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Exploration Concept of Physics on Local Wisdom in Traditional Game *Angkle (Engklek)* as Student Teaching Material

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Abstract

Local wisdom is a characteristic or culture that develops within the local scope from generation to generation in a certain area or region with cultural values. This *engklek* is a game that is done by doing the *engklek*, *angkle*, or *angkling* movement, namely walking and jumping using one leg. This study aims to explore and analyze the relationship between physics concepts and hopscotch games. This research method uses a qualitative research method in the form of a literature study. Data collection techniques in this study were observation and documentation. The data sources used in this study are observation as primary data and literature review as secondary data. The data that has been obtained will be reduced according to the needs to be achieved. Sources of data in this study are divided into 2, namely primary data and secondary data. Primary data is done by observing and documenting the crank game. Secondary data were obtained by reviewing 7 articles between 2016 - 2021. The results of this study found that there are physics concepts in the *engklek* game, namely parabolic motion, Newton's law, and rigid body equilibrium. This can make the *engklek* game an alternative learning media with concrete examples in the surrounding environment. The concept of physics can be found in the surrounding or nearby environment to be used as a more meaningful learning resource. The meaningful learning question is that learning can make it easier for students to understand learning because it connects concepts with real life.

Keywords: Concept Of Physics; *Engklek* Game; Local Wisdom; Physics Learning; Traditional Game

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INTRODUCTION

In this era, the development of science continues to grow along with the development of technology. One of the most rapid developments that can be felt is in the education sector. The Covid-19 pandemic has increasingly changed the

education system, which was originally face-to-face to virtual (Gusty et al., 2020). Changes that occur can have an impact on the nation's generation. What can be done is to improve the quality of education (Nurasiah et al., 2022) Followed by this phenomenon 2021 is the



first year of using the new curriculum. The curriculum originally used the 2013 Curriculum (K13) changed to the Independent Curriculum. In its application, schools can use 2 different curricula, namely Curriculum 13 for grade 12 and Independent Curriculum for grades 10 and 11. The Independent Curriculum's purpose is so that students can face various challenges and needs following the times. In addition, this curriculum also aims to create a high-quality education (Lestari et al., 2022; F. P. Sari et al., 2019; Suhandi & Robi'ah, 2022).

In learning at the senior high school level, one subject must have concrete examples to be understood, namely physics. In line with Fuad et al. (2018) explained that physics is part of the natural sciences that study natural laws and their application in everyday life. Abstract physics concepts are difficult to visualize, thus making it difficult for students to study and understand them (Sari & Alarifin, 2016). This creates a stigma for students that learning physics is difficult, even though various events in everyday life are inseparable from the concept of physics. Oktaviana et al. (2017) explained that if daily environmental activities where students live can be used as learning resources, learning physics will become more meaningful. In this case, a lot can be utilized from the immediate environment, one of which is local wisdom. This is reinforced by the statement of Hartini et al. (2018), which states that the use of local cultural aspects in learning is one way that can be done to improve the quality of the learning process. In addition, student learning outcomes can also increase when oriented to local wisdom. Local wisdom that gives a deep contextual impression makes it easier for students to understand the material (Bachtiar, 2016; Misbah et al., 2020; Wati et al., 2019).

According to Askodrina (2022) & Njatrijani (2018), local wisdom is a characteristic that develops within the local scope in a particular area or region with cultural values. In general, the meaning of local wisdom is an idea that can be understood as a local idea that is wise, wise, valuable, embedded, and followed by community members. (Sudarmin, 2014). The existence of local wisdom will be an alternative that can be used as media or teaching materials in schools. In addition, education integrated with local wisdom can have a positive impact, including students becoming aware of local excellence in the place where they live (Rumiati et al., 2021). Several studies show that the use of local wisdom in physics subjects has a positive impact on students. According to R & Susanti (2019), through the results of their research, he said that the development of teaching materials based on local wisdom could be one of the learning media that significantly impacts students' knowledge and skills. In addition, Jufrida et al. (2022) explained an increase in student learning outcomes when using local wisdom-based learning products on sound wave material. Hartini et al. (2017) also stated that the learning process becomes effective when integrating physics learning with local wisdom.

One form of local wisdom is traditional games. Kurniati (2016) explained that traditional games are one of the elements of local culture often found in various parts of the archipelago and are common in rural communities. In addition, this traditional game is not just playing but can influence the psychology and nature of social life. According to Rumiati et al. (2021) traditional games have many benefits, including being able to train children's creativity, control emotions, and social intelligence, bringing children closer to nature, being able to develop children's motor skills, beneficial training health, honing

children's sensitivity, and so on. That way, it is very appropriate to integrate physics concepts in games into teaching materials to get concrete examples and more meaningful learning.

There is much local wisdom in Indonesia, including the City of Sidoarjo. The city of Sidoarjo has many cultures, special foods, and characteristics (Shofiyah et al., 2020). One of the traditional games that still exists is the game "*Angkle*" or "*Engklek*". According to Ashar (2017), this *engklek* game is a game that is done by doing the *engklek*, *angklek*, or *angkling* movement, namely walking and jumping using one leg. Based on how to play the game, the researcher is interested in exploring the physics concepts contained in the game. In addition, it can also be used as a learning medium based on local wisdom in *Angklek* games. The specific purpose of writing this article is to explore the concept of physics and serve as teaching material while preserving the culture in Sidoarjo.

METHOD

This research was conducted using qualitative methods. In the form of a literature study. Nana (2019) explains that using the literature study method, data is collected for analysis and then presented in the discussion results so that conclusions can be drawn. Data collection techniques used in this study are observation and documentation. In addition, direct observations were made on the crank game and then documented and made material for analysis.

Two sources of data used in this research are primary data and secondary data. Observation processing results are used as primary data sources and literature study results are used as secondary data sources. The literature study was carried out by reviewing 7 articles in the range from 2016 to 2021.

The data analysis technique used is to reduce the data and then draw

conclusions. Moreover, Nurhidayat et al. (2020) explain that using data reduction can enable researchers to analyze the initial data into data that is more relevant to the research objectives. Primary data obtained from observations will be studied regarding existing physics concepts. Then, on secondary data, namely reviewing articles related to ethnophysics learning. The review aims to find out how much potential ethnophysics has when it is applied to the learning process.

RESULT AND DISCUSSION

Exploration of Physics in the Traditional Game of *Engklek*

According to Ashar (2017), many traditional games contain sportsmanship, togetherness, hard work, and fun. One such game is *engklek*. Besides, Ashar (2017) explains that a game that is carried out by making a *engklek*, *angklek*, or *angkling* movement or walking and jumping using one leg is the meaning of the *engklek*. The same page with Fuad et al. (2018) also explained that the game of *baingkaan* or *engklek* is a game that requires players to do *tangka* or walk on one leg. Therefore, it has become a choice how the game of *hopscotch* be a game that is defended. Preserving it is something that must be done so that traditional games are not lost in the midst of the onslaught of modern games that have developed at this time (Febriawan, 2015).

The *engklek* game has several types of playing areas. According to Tambunan & Simanjuntak (2021) there are three types of area shapes, namely ordinary, helicopter, and airplane. The shape of the area that is often used is the plane shape. In this area, the shape of the area is a net of cubes. Each game has its own rules. Before starting the game, all players *hompimpa* to determine who will do the game first and the order after. Player 1 throws *gaco* into box 1. Figure 1 shows a *gaco* in the box. *Gaco* in question is a

lump or piece of house tile that is not used.



Figure 1 *Gaco*

The rules of the *engklek* are that you cannot step on the box with the *gaco*. So, the first player has to jump to box 2 and then to box 3, 4, 5, 6, and 7 using one foot. Then the first player jumps to box 7, 6, 5, 4, 3, 2 and then ducks to take *gaco* in box 1 while still using one foot and then gets out of the game box. Then the first player continues the game by throwing *gaco* into box 2 and so on.

If the player can throw *gaco* correctly in each box up to the last box, then the player will place the *gaco* on the back of his hand with his back to the game box then throw the *gaco* backward. If the *gaco* falls right on one of the boxes, then that box becomes the *omah* player's. The advantage of having a "house" is that players can stop using both feet and the other players are not allowed to step on the square.

The *engklek* player is said to have failed or made a substitution when several things happened, namely the player could not throw *gaco* at the box correctly or *gaco* was on the line between the boxes as shown in figure 2. Then when the player jumps and steps on the line between the boxes it can also be said to have failed. The player steps on another player's "house", and the player uses two feet when passing the box.



Figure 2 *Gaco* that comes out of the box



Figure 3 Throwing *gaco*

Figure 3 shows the player who will throw *gaco*. The concept of physics that exists when the player stands before throwing *gaco* is Newton's First Law, namely:

$$\Sigma \mathbf{F} = 0$$

$$W - N = 0 \quad (1)$$

Where $\mathbf{F}$ (N) is the force, W (N) is the object's weight, and N (N) is the normal force of the object.

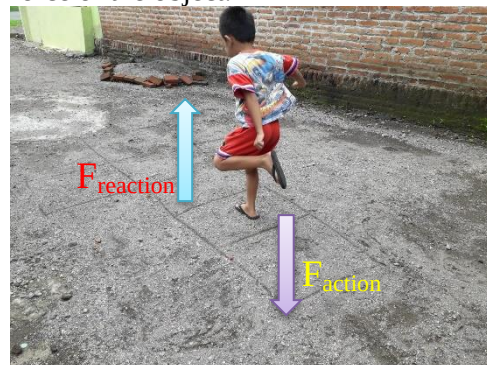


Figure 4 Player jumps from 1 box to another

In Figure 4, when a player jumps with 1 foot from one box to another, there are several concepts, namely Newton's Third Law and Equilibrium. When a player jumps, Newton's III Law applies, namely:

$$\mathbf{F}_{\text{action}} = - \mathbf{F}_{\text{reaction}} \quad (2)$$

The action force ($\mathbf{F}_{\text{action}}$) is given by the foot jumping on the ground or to the center of the earth, and the reaction force ($\mathbf{F}_{\text{reaction}}$) is given when the ground gives a force in the opposite direction so that the body can be pushed to the ground down. According to Wulansari & Admoko (2021) explained that if you have the same magnitude of the force in

opposite directions and act on different objects, Newton's Third Law can occur. Therefore, Newton's Third Law works when players jump from one box to another

Then, when the player is still standing on one foot when he is going to take *gaco*, there will be an equilibrium so that he does not fall.

$$\Sigma \tau = 0 \quad (3)$$



Figure 5. Throwing *gaco* with his back to the box

In Figure 5, when the player throws the *gaco*, the *gaco* will have a parabolic motion. For example, when calculating the farthest distance, it can be used using the equation

$$X_{\max} = \frac{v_0^2 \sin 2\theta}{g} \quad (4)$$

Meanwhile, when the *gaco* is thrown, *gaco* will be at its maximum height, so it can be studied on the Y axis so it can be calculated using the equation

$$Y_{\max} = \frac{v_0^2 \sin^2 \theta}{2g} \quad (5)$$

Then, when the *gaco* returns to the ground, it takes time from the time it was thrown to landing, so that it can be calculated using the

$$t_{X \max} = 2 \times t_{Y \max} \quad (6)$$

$$t_{Y \max} = \frac{v_0 \sin \theta}{g} \quad (7)$$

at any time which can be expressed in 2 points, namely from the X and Y axes. On the X axis the *gaco*'s velocity is constant. The position of the object is the product of the velocity on the X axis with time, so that

$$X_{gaco} = v_0 \cdot \cos \theta \cdot t \quad (8)$$

Meanwhile, the speed of the *gaco* varies on the Y axis, this is due to the influence of the acceleration due to gravity. Then the *gaco* position on the Y axis can be formulated by

$$Y_{gaco} = v_0 \cdot \sin \theta \cdot t - \frac{1}{2}gt^2 \quad (9)$$

According to Sari et al (2019), in crank playing there are also the concepts of momentum and impulse. The concept of momentum occurs when *gaco* is still or moving. When the *gaco* is stationary or ($v = 0$) and when the *gaco* is moving or ($v \neq 0$). the difficulty in stopping the movement of an object is known as momentum (Sari, 2019).

$$\mathbf{P} = m \mathbf{v} \quad (10)$$

With $\mathbf{P}$ (kg.m/s) is *gaco*'s momentum, m (kg) is the mass possessed by *gaco*, and $\mathbf{v}$ (m/s) is the speed possessed by *gaco*

When a player changes, it is possible to have 2 or more *gacos* in the same box. So, if when throwing the *gaco* hits another player's *gaco*, then there will be an impulse concept. The player exerts an average impulse force over a short time interval. So that it can be formulated

$$\mathbf{I} = \mathbf{F} \Delta t \quad (11)$$

Based on equation 11 it can be seen that the impulse value is proportional to the average impulse force and the time interval. Impulse can also be interpreted as a change in momentum, this can be seen from the change in the movement speed of the *gaco*. So, the equation can be written

$$\mathbf{I} = \Delta \mathbf{P} \quad (12)$$

$$\mathbf{I} = m (\mathbf{v}_2 - \mathbf{v}_1) \quad (13)$$

Where $\mathbf{I}$ (kg.m/s) is the impulse that occurs in the *gaco*, m (kg) is the mass of the *gaco*, and $\mathbf{v}_1$ (m/s) is the initial velocity and $\mathbf{v}_2$ (m/s) is the velocity end.

Exploration of Engklek games as teaching materials for physics learning

Based on the above analysis results, the concept of physics in *engklek* can be integrated into learning physics according to the basic competencies according to K13 which are presented in Table 1.

Table 1 The relationship between physics concepts in hopscotch games with KD K13

The concept of physics in the <i>engklek</i> game	Basic Competencies K13
Newton Law	3.7 Analyze the interaction of forces and the relationship between force, mass, and straight motion of objects and their applications in everyday life. 4.7 Conducting experiments along with presenting the results regarding force and the relationship of force, mass, and acceleration in straight motion of objects by applying the scientific method
Equilibrium of a rigid body	3.1 Applying the concepts of torque, the center of gravity, and angular momentum to rigid bodies (static and dynamic) in everyday life, for example in sports. 4.1 Create a work that applies the concept of the center of gravity and equilibrium of a rigid body.
Parabolic motion	3.5 Analyzing parabolic motion using vectors, along with their physical meaning and their application in everyday life. 4.5 Presenting data from parabolic motion experiments and their physical meaning
Momentum and Impulse	3.10 Applying the concepts of momentum and impulse, as well as the law of the conservation of momentum in daily life 4.10 Presenting the results of testing the application of the law of conservation of momentum, for example, a ball falling freely from the floor and a simple rocket

Physics concepts in *engklek* games with K13 basic competencies can be integrated into physics learning. In addition to understanding the concepts of physics, students also do not forget the local wisdom of their region. Laos et al (2019) explained that students think it is easy to solve physics concepts which are considered difficult because they are connected with the existence of culture in

the learning process. Learning with an ethnosience approach can provide students with understanding regarding the use of science in everyday life and can appreciate nature more (Kartimi, 2014). Table 2 describes several previous studies that discussed the application of ethnosience and local wisdom in physics learning.

Table 2 Review of articles on the implementation of local wisdom in learning physics

Author	DOI Resolution Documentation	Result	Recommendation
(Dinissjah et al., 2019)		The results of this study indicate that the application of the ethnosience-based Direct Instruction learning model has the potential to provide positive encouragement for students in physics assignments. This is based on an increase in the N-gain value of 0.73 in the high category.	Suggestions for further research are (1) to improve critical thinking skills, teachers should be able to choose the right learning model. (2) the need for further research on physics learning that is integrated with ethnosience.

Author	DOI Resolution Documentation	Result	Recommendation
(Rima et al., 2019)		The results showed that applying teaching materials based on local cultural wisdom in physics learning could increase students' physics learning activities and achievements. This is based on an average score of 83.75.	There are several suggestions for further research: (1) learning outcomes can be increased if students optimize performance in supporting classroom learning. (2) teachers can choose more innovative learning models, become facilitators for students, and design activities and learning tools well. Based on the results obtained, several suggestions are useful for further research: (1) teachers should pay more attention to aspects of motivation, interest, and how to relate one material to another.
(Sumalong et al., 2021)		This study's results indicate that applying the ethnoscience-based problem-based learning model with causal reasoning strategies can improve students' physics learning outcomes.	(1) at the implementation stage, time efficiency must be given more attention. (3) the completeness of the tools used in the practicum must also be considered because it affects the success of the practicum. (4) the teacher can determine a learning model that suits the needs of students.
(Satriawan & Rosmiati, 2017)		The results of this study show that students' understanding of physics concepts can be increased by using contextually based physics teaching materials by integrating local wisdom. This is based on the high category's N-gain values of 0.86 and 0.74.	There are several suggestions for further research: (1) the use of the material studied can be expanded so that it is not only on mechanics material. (2) when conducting a large-scale trial, a larger sample of students should be used to represent the existing population.
(Wati et al., 2017)		The results of this study indicate that the development of physical modules integrated with local wisdom upstream of the southern river is appropriate for use in learning and has a positive effect on student learning outcomes. This is the average radiance, which increased from 2.65 to 79.42. The N-score value obtained is 0.79 or more.	Suggestions for further research are (1) the study of local wisdom upstream of the southern river can be studied with more diverse physics concepts. (2) the development of teaching materials based on local wisdom can be linked to other local wisdom in the area of South Kalimantan

Author	DOI Resolution Documentation	Result	Recommendation
(Hartini et al., 2018)		This researcher produced glass teaching materials integrated with aspects of local wisdom. Through validity, practicality, and effectiveness tests, the teaching materials developed are included in the appropriate category for use in specific physical learning on students' character.	It is hoped that research like this will continue to be developed. This is because it has great potential to be one of the learning media that can provide real examples for students, especially in physics learning material.
(Suastra et al., 2017)		The research conducted on 20 physics teachers showed that there are characters based on local wisdom that can be used and developed in physics learning. Apart from that, the learning method that is suitable for this research is the inquiry model.	It is hoped that further research can apply it to a wider scope. In addition, the learning model that has been developed continues to be assessed to develop the character of students based on local wisdom.

From the results of the description above, it can be seen that the use of popular science in physics lessons can positively influence academic achievement, critical thinking, personality development, and students' understanding of concepts. Using innovative and relevant media and teaching materials based on local wisdom can improve student learning outcomes. This follows Wati's research (2019) that physics materials are practically used based on local wisdom. In addition, Ramadhan et al (2019) found that using local wisdom-based comic media can train higher-order thinking skills (HOTS). Based on the research (Yuliana Kua et al., 2021) recommends that in basic physics practicum activities, you can use a virtual physics laboratory with real-world problems based on local wisdom. This study has several limitations, namely, (1) it has not yet connected the existing concepts in the hopscotch game with the independent curriculum, (2) it has not discussed in more detail the amount of energy

required, the effect of the player's height on the jump during the game, and several types of forms in the crank game, (3) this research is still a preliminary study that has not been implemented. That way, it is hoped that the urgency of research like this will continue to be developed and researched so that it can become a source of reference for further development.

CONCLUSION

Based on the analysis above, it can be concluded that *Engklek* is a traditional game carried out by carrying out the *Engklek*, *Angklek*, or *Angkling*, namely walking, and jumping using one leg. In *engklek*, several physics concepts are used, such as parabolic motion, Newton's law, equilibrium of rigid bodies, momentum, and impulse. That way, the concepts obtained can be used as teaching materials based on local wisdom so that students better understand and experience concrete and meaningful learning.

There are several implications for future research. (1) for researchers, it can

deepen the concepts of physics and even other subjects found in traditional *engklek*. (2) for librarians, it can be used as reference material and knowledge that can be applied in the learning process. (3) for the government, it can provide guidance and training related to local wisdom-based learning in physics subjects.

REFERENCES

- Ashar, H. (2017). Pengaruh pembelajaran diskusi caologium berbasis permainan engklek terhadap hasil belajar fisika. *Jurnal Pendidikan Fisika UIN Alauddin Makassar*, 5(1), 45–48.
- Bakhtiar, A. M. (2016). Curriculum development of environmental education based on local wisdom at elementary school. *International Journal of Learning, Teaching and Educational Research*, 15(3), 20-28.
- Dinissjah, M. J., Nirwana, N., & Risdianto, E. (2019). Penggunaan model pembelajaran direct instruction berbasis etnosains dalam pembelajaran fisika untuk meningkatkan kemampuan berpikir kritis siswa. *Jurnal Kumparan Fisika*, 2(2), 99–104. <https://doi.org/10.33369/jkf.2.2.99-104>
- Fuad, Z., Misbah., Hartini, S., & Zainuddin. (2018). Identifikasi kearifan lokal kalimantan selatan sebagai sumber belajar fisika kelas x. *Seminar Nasional Pendidikan*, 158-169
- Febriawan, K. (2015). Engklek sebagai sarana pembelajaran asyik di tengah permainan modern. Universitas Widya Dharma Klaten, Klaten.
- Gusty, S., Nurmiati, N., Muliana, M., Sulaiman, O. K., Ginantra, N. L. W. S. R., Manuhutu, M. A., & Warella, S. Y. (2020). Belajar mandiri: Pembelajaran daring di tengah pandemi covid-19. Yayasan Kita Menulis.
- Hartini, S., Firdausi, S., Misbah, & Sulaeman, N. F. (2018). The development of physics teaching materials based on local wisdom to train Saraba Kawa characters. *Jurnal Pendidikan IPA Indonesia*, 7(2), 130–137. <https://doi.org/10.15294/jpii.v7i2.14249>
- Hartini, S., Misbah, M., Helda, H., & Dewantara, D. (2017). The effectiveness of physics learning material based on South Kalimantan local wisdom. *AIP Conference Proceedings*, 1868(August). <https://doi.org/10.1063/1.4995182>
- Hijriadi Askodrina. (2022). Penguatan kecerdasan perspektif budaya dan kearifan lokal. *Al-Ihda': Jurnal Pendidikan Dan Pemikiran*, 16(1), 619–623. <https://doi.org/10.55558/alihda.v16i1.52>
- Jufrida, J., Dani, R., Basuki, F. R., & Suci Rahma Dwi Astuti, S. (2022). Pengembangan perangkat pembelajaran berbasis kearifan lokal materi gelombang bunyi untuk sma kelas xi. *Physics and Science Education Journal (PSEJ)*, 2(April), 17–31. <https://doi.org/10.30631/psej.v2i1.1271>
- Kurniati, E. (2016). Permainan tradisional dan perannya dalam mengembangkan keterampilan sosial anak. Kencana.
- Lestari, S., Fatonah, K., & Halim, A. (2022). Mewujudkan merdeka belajar: studi kasus program kampus mengajar di sekolah dasar swasta di jakarta. *Jurnal Basicedu*, 5(6), 6426–6438. <https://doi.org/10.31004/basicedu.v5i6.1679>
- Misbah, M., Hirani, M., Annur, S., Sulaeman, N. F., & Ibrahim, M. A. (2020). The development and validation of a local wisdom-integrated physics module to grow the

- students' character of sanggup bagawi gasan masyarakat. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 5(1), 1-7.
- Nana, N. (2019). Penerapan model creative problem solving berbasis blog sebagai inovasi pembelajaran di sekolah menengah atas dalam pembelajaran fisika. *Prosiding SNFA (Seminar Nasional Fisika Dan Aplikasinya)*, 3, 190. <https://doi.org/10.20961/prosidingsnf.a.v3i0.28544>
- Njatrijani, R. (2018). 3580-10649-3-Pb. *Gema Keadilan*, 5(September), 16–31.
- Nurasiah, I., Marini, A., Nafiah, M., & Rachmawati, N. (2022). Nilai kearifan lokal: Projek paradigma baru program sekolah penggerak untuk mewujudkan profil pelajar pancasila. *Jurnal Basicedu*, 6(3), 3639–3648. <https://doi.org/10.31004/basicedu.v6i3.2727>
- Nurhidayat, W., Aprilia, F., Wahyuni, D. S., & Nana, N. (2020). Etno fisika berupa implementasi konsep kalor pada tari mojang priangan. *ORBITA: Jurnal Kajian, Inovasi Dan Aplikasi Pendidikan Fisika*, 6(1), 138. <https://doi.org/10.31764/orbita.v6i1.2097>
- Oktaviana, D., Hartini, S., & Misbah, M. (2017). Pengembangan modul fisika berintegrasi kearifan lokal membuat minyak lala untuk melatih karakter sanggam. *Berkala Ilmiah Pendidikan Fisika*, 5(3), 272. <https://doi.org/10.20527/bipf.v5i3.3894>
- R, N., & Susanti, D. (2019). Pengembangan bahan ajar trigonometri berbasis literasi matematika. *Jurnal Borneo Saintek*, 2(1), 37–45. https://doi.org/10.35334/borneo_saintek.v2i1.633
- Rima, P., Rosadi, E., Rapi, N. K., & Yasa, P. (2019). Penerapan bahan ajar sains berbasis kearifan budaya lokal untuk meningkatkan aktivitas dan prestasi belajar fisika siswa kelas x mipa 7 di sma negeri. *Jurnal Pendidikan Fisika Undiksha*, 9(2), 2599–2554.
- Rumiati, R., Handayani, R. D., & Mahardika, I. K. (2021). Analisis konsep fisika energi mekanik pada permainan tradisional egrang sebagai bahan pembelajaran fisika. *Jurnal Pendidikan Fisika*, 9(2), 131. <https://doi.org/10.24127/jpf.v9i2.3570>
- Sari, A. T. W., & Alarifin, D. H. (2016). Pengembangan modul berbasis poe (predict, observe, explain) materi usaha dan energi ditinjau dari kemampuan kognitif. *Jurnal Pendidikan Fisika*, 4(2), 124. <https://doi.org/10.24127/jpf.v4i2.531>
- Sari, F. P., Nikmah, S., Kuswanto, H., & Wardani, R. (2019). Developing physics comic media a local wisdom: Sulamanda (engklek) traditional game chapter of impulse and momentum. *Journal of Physics: Conference Series*, 1397(1). <https://doi.org/10.1088/1742-6596/1397/1/012013>
- Satriawan, M., & Rosmiati, R. (2017). Pengembangan bahan ajar fisika berbasis kontekstual dengan mengintegrasikan kearifan lokal untuk meningkatkan pemahaman konsep fisika pada mahasiswa. *JPPS (Jurnal Penelitian Pendidikan Sains)*, 6(1), 1212. <https://doi.org/10.26740/jpps.v6n1.p1212-1217>
- Shofiyah, N., Hasanah, F. N., & Miluningtias, S. (2020). Workshop untuk pembuatan bahan ajar ilmu pengetahuan alam berbasis kearifan lokal sidoarjo. *JPM (Jurnal Pemberdayaan Masyarakat)*, 5(2), 453–460. <https://doi.org/10.21067/jpm.v5i2.4416>
- Suastra, I. W., Jatmiko, B., Ristiati, N. P., & Yasmini, L. P. B. (2017). Developing characters based on local

- wisdom of bali in teaching physics in senior high school. *Jurnal Pendidikan IPA Indonesia*, 6(2), 306–312. <https://doi.org/10.15294/jpii.v6i2.10681>
- Suhandi, A. M., & Robi'ah, F. (2022). Guru dan tantangan kurikulum baru: Analisis peran guru dalam kebijakan kurikulum baru. *Jurnal Basicedu*, 6(4), 5936–5945. <https://doi.org/10.31004/basicedu.v6i4.3172>
- Sudarmin. (2014). Pendidikan karakter, etnosains dan kearifan lokal (konsep dan penerapannya dalam penelitian dan pembelajaran sains). Semarang: Universitas Negeri Semarang
- Sumalong, O., Kade, A., & Muslimin. (2021). Pengaruh model pembelajaran berbasis masalah dalam strategi penalaran kausal berbasis etnosains terhadap hasil belajar fisika. *Jurnal Kreatif Onlin*, 9(2), 64–71.
- Tambunan, H.-, & Simanjuntak, J. (2021). Etnomatematika: Eksplorasi permainan engklek sebagai media pembelajaran matematika (etnomathematics: exploration of engklek games as a mathematics learning media). *Jurnal Curere*, 5(2), 1.
- <https://doi.org/10.36764/jc.v5i2.664>
- Wati, M., Hartini, S., Misbah, M., & Resy, R. (2017). Pengembangan modul fisika berintegrasi kearifan lokal hulu sungai selatan. *Jurnal Inovasi Dan Pembelajaran Fisika*, 4(2), 157–162.
- Wati, M., Hartini, S., Lestari, N., Annur, S., & Misbah, M. (2019). Developing a physics module integrated with the local wisdom of baayun maulid to build wasaka character. *International Journal of Recent Technology and Engineering (IJRTE)*, 7, 720-724.
- Wulansari, N. I., & Admoko, S. (2021). Eksplorasi konsep fisika pada tari dhadak merak reog ponorogo. *PENDIPA Journal of Science Education*, 5(2), 163–172. <https://doi.org/10.33369/pendipa.5.2.163-172>
- Yuliana Kua, M., Wayan Suparmi, N., & Ngurah Laba Laksana, D. (2021). Virtual physics laboratory with real world problem based on ngada local wisdom in basic physics practicum. *Journal of Education Technology*, 5(4), 520–530. <https://dx.doi.org/10.23887/jet.v5i4.4>