Jurnal Penelitian Fisika dan Aplikasinya (JPFA)
Volume 12, Issue 1, June 2022
https://journal.unesa.ac.id/index.php/jpfa/

p-ISSN: 2087-9946
e-ISSN: 2477-1775

Analysis of Equilibrium Concepts at Traditional Dance of Tari Banjarkemuning, Sidoarjo as an Innovation of Physics Learning by Ethnoscience Approach

Achmad Maulana Satria Putra [1,a], Rif'ati Dina Handayani [1,b,*], Trapsilo Prihandono [1,c], and Rayendra Wahyu Bachtiar [1,2,d]

[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Jember
Jalan Kalimantan 37, Jember 68121, Indonesia
[2] Freudenthal Institute for Science and Mathematics Education, Utrecht University
Princetonplein 5, CC Utrecht 3584, Netherland

e-mail: [a] maulanacahsmanig@gmail.com, [b] rifati.fkip@unej.ac.id, [c] trapsilo.fkip@unej.ac.id, and [d] rayendra_fkip@unej.ac.id
* Corresponding Author

Received: 20 March 2022; Revised: 02 May 2022; Accepted: 30 May 2022

Abstract

Physics learning is rarely associated with local wisdom, so many people think the local arts have a separate topic from scientific study. This research analyzes the equilibrium concepts at Tari Banjarkemuning from Sidoarjo, East Java. This qualitative research uses content analysis techniques divided into six steps: unitizing, sampling, coding, reducing, inferring, and narrating. The data were collected by observation, documentation, and interviews. The research indicates that the equilibrium concept at Tari Banjarkemuning is the condition of equilibrium and the center of mass. The equilibrium state is shown in the motion of Embat-Embat and Solah Kembang Turi at the Sagah position (the silent moment of the dancers while inclined the bodies sideways and backward). Then, the center of mass is shown in the motion of Kejer (the dancers raise one leg) and Kencrongan (the dancers at the Tanjak position open-dancers' legs perpendicularly at the knee). The integration of Tari Banjarkemuning in learning activities is expected for students to understand physics concepts easily. At the same time, it can make meaningful physics learning and build a better character for students.

Keywords: *ethnoscience; equilibrium; innovation of physics learning; Tari Banjarkemuning*

How to cite: Putra A M S, et al. Analysis of Equilibrium Concepts at Traditional Dance of Tari Banjarkemuning, Sidoarjo as an Innovation of Physics Learning by Ethnoscience Approach. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA)*. 2022; **12**(1): 62-75.

INTRODUCTION

Physics is a part of science that examines the macro and the micro natural phenomena with their interactions. Physics, as one of the subjects in school, contains various concepts used as a basis for a thinking process to create a particular principle and to generalize of students' understanding [1]. However, previous research showed that students cannot understand the physics concept easily since it has abstract content and is not contextual [2–4]. The teachers carry out physics learning by separating knowledge from the student's experiences in their daily life. Then, a negative perspective emerged that physics is complex, not exciting, and boring [5]. Also, physics learning focuses more on the mathematics aspect and is unintegrated with the local culture in each region [6]. Therefore, applying a suitable approach incorporating the local culture in physics learning is necessary.

Ethnoscience is one of the ways that can relate a local culture with scientific knowledge. Ethnoscience is the knowledge rooted in local societies' norms and beliefs that influence the communities' ability to understand various phenomena [7]. Physics learning through an ethnoscience approach is based on local culture and involves extracting the general understanding of a specific local culture from students and converting it into scientific knowledge [8]. Physics is not about memorizing products such as principles, theories, laws, and concepts, but physics is needed for re-examination to create an excellent scientific attitude in students [9,10]. Furthermore, education has an essential role in developing good character in students. Integrating scientific knowledge in physics learning based on the ethnoscience approach can make the student easily understand the physics phenomena that occur in society, such as local culture [11,12]. Using a cultural value in learning can help the students increase their socio-cultural attitudes in real life [13]. Thus, integrating local matters into the learning process can make the students appreciate their local culture more than the foreign one [14].

Learning innovation is all about the idea, the change process to create a new paradigm of the learning process and solving the problems around the community [15]. Innovation in physics learning can be reached by integrating an ethnoscience approach because it comes from the local culture around the students related to their daily lives [16]. Physics learning should be fun and comfortable for students. In addition, teachers need to raise the topic of local culture or local wisdom to make meaningful learning [17]. Offering the local culture, such as a traditional dance in physics learning, is a creative idea that can provide information about the marginalized local culture and influence the students to understand physics concepts [12,18].

The globalization era with a fantastic digitalization system is one of the factors that can reduce the local tradition in society [19,20]. Since then, the local culture has been marginalized because it is not correlated with the development of this era. That problem causes imbalance in society, making the cultural values of local cultures abandoned [21]. The paradigm of *Arek* culture in socio-economic and cultural interaction between Surabaya and Sidoarjo influences the development of cultural arts in Sidoarjo [22]. In the Sidoarjo region, one of the marginalized local culture is *Tari Banjarkemuning*. *Tari Banjarkemuning* has a local value that reflects the daily life of fishermen's wives on the coast of Sidoarjo named Banjarkemuning village [23]. *Tari Banjarkemuning* tells about the kindness and strongness of the fishermen's wives when her husband caught a fish in the open sea to meet their daily life.

Based on previous studies, the physics concept appears in *Reog Ponorogo* traditional dance that contains Newton's Law [24]. Furthermore, *Reog Ponorogo* has a physics concept of equilibrium when *Pembarong* bite the mask of *Dhadak Merak* and their moving attraction [25]. However, the studies only focused on the dynamic motion of *Reog Ponorogo* even though many traditional dances from East Java contain physics concepts, such as *Tari Banjarkemuning* from Sidoarjo. Based on the preliminary research, many physics teachers at senior high school in Sidoarjo rarely connected the local cultures in their physics classroom because they have never imagined the correlation between local cultures, especially *Tari Banjarkemuning*. Also, the dancing artist admits that no one has ever researched the relationship between the physics concept and *Tari Banjarkemuning*. At the same time, each part of the motion in *Tari Banjarkemuning* has equilibrium concepts that focused on the static motion which has a local indigenous value. This research aims to explore and analyze the movement of *Tari Banjarkemuning* that contains equilibrium concepts that can be an innovation of physics learning using the ethnoscience approach.

METHOD

This research is qualitative research with the main topic of *Tari Banjarkemuning*. This research focuses on the main motion at *Tari Banjarkemuning,* which contains equilibrium concepts such as *Embat-Embat*, *Solah Kembang Turi*, *Kejer*, and *Kencrongan*. The data were collected by observation, documentation, and interviews with four informants. The informants of this research are a dancing teacher and three dancers. The steps of this research design are shown in Figure 1.

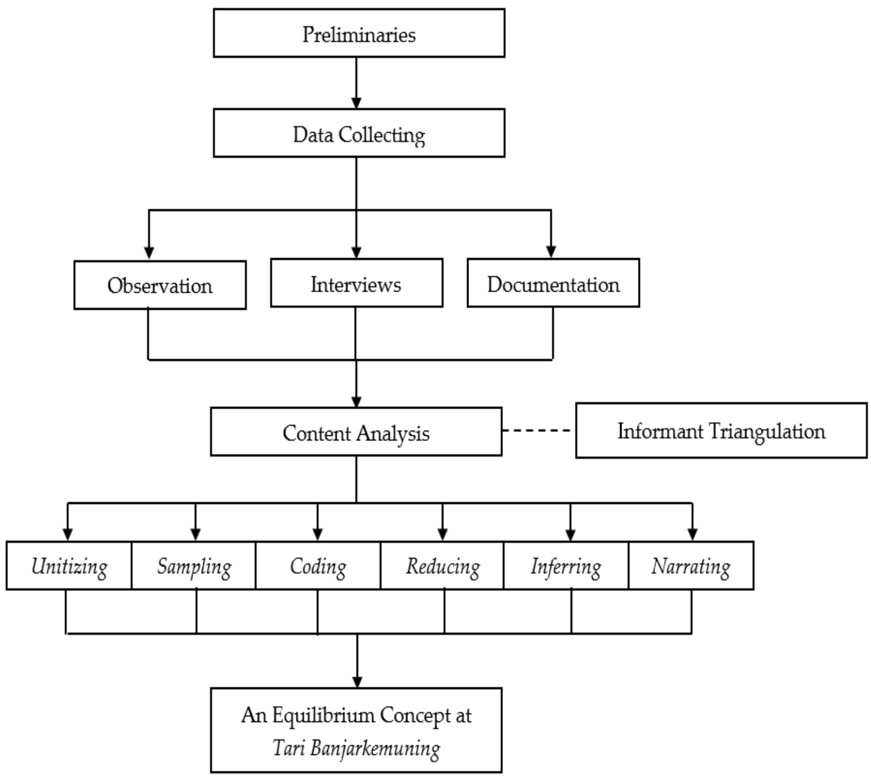

Figure 1. The steps of research design

The data analysis of this research used content analysis of six steps: *unitizing*, *sampling*, *coding*, *reducing*, *inferring*, and *narrating* [26]. This research used informant triangulation to check the validation of the data. Informant triangulation asks the informant of the study about the data, so the data is valid [27]. The informant triangulation is integrated with the steps of content analysis.

Unitizing is the step of collecting information about *Tari Banjarkemuning,* such as texts, photos, and videos. The data in this research were collected using observation, semi-structured interviews, and documentation. The data obtained through a semi-structured interview was voice recorded and transcribed into text conversation type. The guidelines in Table 1 are used in this research to transcript the voice record.

Table 1. The guidelines for transcript a voice record data

Initial Name	Role	Code
AMSP	Researchers	Q
AIR	1st Dancer	A1
DI	2nd Dancer	A2
ARA	3rd Dancer	A3
FCA	Dance Teacher	A4

Sampling is the step to select the data to make clear boundaries of the discussion about an equilibrium concept at *Tari Banjarkemuning*. The *sampling* context in this research can also integrate with informant triangulation. *Coding* is the step to give a symbol or create an illustration of the selected data. *Reducing* is the step to reduce the data irrelevant to the topic of an equilibrium concept at *Tari Banjarkemuning*. *Inferring* is the step to analyze an equilibrium concept at *Tari Banjarkemuning* deeply. Then, *narrating* is the step to display the findings in a descriptive text, making it easier for readers to understand an equilibrium physics concept at *Tari Banjarkemuning*.

RESULTS AND DISCUSSION

The research showed that each central part of *Tari Banjarkemuning* motion had an equilibrium concept, divided into the equilibrium condition and the center of mass. The classification of the result of this research shows in Table 2.

Table 2. The classification results of

The Motion Variety	The Equilibrium Concepts
Embat-Embat	1st Condition of Equilibrium ($\sum F = 0$) 2nd Condition of Equilibrium ($\sum \tau = 0$)
Solah Kembang Turi	1st Condition of Equilibrium ($\sum F = 0$)
Kejer and Kencrongan	Center of Mass (CM)

Embat-Embat

The first condition of equilibrium ($\sum F = 0$) was shown at the *Sagah* position of *Mendak*. In this position, the dancer stopped for a moment, inclined her body to the right side, then pushed her buttocks to the left side. The participants' answers below explained *Mendak* position through a semi-structured interview.

"… when facing at the front, the body should be *Mendak* immediately and inclined the upper body which called *Hoyog* at the right side, also the dancers should push her buttocks to the left side backward." (DI, 10 January 2022).

The explanation of this position was also supported by the two statements below.

"… *Mendak* positions like lowering the body, then the upper body is inclined to the right side, and the buttocks are pushed to the left side. So, the left thigh was felt more tension." (ARA, 12 January 2022).

"… as soon as the dancers make position called *Mendak* with *Hoyog* to the right side. *Hoyog* is the position in which the dancer inclined her body. Her buttocks are also pushed to the left side, so the left thighs support this position. The dancers stay in the static position, which is called S*agah*." (FCA, 12 January 2022).

The statement indicated that the dancer inclined her upper body, and a muscle force caused her body to tilt to the right side. Then, the dancers push their buttocks with force to the left to keep their balance. The dancers' weight also balances with the normal force at their feet. The illustration of the force system in this position shows in Figure 2.

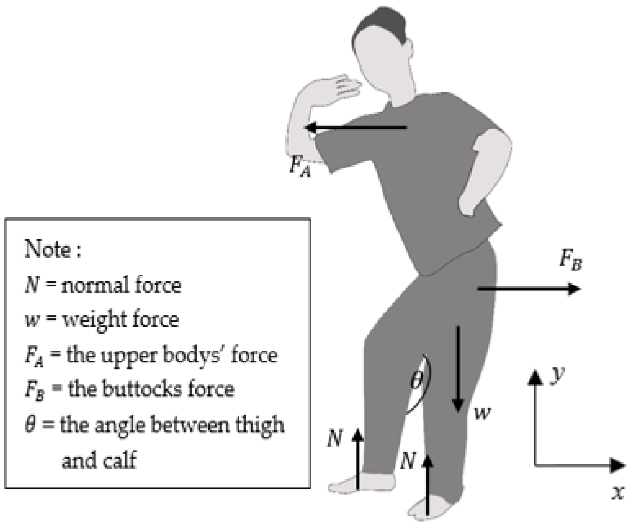

Figure 2. The illustration of the force system in the *Sagah* position of *Mendak*

The *Sagah* position of *Mendak* can strengthen posture supported by the thigh [28]. The *Sagah* position of *Mendak* is similar to *Sagah* at *Tari Gandrung*, with the dancers also facing the body to the side and the left hand on the waist, then the right hand bent in front of the body [29]. This position contains a concept of the first condition of equilibrium, where the resultant of forces acting in the system is zero or $\sum F = 0$ [30]. In Figure 2, the *Sagah* position of *Mendak* contains a force acting at the horizontal axis (x-axis) and the vertical axis (y-axis). Each axis has two forces with an opposite direction to keep the balancing body position at the x-axis and at the y-axis.

$$\sum F_x = 0$$
$$F_A - F_B = 0 \tag{1}$$
$$\sum F_y = 0$$
$$N - w = 0 \tag{2}$$

Newton's law provides correlation to the acceleration, speed, time, and position [31]. Newton's first law, or the law of inertia, stated if the object does not have external forces, it will keep its condition or move at a constant velocity [32]. The *Sagah* position of *Mendak* is static, so it is also related to Newton's first law because the acceleration in this position is equal to zero, $\sum F = 0$.

The second condition of equilibrium ($\sum \tau = 0$) shows at the end of the motion of *Embat-Embat* when the dancer makes a rotation motion with constant angular velocity. This motion can be seen before the *Sagah* position of *Mendak*. This rotational motion is explained in the participants' statement below.

"… then, both hands are thrown to the right side, and the left leg should be crossed to the right side too. After that, the dancers rotated her body, and both hands make a rotational motion while the dancers' bodies are rotated, which is used as a preparation for *Mendak* position …" (ARA, 12 January 2022).

The explanation of this motion was also supported by the two statements below.

"…both hands make a thrown motion to the right side which the rotational focus on the elbow, at the same time the body also make a rotational motion into the front side …" (DI, 10 January 2022).

"… the hands should be swinging to the right side downward, then rotated her body until facing at the front side …" (AIR, 27 December 2021).

The informants' information indicated that when the dancers make a rotational motion, it has an angular velocity (ω) and a moment of inertia (I). The illustration of *Embat-Embat* motion is ilustrated in Figure 3.

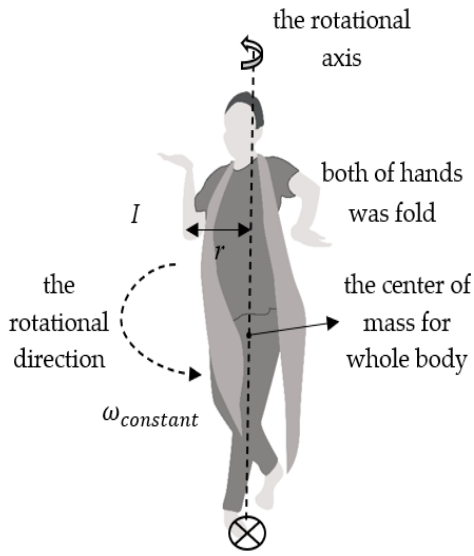

Figure 3. The illustration of a rotational motion at *Embat-Embat*

The rotational motion at the motion variety of *Embat-Embat* is analog to the second equilibrium condition. The second condition of equilibrium is reached when the result of torque acting in the system is zero or known as $\sum \tau = 0$ [33]. The second Newton's law for rotational motion states that the resultant torque is equal to the multiplication result of a moment of inertia (I) and the angular acceleration (α) [34]. Both dancers' hands were folded when the dancer made a rotational motion. This motion contains a moment of inertia because the moment of inertia is affected by the object's radius from the rotational axis [35]. The dancers' folded hand aims to make a small radius from the rotational axis that causes a smaller value of the moment of inertia, so the dancers' bodies can make a rotational motion easily [34]. The left foot is a central rotational axis, and the right foot should raise slightly to keep the balancing motion. The equilibrium condition when the dancers make a rotational motion is one type of dynamic equilibrium state [36]. In this motion, to reach a dynamic equilibrium, the angular velocity should be constant, which causes the value of angular acceleration is zero.

Solah Kembang Turi

Solah Kembang Turi describes the woman's personality as the fishermen's wife, who is firm but still shows her elegance and beauty [37]. This motion has the first condition of equilibrium ($\sum F = 0$) when the dancers hold the *Sampur* upward and incline her body backward. The S*ampur* property at the traditional dance is identic to a scarf [38]. This position is explained through a semi-structured interview in the statement below.

"… The dancers are ready to clamp her *Sampur* with her right hand and her left hand resting on her waist. The dancers walk until the formation of the static moment. Her right hand should raise the *Sampur,* and her body should be inclined backward. The position of legs is slightly bent, and the right foot was tiptoe in front of the left foot, so the left thigh supports it." (AIR, 27 December 2021).

The two participants' statements below supported the explanation of this position.

"The *Sampur* was clamped immediately by the right hand, the left hand at the side of the waist called *Malangkerik*. When the dancers stop for a moment, her body is inclined to the backside, and she raises the right hand by clamping a *Sampur*, making the dancer keep this position for a moment easier. The right foot should be in front of the thumb of the left side with tiptoe slightly." (DI, 10 January 2022).

"The motion called *Solah Kembang Turi,* where the dancers clamp the *Sampur* by the right hand and the other hand at the side of the waist. Then, the dancers make a horizontal side formation and *Sagah* position. This S*agah* position is the dancers' stop position for a moment, clamping the *Sampur* upward and inclining her body backward, called *Hoyog*. The right foot was tiptoe slightly in front of the left side, supporting it by the left foot." (FCA, 12 January 2022).

The interview results indicate that the *Sagah* position of *Solah Kembang Turi* has a force-acting system that causes the dancers' inclined bodies and the dancers to clamp the *Sampur* upward. The dancers' feet also have a force-acting system of normal force and weight. The illustration of the S*agah* position of *Solah Kembang Turi* shows in Figure 4.

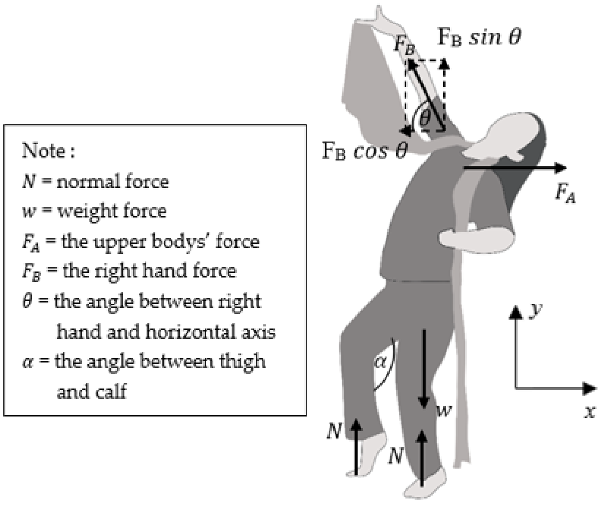

Figure 4. The illustration of the force system in the S*agah* position of *Solah Kembang Turi*

Figure 4 illustrates that the right-hand force has an angle so it can elaborate to the x-axis of $F_B \cos\theta$ and to the y-axis of $F_B \sin\theta$. The function of the right foot was to tiptoe slightly with the right hand clamping the *Sampur* upward to keep this position balance. Both feet were opened and bent slightly, which can make an equilibrium condition because the linear radius of the center of gravity from the pedestal point is directly proportional with an inclined direction, and it is the closest to the surface so that it can make an equilibrium condition [39]. The equilibrium condition at *Solah Kembang Turi* is the type of indifferent equilibrium since there is no external force to move it in either way [35,40]. The dancers' bodies and feet consist of a force-acting system that can be separated from the component of the x-axis.

$$F_A - F_B \cos\theta = 0 \tag{3}$$

And also, of the y-axis.

$$N + F \sin\theta - w = 0 \tag{4}$$

The sum of force acting in each axis component should be zero, so the dancers can keep a stable and balancing condition. It means that the first condition of equilibrium is reached in this position because the force acting on the x-axis and y-axis is equal to zero ($\sum F_x = 0$ and $\sum F_y = 0$).

Kejer

The center of mass is also one of the physics concepts of equilibrium. The variety motion of *Kejer* contains a center of mass when the dancers raise her right leg only. This position is also explained in the informants' statement below.

"The dancer should have to raise the right leg perpendicularly between her thigh and calf. The dancers usually flex their toes while they raise to be balanced. The left leg supports the whole body, so it feels tension around the thigh until the calf. It does not wobble easily; the dancer should be well prepared before raising her right leg." (AIR, 27 December 2021).

The two informants' information below supported the explanation of this position.

"The dancer should be able to balance her body supported by her left leg, and the right leg was raised with a 90° on the knee. The *Nyelekenting* position on the toes, known as flexing up the toes, is to make a stable condition while the dancers raise her right leg. The right leg is tilted at the right side, and the right hand is closest to the knee while *Ndoding*. The guideline of the woman's traditional dance is when the dancer opens her hand in *Ndoding* position should be 45^0 from the body." (FCA, 12 January 2022).

"… Yes, the right leg is raised and makes a 90^0 shape between the thigh and the calf, so the support system is the left leg, especially around the thigh until the calf. Because of the support by the left leg, the dancer does not fall easily. Her right hand seems to be pointing slightly down towards the knee. To be balanced, the dancers should make a good starting point, so during 1x8 second, the dancer can keep her stability." (ARA, 12 January 2022).

The statement covered that while the dancer raised her right leg, the left leg supported her whole body. In physics, the left leg has a center of mass for the entire body. Since the center of mass points to the whole body at the left leg, the center of mass axis is located along the left side of the body; this position also has a normal force and weight. The illustration of the center of mass in this position is shown in Figure 5.

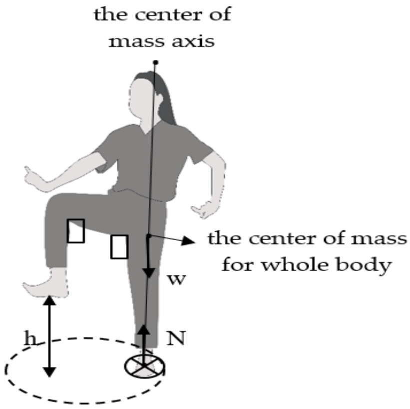

Figure 5. The illustration of the center of mass while the dancer raised her right leg

Figure 5 illustrates the position to reach a postural balance for the dancers. Postural balance is defined as the body's ability to maintain the center of mass based on the body's support limits [41]. When the dancers raise their right leg, the left leg is supported by the dancers' bodies, and the axis keeps stable as a center of mass. The center of mass for the whole body is the closest to the center of gravity as a dancer's body weight. To maintain this position, the soles of the feet have a normal force that has an opposite direction from the dancers' body weight. The normal force in this condition can be known as a center of pressure in biomechanics. The center of pressure is the focus of body pressure when at the stopping position or motion, always in the center of the mass area, so the body is stable [42]. Figure 5 also illustrates that the distance between the body's center of mass and the pedestal should be increased [40]. It shows when the dancers make a 90° on the knee and between the right and left thighs. Thus, the dancers do not wobble easily to the increased supported area in this static position.

Kencrongan

Kencrongan is another variety motion at *Tari Banjarkemuning*. In this motion, the sound of the *Gongseng* property is repeated, which shows the power of fishermen's wives [43]. *Kencrongan* describes the togetherness personality of the native people at Banjarkemuning village [37]. *Kencrongan* contains a center of the mass concept. It shows when the dancer is in the middle type of *Tanjak* position [44]. This position can be explained with the participants' statements obtained through a semi-structured interview below.

"The first step of this motion is the dancers opening both legs to the side like the *Tanjak* position for men at *Remoan*. The soles of the feet are also facing to the side. The right leg should be used for *Gejrug* because the *Gongseng* property is only used on the right leg. The second step is the hand's motion, the right hand is straight at the shoulder level, and the left hand is on the waist, then making this motion repeatedly. When making a *Gejrug* motion, the palm is rotated simultaneously while shaking the head to the left and right." (ARA, 12 January 2022).

The other participants' statements below supported the explanation of this motion. "This motion of *Tanjak* seems like for a man. Both legs are opened to the side, followed by the soles of the feet. The opened legs are conditional or not only 90° because each dancer has a different capability. Then, the dancer makes a rotational motion with her palm hands, and it starts with the right hand, which opens until at shoulder level, followed by rotating her head, called *Keter*, which should be done alternately. *Keter,* at the woman traditional dance of East Java, makes a 45-degree head rotational motion." (FCA, 12 January 2022).

"Both feet are opened to the side, and do not forget to make a sole of feet facing to the side, not forward. The angle of opening both feet depends on the dancer's ability, but usually, it is not perpendicular to the knee. At least it rises slightly. Because the right leg makes a *Gejrug* motion, the weight is most felt on the left leg. Then, one hand is opened to the side at shoulder level, and the other is on the waist. The hand that was opened earlier makes a rotating motion by the palm of hands, and the head should make a shaking motion based on the beat of the music." (AIR, 27 December 2021).

The informant's statement means that when the dancers are doing a *Tanjak* position, it contains a physics concept of center of mass. Figure 6 below illustrates the center of mass of *Tanjak*.

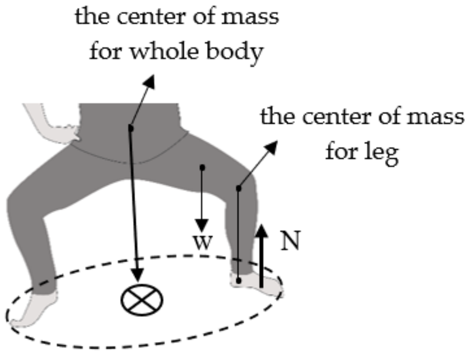

Figure 6. The illustration center of mass in the middle type of the *Tanjak* position

The central of mass is represented by the motion of an object at a certain position that reached the equilibrium condition [45]. Figure 6 shows that the *Tanjak* position is similar to the position of *Kuda-Kuda* at *Pencak Silat*. This position is known as the middle type of *Tanjak* in the traditional dance, adapted from the iconic conventional dance of East Java called *Remo*. The central class of *Tanjak* was a position in which the dancers opened their legs to the side, forming around 90°-120° by the knees. Then the body should be straight, so the center of mass of the body is focused on the middle [44]. The knees form the opened legs around 90°-120° to make a more stable condition. In addition, to make a more stable condition the soles of the feet should face the side. The balance is proportional to the body's support area, facing the soles of the feet to the side, causing the support area of the dancer's body to be larger than the soles of the feet facing forward [40]. In this position, the right leg usually makes a *Gejrug* motion to sound a *Gongseng* property then the left leg is silent. The *Gejrug* movement is one of the dancers' strategies to distribute their whole-body weight evenly, so it is not focused on the left thigh.

According to this research, traditional dance is related to scientific knowledge that is limited to four positions in *Tari Banjarkemuning*. *Tari Banjarkemuning* contains concepts of the physics of equilibrium. The equilibrium concepts not only focus on rigid objects that have an abstract idea and are focused on teacher-centered learning but also apply to the local culture so that the students can understand a physics concept more effectively and efficiently. Exploring traditional knowledge in learning is an effort to introduce the uniqueness of local expertise to students [46]. Local culture is a valuable knowledge source for students that can be used to build a better civic character [47–49]. Thus, bridging physics knowledge with student experience helps them to study in a more meaningful learning. The result of this research is suggested to create a teaching material by integrating local indigenous of *Tari Banjarkemuning* for further research.

CONCLUSION

The research results explain the concept of equilibrium in *Tari Banjarkemuning*. The results can be used as a reference to apply an ethnoscience approach based on *Tari Banjarkemuning* through the process of physics learning, especially in the equilibrium chapter of the eleventh grade. It also can be used to develop a physics teaching material based on the local culture of *Tari Banjarkemuning*. The limitation of this research is focused on the part of motion at *Tari Banjarkemuning* that contains a physics concept of equilibrium. Exploring the other physics concepts at *Tari Banjarkemuning* is suggested for further research.

AUTHOR CONTRIBUTIONS

Achmad Maulana Satria Putra as a writer, conseptualization, and researcher; Rif'ati Dina Handayani as a main supervisor; Trapsilo Prihandono as a formal analysis editor of physics concepts; Rayendra Wahyu Bachtiar as a final reviewer. All authors have agreed to the published version of the article manuscript.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

[1] Suhendi HY, Ramdhani MA, and Irwansyah FS. Verification Concept of Assessment for Physics Education Student Learning Outcome. *International Journal of Engineering and Technology*. 2018; **7**(3.21): 321-325. DOI: http://dx.doi.org/10.14419/ijet.v7i3.21.17181.

[2] Park M. Seeing the Forest Through the Trees Using Network Analysis: Exploring Student Responses to Conceptual Physics Questions. *Journal of Science Education and Technology*. 2020; **29**: 605-621. DOI: https://doi.org/10.1007/s10956-020-09840-w.

[3] Yeo J, Lim E, Tan KCD, and Ong YS. The Efficacy of an Image-to-Writing Approach to Learning Abstract Scientific Concepts: Temperature and Heat. *International Journal of Science and Mathematics Education*. 2021; **19**: 21-44. DOI: https://doi.org/10.1007/s10763-019-10026-z.

[4] Santhalia PW and Yuliati L. An Exploration of Scientific Literacy on Physics Subjects within Phenomenon- based Experiential Learning. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA)*. 2021; **11**(1): 71-82. DOI: https://doi.org/10.26740/jpfa.v11n1.p72-82.

[5] Wulansari NI and Admoko S. Identification of Physics Concepts in Reog Ponorogo's Dhadak Merak Dance as A Source of Learning Physics: An Analytical Study. *Berkala Ilmiah Pendidikan Fisika*. 2021. **9**(1): 105-113. DOI: http://dx.doi.org/10.20527/bipf.v9i1.9862.

[6] Husin VER and Billik AH. Identifikasi Konsep Fisika pada Kearifan Lokal Anyaman di Kabupaten Timor Tengah Selatan. *Jurnal Fisika: Fisika Sains dan Aplikasinya*. 2019; **4**(2): 153-158. DOI: https://doi.org/10/35508/fisa.v4i2.1828.

[7] Fasasi RA. Effects of Ethnoscience Instruction, School Location, and Parental Educational Status on the Learners' Attitude Towards Science. *International Journal of Science Education*. 2017; **39**(5): 548-564. DOI: https://doi.org/10.1080/09500693.2017.1296599.

[8] Sudarmin, Febu R, Nuswowati M, and Sumarni W. 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**: 012024.

DOI: https://doi.org/10.1088/1742-6596/824/1/012024.

[9] Dwikoranto, Jatmiko B, Hariyono E, Lestari NA, Prahani BK, and Suyidno. MobLen Model for Enhancing Scientific Creativity of Physics Students: An Alternative in the Covid-19 Pandemic. *Journal of Physics: Conference Series*. 2021; **1805**: 012006. DOI: https://doi.org/10.1088/1742-6596/1805/1/012006.

[10] Haspen CDT and Syafriani. The Preliminary Study in the Development of e-Physics Module Integrated Ethnoscience. *Journal of Physics: Conference Series*. 2020; **1481**: 012056. DOI: https://doi.org/10.1088/1742-6596/1481/1/012056.

[11] Atmojo SE, Lukitoaji BD, and Muhtarom T. Improving Science Literation and Citizen Literation Through Thematic Learning Based on Ethnoscience. *Journal of Physics: Conference Series*. 2021. **1823**: 012001. DOI: https://doi.org/10.1088/1742-6596/1823/1/012001.

[12] Khoiri A, Nulngafan, Sunarno W, and Sajidan. How is Students' Creative Thinking Skills? An Ethnoscience Learning Implementation. *Jurnal Ilmiah Pendidikan Fisika Al Biruni*. 2019; **8**(2): 153-163. DOI: https://doi.org/10.24042/jipfalbiruni.v0i0.4559.

[13] Rokhman M and Mukhibat. Internalisasi Nilai-Nilai Sosio-Kultural Berbasis Etno-Religi di MAN Yogyakarta III. *Edukasia: Jurnal Penelitian Pendidikan Islam*. 2017; **12**(1): 31-56. Available from: https://library.unismuh.ac.id/uploaded_files/temporary/DigitalCollection/MWNmMjVkMjE4NDQyOWIxNDY3NjZkMzFjZWQ4Y2I2MWFlNjMyNjUxNw==.pdf.

[14] Ardianti SD, Wanabuliandari S, Saptono S, and Alimah S. A Needs Assessment of Edutainment Module with Ethnoscience Approach Oriented to The Love of The Country. *Jurnal Pendidikan IPA Indonesia*. 2019; **8**(2): 153-161. DOI: https://doi.org/10.15294/jpii.v8i2.13285.

[15] Laos LE and Tefu MOFI. Identifikasi Konsep Fisika pada Kearifan Lokal Pengolahan Sagu (Putak) Kabupaten Timor Tengah Selatan. *Jurnal Fisika: Fisika Sains dan Aplikasinya*. 2019; **4**(2): 77-84. DOI: https://doi.org//10.35508/fisa.v4i2.1827.

[16] Novitasari L, Agustina PA, Sukesti R, Nazri MF, and Handhika J. Fisika, Etnosains, dan Kearifan Lokal dalam Pembelajaran Sains. *Proceeding of SNPF (Seminar Nasional Pendidikan Fisika) III*. Madiun: Universitas PGRI Madiun. 2017; 81-88. Available from: http://e-journal.unipma.ac.id/index.php/snpf/article/viewFile/1617/1276.

[17] Kusumah RGT, Andaria M, Misriani A, Purdiyanto, and Samsilayurni. Development of Ethnoscience Module on Pond Ecosystem, in Serawai Tribe, Seluma Regency. *Journal of Physics: Conference Series*. 2022; **2165**: 012029. DOI: https://doi.org/10.1088/1742-6596/2165/1/012029.

[18] Hidaayatullaah HN, Suprapto N, Hariyono E, Prahani BK, and Wulandari D. Research Trends on Ethnoscience based Learning through Bibliometric Analysis: Contributed to Physics Learning. *Journal of Physics: Conference Series*. 2021; **2110**: 012026. DOI: https://doi.org/10.1088/1742-6596/2110/1/012026.

[19] Peters MA and Jandrić P. Dewey's Democracy and Education in the Age of Digital Reason: The Global, Ecological and Digital Turns. *Open Review of Educational Research*. 2017; **4**(1): 205-218. DOI: https://doi.org/10.1080/23265507.2017.1395290.

[20] Schröder, T. A Regional Approach for the Development of TVET Systems in the Light of the 4th Industrial Revolution: The Regional Association of Vocational and Technical Education in Asia. *International Journal of Training Research*. 2019; **17**(S1): 83-95. DOI: https://doi.org/10.1080/14480220.2019.1629728.

[21] Handayani RD, Wilujeng I, Prasetyo ZK, and Triyanto. Building an Indigenous Learning Community through Lesson Study: Challenges of Secondary School Science Teachers. *International Journal of Science Education*. 2018; **41**(3): 281-296. DOI: https://doi.org/10.1080/09500693.2018.1548789.

[22] Pratama DM and Alrianingrum S. Tari Cokronegoro dalam Perspektif Historis Kabupaten Sidoarjo. *AVATARA, e-Journal Pendidikan Sejarah*. 2019; **8**(2): 31106. Available from: https://ejournal.unesa.ac.id/index.php/avatara/article/view/31106.

[23] Anggraeni NP, Wartoyo FX, and Prasetyo Y. *Peran Kebudayaan Tari Banjarkemuning dalam Melestarikan Kearifan Sejarah Lokal di Kabupaten Sidoarjo 1999 – 2018*. Thesis. Unpublished. Sidoarjo: STKIP PGRI Sidoarjo; 2019.

[24] Rahmawati E, Jamalludin, Sholihah L, Safitri ZA, Handayani RD, and Putra PDA. Analysis of Physics Concept of Newton's Law on the Dhadak Merak Dance in the Reog Ponorogo Cultural Arts. *Journal of Physics: Conference Series*. 2021; **1832**: 012038. DOI: https://doi.org/10.1088/1742-6596/1832/1/012038.

[25] Wulansari NI and Atmoko S. Eksplorasi Konsep Fisika pada Tari Dhadak Merak Reog Ponorogo. *FKIP e-Proceeding*. Jember: FKIP Universitas Jember. 2020; **5**(1): 15-21. Available from: https://jurnal.unej.ac.id/index.php/fkip-epro/article/view/21697.

[26] Krippendorf K. *Content Analysis: An Introduction to Its Methodology*. California: Sage Publication; 2004.

[27] Sugiyono. *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta; 2019.

[28] Pramutono RM, Widyastutieningrum SR, and Kuncoro JS. Srimpi Menak Lare Sebuah Tipe Tari Edukasi Anak. *Jurnal Sitakara*. 2019; **4**(1): .313. DOI: http://dx.doi.org/10.31851/sitakara.v4i1.2554.

[29] Finahari N and Rubiono G. Analisis Komparasi Aspek Gerak dan Biomekanika Tari Gandrung Banyuwangi dan Balet Klasik. *Jurnal Panggung*. 2021; **31**(1): 133-148. DOI: http://dx.doi.org/10.26742/panggung.v31i1.1017.

[30] Giancoli DC. *Fisika: Prinsip dan Aplikasinya*. Edisi Ketujuh Jilid 1. Jakarta: Erlangga; 2014.

[31] Knight RD and Knight R. *Physics for Scientist and Engineers: A Strategic Approach with Modern Physics with Mastering Physics*. San Fransisco: Benjamin Cummings; 2004.

[32] Jati BME. *Pengantar Fisika Kedokteran*. Yogyakarta: Gadjah Mada University Press; 2020.

[33] Young HD and Freedman RA. *Fisika Universitas*. Edisi Kesepuluh Jilid 1. Jakarta: Erlangga; 2001.

[34] Giancoli DC. *Fisika*. Edisi Kelima Jilid 1. Jakarta: Erlangga; 2001.

[35] Tipler PA and Mosca G. *Physics for Scientist and Engineers*. 6th Edition. New York: W.H. Freeman and Company; 2008.

[36] Yuliadarwati NM, Agustina M, Rahmanto S, Susanti S, and Septyorini. Gambaran Aktivitas Fisika Berkorelasi dengan Keseimbangan Lansia. *Jurnal Sport Science*. 2020; **10**(2): 107-112. DOI: http://dx.doi.org/10.17977/um057v10i2p107-112.

[37] Nugraha FP. *Simbol Identitas Lokal dalam Tari Banjarkemuning*. Undergraduate Thesis. Unpublished. Surabaya: Sekolah Tinggi Kesenian Wilwatikta; 2019.

[38] Wulandari MN and Kuswarsantyo K. Analisis Struktur dan Bentuk Penyajian Tari Remo Sutinah di Padepokan Gema Buana Kabupaten Bondowoso Jawa Timur. *Pendidikan Seni Tari-S1*. 2018; **7**(2). Available from: https://journal.student.uny.ac.id/index.php/tari/article/viewFile/13593/13125

[39] Marzuki C. *Azas-Azas Mekanika dalam Pendidikan Jasmani dan Olahraga*. Malang: Wineka Media; 2009.

[40] Tipler PA. *Fisika untuk Sains dan Teknik*. Edisi Ketiga Jilid 1. Jakarta: Erlangga; 2015.

[41] Priyanto A, Putra DP, and Rusliyah. Pengaruh Balance Exercise Terhadap Keseimbangan Postural pada Lansia (Studi di Wilayah Kerja Puskesmas Burneh). *NURSING UPDATE: Jurnal Ilmiah Ilmu Keperawatan*. 2019; **11**(1): 19-27. Available from: https://stikes-nhm.e-journal.id/NU/article/download/164/135.

[42] Dewanti NKAS, Saraswati PAS, and Adiputra LMISH. Studi Literatur Hubungan Kualitas Tidur Terhadap Stabilitas Postural Gaya Berjalan pada Lansia. *Indonesian Journal of Physiotherapy Research and Education*. 2021; **2**(1): 5-12. Available from: https://journal.aptifi.org/index.php/ijopre/article/view/9/10.

[43] Himawan AT. *Identitas Lokal Sidoarjo dalam Koreografi Banjarkemuning Karya Agustinus Heri Sugianto*. Thesis. Surakarta: Fakultas Seni Pertunjukan Institut Seni Indonesia Surakarta; 2021. Available from: http://repository.isi-ska.ac.id/5610/1/SKRIPSI%20ARUM%20TRIANINGSIH%20upload.pdf

[44] Mariati P. Proses Kreatif Ali Markasa dalam Penciptaan Tari Remo Jombangan. *Seminar Nasional Seni dan Desain: Positioning Seni dan Desain Indonesia dengan Visi Global (Konsep, Strategi dan Implementasi)*. Fakultas Bahasa dan Seni, Universitas Negeri Surabaya. 2016; 1-7. Available from: http://repository.unusa.ac.id/2764/1/Proses%20Kreatif%20Ali%20Markasa%20dalam%20Penciptaan%20Tari%20Remo%20Jombangan.pdf.

[45] Nikmah F, Yulianto A, and Wahyuni S. Bahan Ajar Kesetimbangan dan Dinamika Rotasi dengan Pendekatan Filosofis. *Eksakta: Jurnal Penelitian dan Pembelajaran MIPA*. 2020; **5**(2): 122-132. DOI: http://dx.doi.org/10.31604/eksakta.v5i2.122-132.

[46] Handayani RD, Wilujeng I, and Prasetyo ZK. Elaborating Indigenous Science in the Science Curriculum. *International Journal of Learner Diversity and Identities*. 2018; **19**(2): 21-34. DOI: https://doi.org/10.18848/2327-0128/CGP/v25i02/21-34.

[47] Martiniano C. The Scientization of Creativity. *Journal of the Midwest Modern Language Association*. 2016; **49**(2): 161-190. Available from: http://www.jstor.org/stable/44164809.

[48] Prihandoko Y, Slamet YS, and Winarno. Cognitive Moral Approach to Civics Education Material Development in The Elementary School. *Jurnal Kependidikan*. 2017; **1**(2): 200-213. Available from: https://journal.uny.ac.id/index.php/jk/article/view/15279.

[49] Sari SCW, Murdiono M, Fenditasari K, and Rukmana IS. Indigenous *Srimpi Pandelori* as Android-Based Civic E-Learning Media Toward Students' Creative Thinking Skills Engangement. *Jurnal Pendidikan Indonesia*. 2019; **8**(2): 276-284. DOI: https://doi.org/10.23887/jpi-undiksha.v8i2.22925.