Mathematics and Science Education*, 1(1), 1–10.

Harefa, A. R. (2017). Learning physics in schools through the development of ethnoscience. *Warta Journal*, 53, 1–10.

Hariastuti, D. (2020). *Pengembangan permainan tradisional dalam pendidikan karakter anak*. Pustaka Media Guru.

Hariastuti, R. T., & Laili, P. (2020). Development of "ITTR" media as a relaxation exercise to reduce student learning stress at SMAN 3 Sidoarjo. *Journal of BK UNESA*, 11(5), 755–764.

Herimanto, & Winarno. (2010). *Basic social sciences and culture*. PT Bumi Aksara.

Indrawati, M., & Qosyim, A. (2017). The effectiveness of ethnoscience-based student worksheets (LKS) on biotechnology materials to train class IX students' science process skills. *UNESA E-Journal*, 5(2), 1–10.

Khery, Y., & Erna, M. (2019). Ethnoscience studies in chemistry learning to develop scientific literacy. *Journal of Indonesian Science Education*, 3(1), 1–8.

Lutfiana, D. S., & Nurrahmawati, Y. (2017). *Getting to know science in traditional games*. University of Jember.

Mardikantoro, H. B., & Supatmi. (2022). Penerapan teknologi digital berbasis budaya lokal dalam pembelajaran IPA. *Jurnal Teknologi Pendidikan*, 24(2), 107–117. https://doi.org/10.21831/jtp.v24i2.48956

Novia, Nurjannah, & Kamaluddin. (2015). Causal reasoning and ethnoscience-based analogies in solving physics problems. *Proceedings of the Bandung Science Innovation and Learning National Symposium*, 1–10.

Novitasari, L., Agustina, P. A., Sukesti, R., Nazri, M. F., & Handhika, J. (2017). Physics, ethnoscience, and local wisdom in learning science. *National Seminar on Physics Education III*, 1–7.

Pertiwi, U. D., & Firdausi, U. Y. R. (2019). Upaya meningkatkan literasi sains melalui pembelajaran berbasis etnosains. *Indonesian Journal of Natural Science Education*, 2(1), 1–10. https://doi.org/10.31002/nse.v2i1.476Jurnal Universitas Tidar

Rahmawati, F., Nugroho, A. S., & Huda, N. L. (2021). Augmented reality berbasis permainan tradisional dalam pembelajaran fisika. *Jurnal Inovasi Pendidikan IPA*, 7(2), 234–243. https://doi.org/10.21831/jipi.v7i2.37245

Riski, Suprapto, & Admoko. (2022). Exploration of physics concepts with traditional engklek (hopscotch) game: Is it potential in physics ethno-STEM learning? *Scientific Journal of Physics Education Al-Biruni*, 11(2), 1–10.

Rosita, S. M. (2019). Ethnomathematics in the Osing Banyuwangi traditional house as material for learning mathematics. [Undergraduate thesis, University of Jember].

Rumiat, R. D. H., & Ketut, I. M. (2021). Analysis of mechanical energy physics concepts in traditional games of stilts as physics learning materials. [Undergraduate thesis, University of Jember].

Setiawan, A., & Rohman, A. (2019). Analisis fisika pada permainan tradisional gasing tarik. *Jurnal Pendidikan Fisika dan Keilmuan*, 7(1), 63–70. https://doi.org/10.25273/jipf.v7i1.4210

Suastra, I. W. (2005). Reconstructing original science in the context of developing local culture-based science education in schools. *UPI Repository*.

Sudarmin. (2014). Integrasi nilai kearifan lokal dalam pembelajaran IPA berbasis kontekstual. *Jurnal Pendidikan IPA Indonesia*, 3(2), 130–138. https://doi.org/10.15294/jpii.v3i2.2899

Sudarmin, Febu, R., Nuswowati, M., & Sumarni, W. (2017). Development of ethnoscience approach in the module theme substance additives to improve the cognitive learning outcome and student's entrepreneurship. *Journal of Physics: Conference Series*, 824(1), 012024. https://doi.org/10.1088/1742-6596/824/1/012024

Sugiyono. (2018). *Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D*. Alfabeta.

Supriyono, A. (2018). *The excitement of old traditional children's games*. Language Development and Fostering Agency, Ministry of Education and Culture.

Supriyono, B. (2018). *Egrang: Permainan tradisional yang hampir punah*. Duta Media.

UNESCO. (2021). *Education for sustainable development: A roadmap*. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000374802

Wahyu, J. (2017). Ethnoscience-based learning in elementary schools. *Journal of Basic Education Innovation*, 1(2), 1–10.

Wahyudi, A. (2014). Implementation of local wisdom-based schools at Sendangsari Pajangan State Elementary School. [Undergraduate thesis, Yogyakarta State University].

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