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Analysis of The Human Musculoskeletal System Concept in Goyang Karawang Dance as a Learning Resource

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Abstract: This study investigates the integration of the traditional Goyang Karawang dance (GoKar) into biology education, particularly in teaching the human musculoskeletal system. Using a qualitative case study approach informed by ethnobiological and ethnopedagogical frameworks, data were collected through performance observations, interviews with dance artists and high school biology teachers, and document analysis. The analysis focused on the biomechanics and socio-cognitive meanings of core GoKar movements. Findings reveal that the dance involves coordinated actions of key muscle groups and joints, such as agonist-antagonist pairs and postural control centered in the hip and shoulder areas. Simultaneously, each movement expresses cultural values of grace, confidence, and balance, reflecting Sundanese philosophies of harmony. These embodied elements connect scientific anatomical knowledge with students' lived cultural experiences. The research contributes to culturally responsive pedagogy by offering an experiential learning model that supports conceptual understanding while reinforcing local wisdom as a valid epistemic resource. This integration aligns with the goals of Indonesia's Merdeka Curriculum and the Profile of Pancasila Students, promoting critical thinking, autonomy, and appreciation of cultural diversity. Overall, the study offers a transdisciplinary approach to science education that is inclusive, contextual, and pedagogically meaningful.

Keywords: Biomechanics; Ethnopedagogy; Experiential learning; Goyang Karawang; Musculoskeletal system

Introduction

Science educations in Indonesia on nowadays is facing the greatest obstacles in bridging learning materials with the local realities of students (Suprapto et al., 2021). Although global discourse encourages a more contextual and relevant approach, the national curriculum still tends to separate science from local cultural and social values (Sihombing et al., 2025). An overly universal approach often ignores the diversity of local knowledge that is rich in scientific potential. As a result, learning becomes unrealistic and fails to build meaningful student engagement. This condition necessitates learning strategies that can integrate science with local wisdom in a scientific and pedagogical manner (Hidayat et al., 2024a). The application of learning that highlights local wisdom can have an impact on improving conceptual knowledge (Lubis et al., 2022).

The Merdeka Curriculum was introduced in response to the need to ground science education in the local context, emphasizing reinforcement of charachters, scientific literacy, and Development of Profile of Pancasila Students (Hasanah et al., 2024). Among the six dimensions of character, the three most relevant to culture-based learning are global diversity,

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critical thinking, and independence (Riyadi & Sukmayadi, 2023). However, the limited number of best practices in the integration of culture and science means that this transformation is normative in nature and not yet systematic in academic and pedagogical terms.

In the field of biology, the human musculoskeletal system is a fundamental topic that covers concepts such as the types and functions of muscles, the structure of bones and joints, the mechanism of muscle contraction, and neuromuscular coordination (Chytas et al., 2024). However, the abstract and physiological nature of the material often poses a challenge in achieving conceptual understanding among students, especially when it is presented without any connection to real activities that are familiar in daily life (Santoso et al., 2023; Sulastri & Pertiwi, 2020). Text- or diagram-focused learning, while important, is insufficient to bridge students' embodied experiences with the scientific concepts they are learning (Zhong et al., 2023). This is why it is important to adopt a contextual approach that can activate students' sensor motor, social, and cultural experiences in the learning process (Kami et al., 2023; Purnamalon et al., 2022).

One form of cultural expression that offers complexity in body movement is traditional dance (Nofianto et al., 2020; Warni et al., 2022). Traditional dance can be an effort to develop local culture-based learning that is tailored to learning characteristics and needs (Sari et al., 2023). Dance movements naturally involve the human body's movement system: muscles, joints, bones, and even the central nervous system (Gao et al., 2024). Research that conducted by Gorwa et al. (2020) has confirmed that dance movements reflect the dynamics of muscle contraction, joint rotation, and body weight distribution and balance. However, despite this great potential, only a few studies have explored traditional dance as a vehicle for learning about the human movement system in secondary school biology curricula. Goyang Karawang dance, a traditional performing art from West Java, represents a form of movement that is rich in biomechanics and culturally meaningful. Movements such as geol, gitek, and goyang not only demonstrate aesthetic beauty but also involve ball-and-socket joints in the shoulders, hinge joints in the elbows and knees, and major muscles such as the triceps, biceps, quadriceps, and hamstrings (Hayati et al., 2021). These movements also demonstrate complex pelvic rotation and the use of the body's center of gravity to maintain postural balance. Within this framework, the Goyang Karawang dance can be interpreted not only as a cultural symbol but also as a biological text that allows for scientific analysis from the perspective of the human movement system.

This integration of culture and science marks a new field of study called educational ethnobiology, which explores how cultural knowledge (such as dance, food, traditional medicine) can be studied and taught within a modern scientific framework (Robles-Piñeros et al., 2020; Sukmawati et al., 2024). his approach has strong epistemological roots in funds of knowledge theory, as well as ethnopedagogy, which emphasizes cultural values in education as part of identity formation, local emancipation, and meaningful learning.

Unfortunately, most of these integrative approaches are still descriptive or normative in nature. There have not been many studies that have conducted in-depth biomechanical analysis of traditional dance movements as a form of enrichment in biology learning. On the other hand, cultural research often does not link bodily movement practices with scientific concepts. As a result, there is an epistemological gap between science and culture in educational practice. This study aims to bridge this gap through a cross-disciplinary approach: ethnopedagogy, biomechanics, and locally-based science education.

Therefore, this study offers something new by making traditional dance the object of biomechanical study for learning about the human movement system in biology. Unlike previous studies, which were only descriptive or cultural in nature, this approach directly links cultural practices with scientific analysis. This is important given the lack of learning models that activate bodily experiences while maintaining the local context of students. Goyang Karawang dance was chosen because it contains complex movement structures, is culturally accessible, and has not been widely explored scientifically. Thus, this research not only fills a knowledge gap but also contributes to the development of culturally based contextual pedagogy.

The main objective of this study is to identify and analyze the main movements in Karawang Goyang Dance biomechanically, map the relationship between these movements and the human movement system based on anatomy and physiology, and design a dance movement integration model as a source of contextual-based high school biology learning. This study is expected to form the basis for the development of more applicable teaching tools, encourage innovation in culture-based biology learning, and open up opportunities for further research in the field of locally-oriented science education.

Method

This study uses a qualitative approach with a case study design based on the conceptual framework of ethnopedagogy and educational ethnobiology. Data

were collected through participatory observation of the Goyang Karawang dance performance by local artists, in-depth interviews with three dance artists and three high school biology teachers, and documentary studies of dance scripts, visual recordings, and cultural and physiological literature. The data were analyzed through thematic coding to extract cultural meanings and movement symbolism, which were then linked to a biomechanical analysis of the body (muscle types, joints, and direction of movement) based on physiological studies. Validation was carried out through triangulation of techniques and sources, as well as consultation with experts from various fields (biomechanics experts, Sundanese dance lecturers, and biology educators) to ensure interdisciplinary accuracy and relevance to the context of local culture-based biology learning.

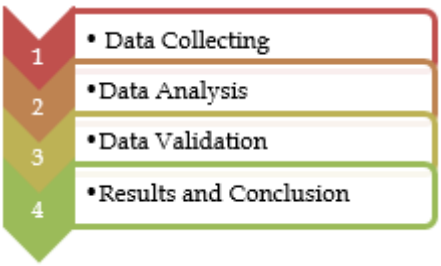

Figure 1. Steps of the research

Result and Discussion

Descripstionf of Finding of Goyang Karawang Dances

The Karawang Dance (GoKar) is a form of traditional art that developed in Karawang Regency, West Java. This dance combines elements of aesthetic movement, social expression, and energetic body dynamics, making it a strong cultural identity within the community. GoKar is commonly performed in various traditional events and contemporary performances as a symbol of hospitality and collective spirit. The uniqueness of its movements lies in the combination of dynamic rhythms and harmonious body postures, making it attractive both visually and as an object of scientific study. In the context of education, this dance shows great potential as a contextual medium for culture-based science learning.

Based on field observations, interviews with local artists, and literature studies, GoKar consists of 18 core movement sequences. Movements such as calik tepak bahu, gitek uget ngepal, gedut, geol karawangan, and goyang nyawang form a complete choreography. Among all these patterns, three types of movements are the main markers, known as 3G: Geol, Gitek, and Goyang. All three focus on hip dynamics and reflect the demands of flexibility, rhythm, and coordination of the lower body muscles simultaneously. This structure is not only culturally important but also interesting to analyze from the perspective of the human movement system (Ahmad & Attas, 2022).

On these findings, it shows the result of the data of comparison as following:

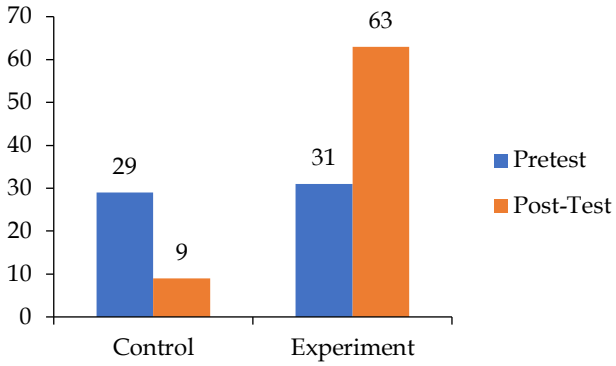

Figure 2. Attached figure in article

Based on the graphic above, it shows the average score on control of the pretest is 29 and the post test of control is 9. Meanwhile, on experiment of pretest is 31 and posttest is increasing to 63. It means GoKar does not only focus on pelvic movements but also integrates the harmonious work of other body parts, such as the arms, hands, and legs. The combination of facial expressions, hand gestures, and footwork forms a comprehensive choreographic pattern that reflects local social values. For example, the open-handed movement in GoKar is often interpreted as a symbol of openness and acceptance towards guests, while the fast-paced footwork reflects the spirit and agility of the Karawang community. Each movement has a dual function: as an aesthetic element and as a socially meaningful marker.

In practice, this dance is transmitted from generation to generation through informal training in studios and community performances. Although not always documented in writing, its structure and movement patterns are collectively preserved by the local artist community. This makes GoKar not only a cultural expression, but also a form of embodied knowledge, knowledge that is attached to the bodies and direct experiences of its performers (Muliadi et al., 2024). This kind of transmission confirms that GoKar contains an implicit pedagogical dimension that can be utilized in the context of formal education, especially through an ethnopedagogical approach.

With its complex yet rhythmic movements that can be accessed visually, GoKar is an ideal medium for bridging abstract concepts in science, especially the human movement system. When dance movements are used as an entry point in biology learning, students not only observe the workings of muscles and joints, but

also connect them to cultural narratives that they are already familiar by Anzelina (2023), Jacinda et al. (2023), and Sholehah & Prahastiwi (2025). Research shows that a local culture-based approach can improve scientific literacy and strengthen students' emotional attachment to the material being studied (Febrian et al., 2024). Therefore, GoKar deserves to be positioned as a learning resource that is not only contextual but also transdisciplinary and applicable.

Analysis of Biomechanicators Towards the Movement

This pattern demonstrates a cycle of muscle work and relaxation that resembles the principle of interval training in exercise physiology. Such movements contribute to core strengthening and local muscle endurance. From a biology education perspective, students can learn about muscle dynamics concretely through movement simulations or demonstrations.

In the upper limbs, movements such as shoulder shrugging and clapping demonstrate the coordinated work of the shoulder (glenohumeral joint) and elbow (hinge joint) joints. The activation of the deltoid, biceps brachii, and triceps brachii muscles forms a pattern of simultaneous contraction that supports the flexibility of the arms in various directions. Elbow movements during flexion and extension demonstrate the principle of antagonistic work in the human muscular system, which can be observed directly through visual demonstrations. The wrist is also involved in subtle movements and hand gestures, demonstrating the role of fine motor skills in maintaining precision of movement. This provides students with the opportunity to connect the concepts of joints, muscles, and motor control in an applicable learning sequence.

Body coordination in GoKar is multisegmental, requiring high neuromuscular control to maintain balance and rhythm. The movements of tandang gedut and gitek uget ngepal demonstrate the simultaneous integration of the upper and lower body, working in dynamic speed and direction of movement. This demonstrates the involvement of the proprioceptive and vestibular systems in maintaining spatial orientation and center of gravity. From the perspective of nervous system physiology, this reflects the activation of feedforward and feedback mechanisms that are important for postural stability (Giguere, 2024). This process is in line with the concept of motion homeostasis that can be explored in science learning.

Variations in intensity and rhythm in GoKart also allow for the exploration of muscle types based on contraction speed. Repetitive movements with long durations train slow-twitch muscles, while explosive movements such as gitek stimulate fast-twitch muscles. Students can be introduced to the functional classification of skeletal muscles through direct observation of movement. In addition, observing movement transitions—for example, from geol to gitek—can be used to understand the concepts of muscle energy and biomechanical efficiency. This approach opens up opportunities for integrating motor observation with a direct and contextual understanding of human physiology concepts.

Cognitive-Social Interpretation of Movement (Ethnopedagogy)

Traditional dance is not merely a series of repetitive movements, but rather a cultural construct rich in symbolic meaning and social value. In the context of the Goyang Karawang (GoKar) dance, each body gesture not only serves an aesthetic function, but also conveys a collective message that has been passed down from generation to generation. The dancer's body acts as a medium of social representation, where physical expression becomes a means of conveying the norms, ethics, and philosophy of the community. This perspective opens up space to interpret dance as a form of cultural literacy that lives in the practice of movement. This approach is important to enrich students' understanding of the role of the body as a social text.

The meaning of the movements in GoKar arises from the interaction between the dancers' bodies, social space, and collective memory. For example, the gitek uget ngepal movement is often interpreted as a symbol of courage and assertiveness, reflecting the value of productive masculinity in Sundanese culture. Meanwhile, the soft and flowing movements at the beginning of the dance reflect the values of gentleness, friendliness, and politeness as highly respected social ethics. This symbolic dimension is not static, but rather the result of interpretations that evolve according to the social context and the generation of dancers. This allows the dimension of dance to become a flexible and reflective space for social learning.

The body in dance can also be understood as an epistemic space, that is, a place where the process of knowledge takes place. In this case, embodied knowledge, or knowledge embedded in bodily experience, becomes a bridge between the physical and cognitive worlds. Through physical involvement in movement, individuals not only understand the world passively, but also actively shape meaning through sensations, emotions, and interactions. This is in line with cognitive theory that links movement to thought processes, where the body becomes the main instrument in the formation of mental structures and conceptual categories. Thus, in the context of learning, dance is not only an art of expression, but also a vehicle for the development of social cognition.

The cognitive-social interpretation of movement also arises through intersubjective mechanisms between dancers and audience members, or between fellow dancers. When movement is performed in a group format, such as in GoKar, there is a collective alignment of rhythm, intention, and tempo that demands precise social responses. This process trains individuals to recognize and adapt to the affect and actions of others, strengthening social-emotional competence. In a learning environment, this is particularly relevant for developing empathy, cooperation, and social connectedness, which are critical for student development. This type of learning bridges the affective and cognitive domains in the same physical space.

From a pedagogical perspective, movement experiences rooted in local culture have the advantage of creating high affective engagement (Ananda & Anjani, 2024; Muspawi, 2020). Students find it easier to form emotional connections and meaning with material when it comes from cultural practices they recognize. Traditional dance, in this case, becomes a means of designing contextualized learning that integrates students' identities with the subject matter. Movement is no longer seen as an external object to be analyzed, but as an experience in the body that can be interpreted scientifically. This approach also allows for epistemic transposition, namely the transformation of cultural knowledge into scientific knowledge.

Within the ethnopedagogical framework, the experience of movement in traditional dance can be used as a tool to develop scientific literacy without separating it from the students' social context (Andini & Sirozi, 2024). When students analyze the structure of geol or goyang movements, they not only understand how muscles and joints work, but also realize the social meaning contained in these movements. This creates a holistic learning experience, where cognitive, social, and affective aspects are interconnected. This process can reinforce scientific concepts because they are directly linked to the social and cultural reality of students. Thus, the meaning of movement becomes an important element in building transdisciplinary learning.

In addition, the rhythm and repetition of movements in GoKar can also be studied from a neuroscience perspective, particularly in the context of action understanding. Research shows that traditional rhythmic movements activate areas of the brain associated with imitation, affection, and empathy. This activation not only improves social understanding, but also helps internalize concepts through intense motor experiences. In educational practice, this condition creates opportunities for the integration of physical and conceptual learning, expanding the ways in which students understand material through nonverbal channels. Thus, the body not only stores memory, but also shapes the learning process itself.

The process of internalizing meaning through movement is also reflective, in which students not only imitate, but also reinterpret movements according to their experiences. This opens up space for personalization of meaning and strengthening of identity, something that is rarely found in abstract and universal approaches to science learning. Traditional dance, through its forms of movement that are open to interpretation, offers pedagogical flexibility to adapt learning to the social background of students (Agustini, 2020; Zainuddin & Habibi, 2025). Thus, movement becomes a channel for designing learning that is fair, inclusive, and based on real experiences.

Meaning in movement involves not only symbolic aspects but also shows how the body "thinks" through space and time. When students move to the rhythm of GoKar, they indirectly develop spatial awareness, time control, and cognitive coordination. This activity simultaneously develops spatial intelligence and bodily-kinesthetic intelligence, which are crucial in children's cognitive development. This process reinforces the argument that traditional dance is not only relevant in arts or cultural learning but also in the development of complex scientific and cognitive skills. Thus, the meaning of movement covers a broad spectrum from the symbolic to the neurological.

Finally, the movement experience in Karawang Dance represents an epistemological mediation between the body, culture, and science. The body becomes a bridge between local values and scientific concepts; culture becomes the context in which science is grounded; and movement becomes the language that unites the two in a form that can be experienced directly. The cognitive-social meaning of this movement not only supports learning, but also enriches the meaning of education itself. With this kind of integration, learning biology is not only a means of mastering concepts, but also a vehicle for strengthening identity, respecting culture, and expanding understanding of the meaning of the human body in its most complete context.

Integration of Movements in Biology Learning

The integration of Karawang Goyang dance movements into biology lessons not only combines art and science, but also serves as a strategic approach to contextualize abstract biological concepts. In the subject of the human musculoskeletal system, these dance movements, which are rich in biomechanical elements, allow students to observe and experience firsthand the workings of muscles, joints, and overall body coordination. This process involves more than just

visualization; it transforms body movements into a medium for scientific learning. Thus, learning becomes not only cognitive, but also sensory, affective, and reflective (Ni'amah & M, 2021).

This approach finds a strong foothold in embodied learning theory, where the body is not only a tool for learning, but also the place where the learning process itself occurs. When students move their bodies following GoKar patterns, they directly activate memory, spatial perception, and motor nervous systems relevant to the concepts being studied. Knowledge is no longer passively transferred but actively constructed through experience. In this practice, the body becomes a bridge between the physical world and scientific conceptual representations.

The learning model that supports this approach is experiential learning (Kolb), which emphasizes the importance of the cycle of concrete experience, reflection, abstraction, and active experimentation (Riyadi et al., 2024). In biology class, teachers can begin with a video or live GoKar performance as a concrete experience, then direct students to analyze the movements in the context of the musculoskeletal system. Reflection is done individually and in groups, and students are asked to connect their observations with concepts such as muscle contraction, types of joints, and biomechanics. This activity provides a dynamic and transformative learning space.

Such learning is also very much in line with culturally responsive pedagogy (CRP), where students' culture is not only considered as background, but also as a learning resource by highlighting GoKar, a dance that is alive in their own environment, learning becomes more relevant, grounded, and meaningful. Students feel valued because their cultural identities are recognized as part of the scientific knowledge system. This significantly increases their confidence, active participation, and motivation to learn.

In practical implementation, learning begins with watching videos or GoKar performances, followed by identifying the body parts that are active in each movement. Students are then asked to map the muscles and joints involved, determine the direction of movement (flexion, extension, abduction, etc.), and explain the biomechanical principles behind it. Teachers can divide students into groups to discuss the relationship between movement and bodily function and insert the socio-cultural meaning contained in each movement pattern. This activity ends with group presentations and individual reflections that combine scientific concepts with cultural narratives.

To support this process, learning media that can be used include: dance anatomy infographics, motion annotation videos, muscle and joint mapping worksheets, and theme-based modules on "Body and Culture." This media allows for more systematic visualization and exploration of movement. Furthermore, the use of reflective worksheets encourages students to reflect on their own bodily experiences while dancing. This is where the integration of empirical bodily data, scientific knowledge, and social meaning takes place.

The integration of this approach is also relevant to the principles of the Merdeka Curriculum, which encourages contextual, locally-based, and flexible learning according to student needs. This curriculum emphasizes learner-centered learning, providing space for teachers to adapt the material to the students' socio-cultural environment (Praditha et al., 2024). The GoKar movement as local content has great potential to revive the classroom as a cultural space. The learning process is no longer one-way but dialogical, dynamic, and relevant to the students' reality.

The main objective of the Merdeka Curriculum is to develop students who are independent in their thinking and actions, while taking into account their identities and social backgrounds. In this approach, students not only understand their bodies biologically, but also as part of a cultural heritage that contains social and historical values. This gives new meaning to the subject of the human movement system, which has been taught mechanistically. Students' emotional involvement with the movements they are familiar with strengthens the internalization of scientific concepts. This is learning that humanizes science (Hidayat et al., 2024b).

On the other hand, this approach also reinforces the dimensions of the Pancasila Student Profile, such as critical thinking, independence, and global diversity. Students are encouraged to analyze movement patterns scientifically (critically), reflect on their own bodily experiences (independently), and appreciate and understand the meaning of local culture in a broader context (global diversity). Collaboration in analyzing movements encourages teamwork skills, while discussing symbolic meanings trains communication and social empathy skills. These values are not instilled through lectures, but grow from the practices carried out by the students themselves.

In terms of learning differentiation, this strategy is also friendly to the diversity of student learning styles. Kinesthetic learners will be more active when moving, visual learners will be assisted by graphic media, and reflective learners will have space to write down their bodily experiences. This makes the learning process more inclusive, providing space for all types of intelligence. Concepts that are usually only conveyed through text can now be experienced multisensorily.

This is the actual form of the principle of learning equity upheld by the Merdeka Curriculum.

Empirically, the integration of dance movements in science learning has also proven effective in improving retention and understanding. International studies show that combining physical activity and cultural symbols strengthens long-term memory connections and the transfer of concepts into real life. In the context of Indonesian students, this approach bridges the gap between their concrete world and abstract science. Science is no longer foreign, but lives in their own bodies, culture, and language. This is an effort to decolonize knowledge in the world of education.

This approach provides space for students to construct personal narratives about the body and scientific knowledge. They are no longer passive subjects in the education system, but active participants who connect their life experiences with the scientific concepts being taught. In this context, science is not only studied, but reconstructed through a cultural lens. This is the essence of contextual learning that touches on the cognitive, affective, and social domains simultaneously. It also provides opportunities for classroom action research and the development of local learning models.

Institutionally, this strategy also supports the strengthening of national cultural identity amid the challenges of globalization. When science can be taught through cultural practices, students become not only future scientists but also guardians of local values. GoKar is not just a dance, but also an epistemic source that can be processed to build down-to-earth science. This integration is a representation of transdisciplinarity in 21st-century education. Body, culture, and science come together in a holistic and relevant learning ecosystem.

Finally, this integration provides a model of good practice for science education in various regions in Indonesia. Each region has unique dances and bodily expressions, which have the potential to be used as learning resources for movement systems, ecosystems, and even respiratory systems. This strengthens the position of local culture in the national curriculum system. If processed appropriately, this strategy not only enriches science learning but also strengthens students' identities and their connection to science. This is a form of education that is reflective, relevant, and meaningful. Local culture-based learning, such as the Goyang Karawang dance, strengthens students' cultural literacy and identity in the context of science education, as explained by Wazni et al. (2023). At the same time, it opens up a transdisciplinary space between art, cognition, and science (Hikmawati et al., 2024; Nawwal & Setyasto, 2025).

Comparisons of Previous Studies

The results of this study confirm that the Karawang Goyang dance can be reconstructed as a source of learning about the human movement system through an ethnopedagogical approach. These findings are in line with trends in international literature that highlight the importance of cultural integration in science education based on bodily experience. In the field of educational ethnobiology, this approach emphasizes that forms of cultural expression such as dance are epistemic media that enable the transfer of scientific knowledge to local cultures. Lieberman et al. (2020), studied the traditions of running and dancing in the Tarahumara culture in Mexico and stated that body movements in local cultures reflect not only functional dimensions but also ecological and social narratives that can be modeled scientifically.

This study also reinforces the idea that traditional dance can be analyzed using a biomechanical framework to reveal the physiological principles hidden in cultural choreography. Stepputat (2022) shows that the use of biomechanical technologies such as motion capture can be a means of uncovering the knowledge of movement embedded in culture without reducing its meaning to mere biomechanical data. Stepputat (2022) emphasizes the importance of an approach that considers the social, symbolic, and cultural contexts when analyzing the body in dance. In this study, the application of biomechanical analysis to the geol, gitek, and goyang movements in the Goyang Karawang dance reveals the involvement of ball-and-socket joints, agonist-antagonist muscles, and complex neuromuscular coordination, making it suitable as an active learning model for movement system material.

On the other hand, the contextual approach in science education has long been advocated by progressive education theory, especially those that place students' local experiences as the starting point for knowledge construction (Riza et al., 2024). Galili (2021) emphasizes that scientific knowledge should not be separated from the culture in which students live, and that effective scientific representation needs to build connections with students' experiences and social representations. The results of this study confirm these findings through evidence that students who associate local dance movements with their own body structure show an increase in their understanding of the concepts of muscles, joints, and biomechanics.

In addition, criticism of the universalistic approach to science education has led to the emergence of a transdisciplinary approach that involves art and culture as a bridge for science teaching. Druker-Ibáñez & Cáceres-Jensen (2022) in their study emphasize that local knowledge and cultural practices, including movement and bodily expression, are important

resources in education for sustainability. This study not only adopts this view but also demonstrates its implementation in the design of a traditional dance-based science learning model.

Conclusion

The integration of Karawang Goyang dance movements in biology learning has the potential to strengthen students' understanding of the human movement system through a contextual and locally-based cultural approach. Dance movements that are rich in symbolism and biomechanical structure open up space for students to directly experience the workings of muscles, bones, and joints, while also understanding the social and ethnopedagogical values contained within them. This study found that the cognitive-social meanings attached to dance movements can be used as a basis for developing a transdisciplinary biology learning model, connecting scientific concepts with students' bodily and cultural experiences. This approach supports the principles of the Merdeka Curriculum and strengthens the dimensions of the Pancasila Student Profile, particularly in terms of critical thinking, independence, and appreciation of cultural diversity. Therefore, the use of traditional dance movements as a learning resource not only enriches learning methods but also broadens the epistemological scope of inclusive and reflective science education.

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Author Contributions
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Conflicts of Interest
The authors declare no conflict of interest.

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