JPPIPA 8(6) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Exploration of Students' Conceptual Understanding and Ethnophysics: A Case Study of *Tifa* In The Tanimbar Islands, Indonesia

John Rafafy Batlolona[1*], Marleny Leasa[2], Pamella Mercy Papilaya[3], Jamaludin[1], Jony Taihuttu[1]

[1]Physics Education Study Program, Faculty of Teacher Training and Education, Pattimura University, Ambon, Indonesia.
[2]Elementary School Education Study Program, Faculty of Teacher Training and Education, Pattimura University, Ambon, Indonesia.
[3]Biology Education Study Program, Faculty of Teacher Training and Education, Pattimura University, Ambon, Indonesia.

Received: September 16, 2022
Revised: December 17, 2022
Accepted: December 23, 2022
Published: December 31, 2022

Corresponding Author:
John Rafafy Batlolona
johanbatlolona@gmail.com

DOI: 10.29303/jppipa.v8i6.2154

Abstract: Contemporary culture has disturbed the local community's culture, which has been maintained since the time of the ancestors. The Tanimbar culture has been preserved and maintained. *Tifa* Tanimbar is a small musical instrument used for arts and cultural performances of the community. It is one of the heritage and wealth of an area different from other regions. This study shows something different, namely *Tifa*, in learning physics. This study aimed to analyze the conceptual physics of students based on ethnoscience on the *Tifa* concept in the Tanimbar Islands. The research was conducted in 10 elementary schools in the Tanimbar Islands Regency with 300 students with 175 male students and 125 female students. The questions given to test students' conceptual tests were physics diagnostic tests, totaling 6 questions. The study results informed that the average conceptual physics of students related to *Tifa* was 55.42. It indicates that the conceptual physics of elementary school students is still very weak with a good category. Therefore, there is a solution to develop ethnophysics-based teaching materials with orientation to local potentials affiliated with science in improving students' conceptual physics. This research implies that teachers can develop teaching materials that foster students' cognition with surrounding phenomena based on local culture.

Keywords: Concept understanding; Ethnophysics; Social culture of the tanimbar islands

Introduction

Concept understanding can be demonstrated by introducing and creating relationships between concepts (Vachliotis et al., 2021). Concept understanding allows students to transfer and explain a phenomenon to different situations (Kola, 2017). Identifying students' misconceptions is important to improve the quality of students' physics. For example, in Taiwan, physics courses cover optics, mechanics, electricity, magnetism, sound, and heat. In the study, a questionnaire was administered to investigate students' misconceptions. The aim was that the findings could help teachers design appropriate learning strategies and curricula (Chang et al., 2007). Physics is a branch of science that tries to describe how nature works using the language of mathematics (Argaw et al., 2017). Conceptual understanding is also an important goal in learning physics because it is needed to understand natural phenomena (Phanphech et al., 2019). The results showed that students and teachers still had high misconceptions (Sarabando et al., 2014). One of the causes of the low understanding of students' physics concepts is that many teachers still apply traditional learning strategies (Lotter et al., 2007; Sholikhan et al., 2020). In addition, socio-cultural and educational factors influence students' conceptual physics (Lin et al., 2015). A modern learning pattern is needed to activate students' cognitive-motor skills to understand physics concepts in depth (Debs et al., 2019).

Currently, understanding concepts is increasingly emphasized in all learning in schools. Developing a deep conceptual understanding requires effort, time, guidance, and repetition. Therefore, student support is

How to Cite:
Batlolona, J.R., Leasa, M., Papilaya, P.M., Jamaludin, J., & Taihuttu, J. (2022). Exploration of Students' Conceptual Understanding and Ethnophysics: A Case Study of Tifa in The Tanimbar Islands, Indonesia. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2717–2727. https://doi.org/10.29303/jppipa.v8i6.2154

needed to achieve deep conceptual understanding, meaningful learning goals, and knowledge transfer (Farrokhnia et al., 2019). Conceptual understanding can be called the engine that underlies meaningful learning by connecting and constructing new ideas with previous knowledge and experience, seeking underlying principles, and critically evaluating knowledge (Gijlers et al., 2013).

Many learning documentations show that learning physics is difficult for students (Kavanagh et al., 2017). Because mathematical questions are difficult, students feel anxious to answer. In history, mathematics is a very powerful tool of physics. Conversely, the process of solving physics problems requires mathematical concepts. For example, Gelileo used geometric formulas rather than algebraic equations to discuss the concept of accelerated downward motion. In addition, Kepler in the 16th and 17th centuries proposed the equation $T2 = kR3$ and Newton formulated the laws of mechanics (Hofer et al., 2017; Kim et al., 2018).

The results of previous studies show that physics is experiencing a rapid decline. For example, global data from South Africa shows that the science learning outcomes of grade 8 students are ranked below among the 50 countries that participated in the Trends in International Mathematics and Science Study in 2003. In addition, the results of passing exams national level are 61.3% which shows a low result (Stott, 2013). In addition, several other countries show poor performance in learning physics, for example, Ethiopia which shows student enrollment and graduation in physics at universities in developed countries such as the United States, England, Germany, and the Netherlands (Osborne et al., 2003; Shishigu et al., 2018). The same data comes from the U.S., which experienced a large decline in physics from the gender aspect, namely female scientists, decreased (Hazari et al., 2010). Similarly, Indonesian students also experience withdrawals in the field of physics. Students are often colored by misconceptions that block their thinking from reaching the target of deep conceptual understanding (Leasa et al., 2021; Jamaludin et al., 2021; Rusmana et al., 2021) because physics teachers pay less attention to and support students' conceptual understanding (Qhobela et al., 2020). This condition is very different from physics education in Finland which has good quality. Finland's key to learning physics is a quality and highly motivated youth (Rolin et al., 2011; Leinonen et al., 2020).

If a person's concept is weak, it will affect their appearance and creativity (Gobert et al., 2011). Therefore, the important role of culture for students and everyday life in their learning experience is to be well established. Culture can encourage knowledge skills and competencies through a continuous learning process (Lin et al., 2018). Culture also affects students' thinking and learning outcomes. Therefore, teachers must understand and take into account the culture of each individual, namely students, so teachers must study the history of culture and the individual environment of students and patterns, perceptions, and ideologies related to education and learning (Lam et al., 2019).

In this era, learning based on local wisdom is seen as innovative learning with great potential, which explores community activities in an area considered sustainable and original. By applying local wisdom-based learning, students' knowledge and understanding can be improved (Uge et al., 2019) and learning outcomes (Ramdiah et al., 2020). Local wisdom-based learning is also reported to empower students' critical thinking (Santiprasitkul et al., 2013). It also empowers conceptual understanding (Berardi, 2021) and students' creativity (Lee, 2015). In line with these findings, students' problem-solving abilities can also be improved (McLaughlin et al., 2018). It is not surprising that learning based on local wisdom is considered learning suitable to be applied in the 21st century (Klieger, 2016).

Local wisdom-based learning is closely related to ethnophysics, where a cultural community owns knowledge. Local wisdom-based learning reflects the ethnoscience of a particular cultural community. Ethnoscience learning in schools can integrate modern science and traditional science to run the student learning process effectively (Bandyopadhyay, 2001). It is because students are invited to understand their environment scientifically. Therefore, this learning is a didactic phenomenology. Students learn concepts, principles, and scientific materials that depart from various contextual phenomena encountered in their surrounding lives (Graffigna et al., 2011). It will turn the negative stigma against science lessons considered difficult boring. Scary lessons into positive stigmas, namely, the lessons are fun, useful, and exist in the student's environment (Fasasi, 2017). Indonesia is a country with diverse cultures. Therefore, Indonesia will not lack references in ethnoscience learning. This diversity will make students have much knowledge. In addition, ethnoscience learning will make students more familiar with their nation's culture and local wisdom so that it will create a sense of love and pride for their nation. This sense of love and pride is important for the younger generation (students) to maintain the nation's existence, maintain national identity, and preserve the nation's culture. Thus, students can later become cultured individuals and become agents who can transfer culture to the next generation.

All knowledge is a product of human thought. The social context influences the process of knowledge creation in culture. Most African countries have indigenous populations (Baquete et al., 2016). Nevertheless, African countries have always adopted the Western way of thinking. It is due to the lack of embracing local knowledge that has been created so that the results of these ideas are less respected and appreciated. It can be seen that local wisdom as a source of learning is sometimes neglected (Msuya, 2007). Experts say that someone physically close to contextual events in society will encourage increased knowledge (Şahin et al., 2013; Monroe et al., 2019). Learning from the environment will increase student academics by 11%. Both teachers expect an exploration of local wisdom to motivate students to further explore indigenous knowledge from culture and the surrounding environment related to the concept of physics (Govender et al., 2021).

Local knowledge can contribute to formal education (Sotero et al., 2020). Therefore, the use of local potential must continue to be a concern and be preserved to support the development of science and technology. Maluku is a province in the form of islands with several biological and non-biological wealth that is still well maintained so that it can be a driving force and high bargaining value in supporting students' economic and academic growth. Many histories about Maluku prove it. The Chinese have been telling the story of the Maluku since 618–906. In the 15th century, cloves and nutmeg were planted in Maluku. The Portuguese monopolized the spice trade around the 16th century. Francisco Serrão was the first European to reach the islands of Banda and Ternate in 1512. Ferdinand Magellan also set his sights on the Maluku, and in 1521 two of his 'Armada de Moluccas' ships arrived in Tidore. The Magellan Expedition states that, after leaving Maluku in 1522, the ship Victoria departed from Buru to the southwest for Solor and its neighboring islands. In the 17th century, Maluku was under the VOC. In 1621, Jan Pieterszoon Coen conquered Banda and established a VOC monopoly over the production and trade of nutmeg and mace in the Banda islands (van Dijk, 2019). This condition is proof that Maluku was already famous in the past and became a contested area for foreign nations in the world to monopolize natural wealth. In addition, many foreign nations have left many cultures for Maluku in the form of dances, music, customs, and games.

The good wealth of Maluku is a fun learning for students. Students' physics learning can be directed based on local wisdom, namely Ethnophysics. Ethnophysics, or ethnoscience, is the study of knowledge in a cultural context that still contains scientific things. People practice it in everyday life (Vlaardingerbroek, 1990). The average community only carries out cultural activities. However, there are many scientific events in these activities in physical conditions. This situation is not picked up by teachers and taught students to explore the physical state of the world around them. Indigenous peoples have retained their original ways of describing and interpreting nature, customary beliefs, and practices in agriculture, medicine, hunting, and food gathering techniques. There has been a lot of world recognition of local wisdom. It is done to preserve existing customs, culture, and natural resources (Majumdar et al., 2021).

Ethnoscience covers various disciplines, namely ethnochemistry, ethnophysics, ethnobiology, ethnomedicine, and ethnoagriculture. The basic principle of this aspect is actual knowledge in the form of basic concepts and practices that are enshrined in dependence on the environment and knowledge that is strengthened by culture, myth, and the supernatural (Adibe, 2014; Faqih et al., 2020). Ethnophysics is widely studied in Africa because it has high local wisdom. The fields of physics being explored are solids, force, and heat transfer at Mufulira College of Education in Zambia (Chongo et al., 2019). One of the concepts that are rarely explored in physics learning is *Tifa*. On average, *Tifa* is researched in history, culture, and anthropology. However, no one has explored *Tifa* in the concept of sound in physics learning. A deeper exploration of *Tifa* in the Tanimbar Islands is carried out through this research.

Many local and international tourists are impressed by the village's uniqueness in the Tanimbar Islands in natural and cultural tourism. It consists of the nature of the sandy and rocky coast and the green and natural Yamdema forest. In addition, several artifacts in the form of a Stone Boat in Sangliat Dol Village, Wood Carvings in Tumbur Village, Japanese Caves in Lingat Village, Gading Gajah in 1911 and a Lake in Lorulung Village, Portuguese Heritage Cannons in Lauran Village, Tanimbar Woven Fabrics in the Selaru Islands, Endemic flowers are Lelemuku Flowers on Larat Island, Coconut Plantations by the Japanese in Matakus Village and Tali Kor in the form of coconut leaves in traditional fishing and many other tours. The stone wall records at Tanimbar include the main island of Yamdena and the islands of Selaru, Larat, and Fordata. There are many records of The Catholic priest Peter Drabbe which talk about Tanimbar (Schapper, 2019).

One of the unique things about Tanimbar, compared to other villages in Maluku, is *Tifa* which is small in size. *Tifa* is a musical instrument in the form of percussion music used during community cultural events. These natural and cultural conditions that are still sustainable are a source of learning and conceptual improvement of students' physics. Therefore, this study aimed to analyze the conceptual physics of students based on ethnoscience on the concept of *tifa* in the Tanimbar Islands.

Method

The research carried out was in the form of a survey. Survey research was conducted to identify the ethnoscience content in the Tanimbar Islands Regency. Before the research was carried out in the field, the researchers discussed with several village heads, school principals, and scholars from the Tanimbar Islands Regency to ask about local potentials in the form of biological and non-biological wealth in the area. In addition, it asks to what extent endemic things in the area are explored in the curriculum so that they are taught in schools. The determination of the school where the study was conducted randomly. The study was conducted for 3 months, from October to December 2021. The study was conducted on 300 elementary school students from 10 schools. The students studied were grades 5 and 6, with an average 10 to 12 years. The number of male students is 175 and female students are 125. The questions were given to students who understand *Tifa* and have been directly involved with *Tifa*. The goal is that students have no difficulty in answering the questions given.

The concept understanding test instrument refers to the rubric developed by Furtak et al. (2010), which includes 4 aspects, namely not conceptual, no logical conceptual, conceptually based on data, conceptually based on evidence, and logical sequential conceptual based on inductive-rules deductive. The research instrument was discussed and validated by three experts, namely theoretical physics and learning physics from Pattimura University, to provide input on science content without conceptual errors. Then, it was also validated by a thematic learning expert to provide good language and content input to make questions so that students could understand well what the question meant. In addition, the researchers also discussed with a cultural sociologist from the Faculty of Social and Political Sciences, Pattimura University, to provide input on cultures in the form of *Tifa* in the Tanimbar Islands Regency.

The researcher corrected the student's answer instruments collected based on the answers provided in the guide that had been made. Each answer was corrected properly and correctly with categories 1 to 4. Research data were analyzed descriptively. The percentage of data was presented in the form of a bar chart to describe the conceptual average of students on each topic related to ethnophysics in the form of *Tifa*.

Result and Discussion

(a) (b) (c) (d)

Figure 1. *Tifa* in Several Areas in the Tanimbar Islands, a) *Tifa* from Adaut Village, b) *Tifa* from Latdalam Village, c) *Tifa* from Tutukembong Village, d) *Tifa* Tanimbar at the Siwalima Museum in 1893.

Records of students' conceptual physics answers for *Tifa* can be shown in Table 1. The presentation of student learning in Table 1 shows that some students answered well and completely with a good conceptual understanding. Even though there were some simple questions, they required analogies and a high level of reasoning. Contextual learning prioritizes the involvement of students to have different abilities and thoughts in presenting new scientific ideas and concepts. In classical learning, most teachers present knowledge to students and ask them to be involved in problems and solve them. Such a classical approach improves students' cognitive performance and affects students' appearance and interest in learning (Sung et al., 2019). Combining contextual-based learning with local potential can provide interest comfort in understanding and developing knowledge. It is because every time students interact with cultural activities. They have merged with nature and culture, passed down from generation to generation. A University of Western Sydney in Australia study found that 20% of students had not completed physics and mathematics at the high school level. They have poor basic physics concepts and processes (Bhathal, 2016). According to a report by the Chief Scientist of Australia, the number of students working on physics and mathematics in universities decreased from 21% to 14% for physics and from 77% to 72% for mathematics from 1992 to 2010. It impacted the quality of institutions in physics that expect students who are smart and proficient in the fields of physics and mathematics (Chubb, 2012).

Table 1. Records of Students' Physics Conceptual Answers for *Tifa*

Questions	Student answers	Respondents
Between the two existing *Tifa* types, which one has the bigger sound?   *Tifa* Tanimbar *Tifa* Ambon	1. Big *Tifa* has a big sound because the sound spreads in all directions, but Little *Tifa* is more focused in one direction 2. Big *Tifa* has a big sound because the air space is large, so the resulting reflection is quite large 3. The area of the *tifa*'s skin is large, so it encourages the sound to move faster. Besides that, the medium of hitting it is light, making the *tifa*'s skin bounce quickly and produce sound quickly. 4. The area of the small *tifa* is small so that the large hand media that is affected by the *tifa* area becomes unbalanced so that the reflected sound produced becomes sluggish.	80
Why can *Tifa* produce sound?	1. There is a vibration in the form of a wave so that it produces sound 2. There is an air hole on the *tifa* to transmit sound 3. The area on the *tifa* is tenser so that the particles move quickly when there is an external reaction in the form of a blow from an object or hand. 4. The water content in the *tifa* has dried up so that the velocity of the particles moves faster so that they are not hindered from producing sound.	211
Why can humans hear the sound when *Tifa* is hit?	1. The existence of sound waves in the form of particles that move into the air to enter the ear. 2. Sound waves travel through the air and enter the eardrum, across the middle ear, the inner ear, and finally to the hearing center in the brain. 3. There is a frequency produced from the drum to push towards the center of hearing. 4. The distance between the sound source and the listener is not too far.	110
Why is it louder when we hear *Tifa*'s sound at a close position than when we are far away?	1. The sound particles scattered in the air have not been exhausted or disappeared 2. Close to the sound source 3. Has a fast time to propagate in the air 4. The incident sound wave strikes the surface of a hard medium and returns to the original medium at the same angle.	51
Why can the big *Tifa* only be hit with the sago leaf midrib /*gaba-gaba*, while the small one can only be beaten by hand?	1. Produces a big sound 2. The media must be balanced with the area so that it produces a large amount of energy 3. Light media produces reflections from the width of the *tifa* so that it produces sound 4. A small-medium with a large area will produce a small sound so that the sound moves more slowly	35
Why is *Tifa* Tanimbar made the front big and the back small?	1. *Tifa* Tanimbar is made to able to hold and focus on the listener 2. *Tifa* Ambon is designed for the sound produced to spread in all directions 3. *Tifa* Tanimbar produces a small sound so as not to make noise when in the building due to the reflection of the sound produced 4. *Tifa* Ambon for the sound produced moves faster because the bat pushes the air to move under the sound	204

Ethnophysics is a cross-discipline that connects human or cultural anthropology with the study of physics. Scientific knowledge is obtained by examining local knowledge contained in the culture of a community or ethnic group. Local wisdom comes from the reasoning and ideas of local people about everyday life, including traditional culture, values, beliefs, and worldviews (Dewi et al., 2021). Cultural communities share the same traditions and understanding across generations. There is a constant change among participants and transformations in community practice (Gutiérrez et al., 2003). These changes include visible aspects of culture such as language and less visible aspects of culture that may not be visible to teachers (Tait et al., 2018). Ethnophysics, rooted in students' everyday lives, is a contextual experience. Contextual-based learning (CTL) based on culture fully emphasizes the process of student involvement in order to find the material being studied and relate it to real-life situations that encourage students to apply it in their lives (Glynn et al., 2004). The knowledge gained by students is the result of their own experience. The individual is empty in knowledge without experience (Teles et al., 2014).

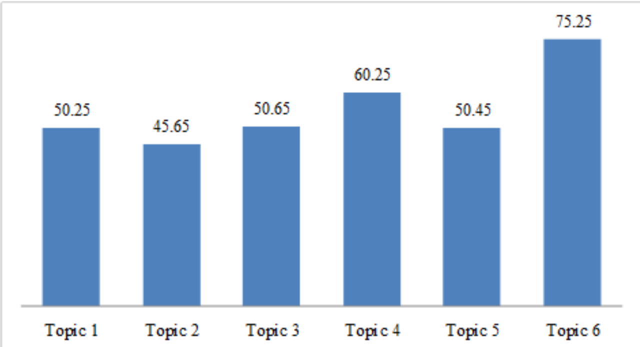

Figure 2. Presentation of students' average scores on each topic in the *Tifa* case

Figure 1 data shows the cultural activities of the people in the past in the form of weaving, burning stones, cooking with a simple aluminum pan, and using wood as fuel. Rituals or habits in the form of community activities are local components that continue to be practiced until now. This procedure is carried out to encourage people to obey the social order and to add motivation and value to a certain level.

Figure 2 data is *Tifa* in the Tanimbar Islands. *Tifa*'s documentation was taken in Adaut, Latdalam, Tutukembong, and *Tifa* Tanimbar at the Siwalima Museum in 1893. *The ancestors inherited tifa*, so it must be protected and preserved for present and future generations. *Tifa* Tanimbar is a small-sized drum that is played by hitting it. This musical instrument is made of several types of wood, namely milkwood, hibiscus wood, or linggua wood, emptied in the middle.

The front of the empty drum usually uses a cover in the form of lizard skin, deer skin, or goat skin that has been dried to produce a sweet and beautiful sound. A missionary has told the existence of Tifa as a musical instrument in Maluku, Francois Valentijn in Oud en Nieuw Oost Indien in the 18th century. In Maluku, *Tifa* has other names tihato and tihal (Central Maluku), Tibal (Fordate and Tanimbar), and Titir (Aru). *Tifa* is used to communicate for formal events combined with accompanying traditional dances and songs and calling people to gather at the *baileo*. Recently, *Tifa* has functioned to notify the arrival of ships carrying fish and encourage rowing participants in a traditional boat race in the form of a bay party to commemorate Ambon City's birthday (Kartomi, 1994).

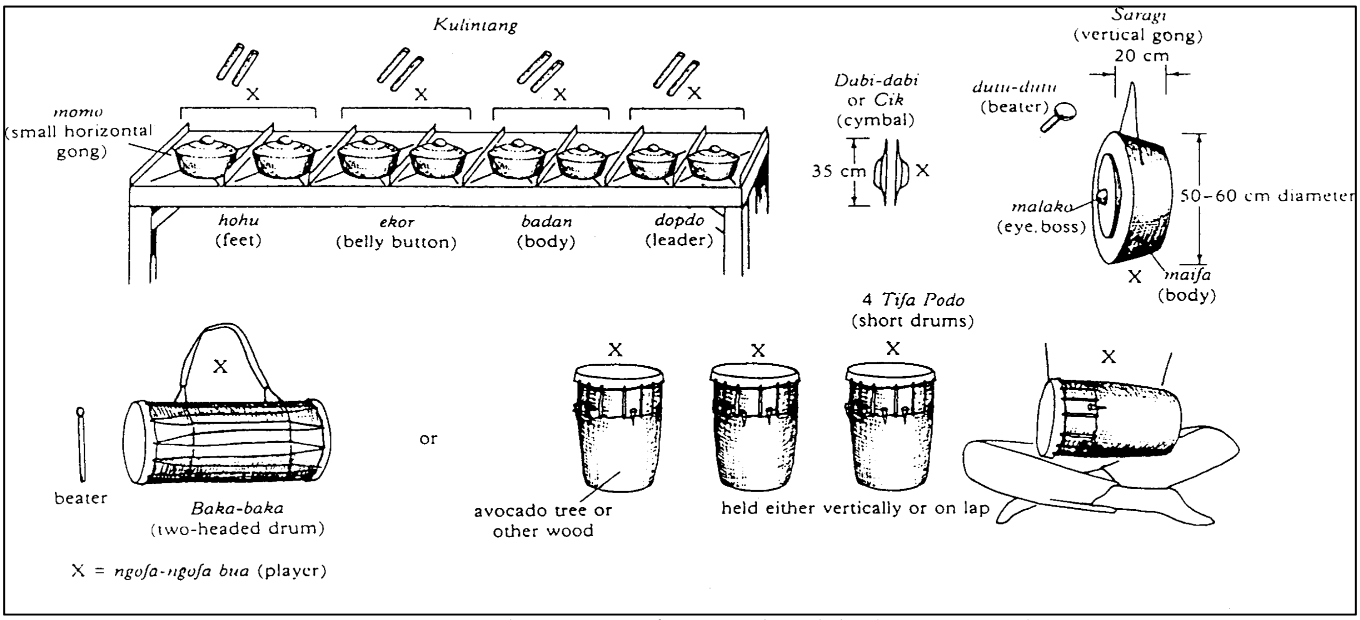

Figure 3. Musical instruments from North Maluku (Kartomi, 1994)

Figure 3 data shows that students' conceptual physics for the *Tifa* concept is still weak. At certain points, students have difficulty in answering. The conceptual aspect is an aspect of scientific literacy. Students' scientific literacy skills in the conceptual aspect began to be grown by providing ethnophysics-based contextual problems when starting learning activities. In addition, the material aspect also makes it difficult for students to answer simple scientific concepts in the form of microscopic phenomena because it requires high analytical power and scientific reasoning (Batlolona et al., 2020; Papadimitropoulos et al., 2021). Moreover, conceptual support from lower levels is weak, and the environment does not impact conceptual improvement. It will interfere with student cognition. Another thing is that the learning carried out in the classroom does not involve or introduce phenomena that occur in everyday life, so the learning process may not positively impact students' scientific abilities. Teachers are more oriented to contextual matters in textbooks than literacy in distant environments (Batlolona et al., 2019; Salta et al., 2020). Simple things in the surrounding environment can be explained and given simple cases to students and asked to analyze the existing situation and provide answers and solutions according to the problems given (Pino-Pasternak et al., 2018).

Ethnophysics is knowledge acquired based on local culture that can be innovated in science-based learning in the classroom. Ethnophysics is a learning approach that elevates culture or local wisdom into objects of physics learning. The introduction of physics learning from local culture and structured local knowledge related to certain natural phenomena and events will increase students' scientific interest and make it easier for them to understand them (Gumbo et al., 2021). Teaching physics with simple, locally sourced materials eliminates the abstractions perceived by students. Mansour (2009) uses the concept of ethnophysics that encapsulates the cultural practices of students to promote teaching and learning in physics content and explores how science and technology are changing modern culture, values , and well-established habits.

Conclusion

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section The study results informed that the average conceptual physics of students related to *Tifa* was 55.42. It indicates that the conceptual physics of elementary school students is still very weak with a good category. Therefore, there is a solution to develop ethnophysics-based teaching materials with orientation to local potentials affiliated with science in improving students' conceptual physics. This research implies that teachers can develop teaching materials that foster students' cognition with surrounding phenomena based on local culture. Teachers can take advantage of opportunities in local contexts in terms of natural and cultural resources for learning and other aspects. It will provide great energy if this research can be extended to other subjects, for example, in science, namely chemistry and biology. In the aspect of the ethnophysics curriculum, the material content, assessment, and language in learning can be expanded.

Acknowledgements

This research was funded by the Rector of the Pattimura University, Prof. Dr. M. J. Saptenno, SH., M.Hum with Decree No. 1497/UN13/SK/2021 in goods provision for research activities for educators/lecturers to the head researcher, Dr. Marleny Leasa, M.Pd.

References

Adibe, M. I. (2014). Innovations in science and technology education: a case for ethnoscience based science classrooms. *International Journal of Scientific & Engineering Research*, *5*(1), 52–56. http://www.ijser.org

Argaw, A. S., Haile, B. B., Ayalew, B. T., & Kuma, S. G. (2017). The effect of problem based learning (PBL) instruction on students’ motivation and problem solving skills of physics. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(3), 857–871. https://doi.org/10.12973/eurasia.2017.00647a

Baquete, A. M., Grayson, D., & Mutimucuio, I. V. (2016). An exploration of indigenous knowledge related to physics concepts held by senior citizens in chókwé, Mozambique. *International Journal of Science Education*, *38*(1), 1–16. https://doi.org/10.1080/09500693.2015.1115137

Bandyopadhyay, S. (2001). Folk Wisdom and cognition: an exploratory appraisal on ethnoscience. Journal of Human Ecology, 12(3), 233–237. https://doi.org/10.1080/09709274.2001.11907608

Batlolona, J. R., Diantoro, M., Wartono, & Latifah, E. (2019). Creative thinking skills students in physics on solid material elasticity. *Journal of Turkish Science Education*, *16*(1), 48–61. https://doi.org/10.12973/tused.10265a

Batlolona, J. R., Diantoro, M., Wartono, & Leasa, M. (2020). Students’ mental models of solid elasticity: Mixed method study. *Journal of Turkish Science Education*, *17*(2), 200–210. https://doi.org/10.36681/tused.2020.21

Berardi, L. (2021). Neighborhood wisdom: an ethnographic study of localized street knowledge. *Qualitative Sociology*, *44*(1), 103–124. https://doi.org/10.1007/s11133-020-09454-z

Bhathal, R. (2016). An appraisal of an online tutorial system for the teaching and learning of engineering physics in conjunction with contextual physics and mathematics, and relevant mathematics. *European Journal of Engineering Education*, *41*(5), 504–511. https://doi.org/10.1080/03043797.2015.1095162

Chang, H. P., Chen, J. Y., Guo, C. J., Chen, C. C., Chang, C. Y., Lin, S. H., Su, W. J., Lain, K. Der, Hsu, S. Y., Lin, J. L., Chen, C. C., Cheng, Y. T., Wang, L. S., & Tseng, Y. T. (2007). Investigating primary and secondary student’s learning of physics concepts in Taiwan. *International Journal of Science Education*, *29*(4), 465–482. https://doi.org/10.1080/09500690601073210

Chubb, I. (2012). Mathematics, Engineering & Science in the National Interest. Canberra: Commonwealth of Australia.

Chongo, E., & Baliga, G. T. (2019). Effect of ethnophysics - based instruction on students ' academic performance and attitude towards density , forces and heat transfer in college physics: a case of mufulira college of education. *Journal of Education and Practice*, *10*(20), 14–25. https://doi.org/10.7176/JEP

Closs, L., Mahat, M., & Imms, W. (2021). Learning environments' influence on students' learning experience in an Australian Faculty of Business and Economics. *Learning Environments Research*, *1*(1), 1–15. https://doi.org/10.1007/s10984-021-09361-2

Debs, L., Miller, K. D., Ashby, I., & Exter, M. (2019). Students' perspectives on different teaching methods: comparing innovative and traditional courses in a technology program. *Research in Science and Technological Education*, *37*(3), 297–323. https://doi.org/10.1080/02635143.2018.1551199

Dewi, C. A., Erna, M., Martini, Haris, I., & Kundera, I. N. (2021). Effect of contextual collaborative learning based ethnoscience to increase student's scientific literacy ability. *Journal of Turkish Science Education*, *18*(3), 525–541. https://doi.org/10.36681/tused.2021.88

Faqih, A., Elizabeth, R., & Azahari, D. H. (2020). The increasing of competitiveness of agro-industry products through institutional empowerment to support the achievement of sustainable agricultural development. *International Journal of Energy Economics and Policy*, *10*(5), 663–671. https://doi.org/10.32479/ijeep.10376

Farrokhnia, M., Pijeira-Díaz, H. J., Noroozi, O., & Hatami, J. (2019). Computer-supported collaborative concept mapping: The effects of different instructional designs on conceptual understanding and knowledge co-construction. *Computers and Education*, *142*(2), 1–15. https://doi.org/10.1016/j.compedu.2019.103640

Fasasi, R. A. (2017). Effects of ethnoscience instruction, school location, and parental educational status on learners' attitude towards science. International Journal of Science Education, (5), 1–17. https://doi.org/ 10.1080/09500693.2017.1296599

Furtak, E., Hardy, I., & Beinbrech, C. (2010). A framework for analyzing evidencebased reasoning in science classroom discourse. *Educational Assessment*, 15(3-4), 175-196. https://doi.org/10.1080/10627197.2010.530553

Gijlers, H., & de Jong, T. (2013). Using concept maps to facilitate collaborative simulation-based inquiry learning. *Journal of the Learning Sciences*, *22*(3), 340–374. https://doi.org/10.1080/10508406.2012.748664

Glynn, S. M., & Winter, L. K. (2004). Contextual Teaching and Learning of science in elementary schools. *Journal of ELementery Science Education*, *16*(2), 3–4. https://doi.org/10.1007/BF03173645

Gobert, Janice; O'Dwyer, Laura; Horwitz, Paul; Buckley, Barbara; Levy, Sharona Tal; Wilensky, Uri (2011). Examining the Relationship Between Students' Understanding of the Nature of Models and Conceptual Learning in Biology, Physics, and Chemistry. *International Journal of Science Education, 33*(5), 653–684. https://doi.org/ 10.1080/09500691003720671

Govender, N., & Mudzamiri, E. (2021). Incorporating indigenous artefacts in developing an integrated indigenous-pedagogical model in high school physics curriculum: views of elders, teachers and learners. *Cultural Studies of Science Education*, 1–24. https://doi.org/10.1007/s11422-021-10076-2

Graffigna, G., Vegni, E., Barello, S., Olson, K., & Bosio, C. A. (2011). Studying the social construction of cancer-related fatigue experience: The heuristic value of Ethnoscience. *Patient Education and Counseling*, *82*(3), 402–409. https://doi.org/10.1016/j.pec.2010.12.017

Gumbo, M. T., Nnadi, F. O., & Anamezie, R. C. (2021). Amalgamating western science and african indigenous knowledge systems in the measurement of gravitational acceleration. *Journal of Baltic Science Education*, *20*(5), 729–739. https://doi.org/10.33225/JBSE/21.20.729

Gutiérrez, K. D., & Rogoff, B. (2003). Cultural Ways of Learning: Individual Traits or Repertoires of Practice. *Educational Researcher*, *32*(5), 19–25. https://doi.org/10.3102/0013189X032005019

Harker-Schuch, I., & Bugge-Henriksen, C. (2013). Opinions and knowledge about climate change science in high school students. *Ambio*, *42*(6), 755–766. https://doi.org/10.1007/s13280-013-0388-4

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M. C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching*, *47*(8), 978–1003. https://doi.org/10.1002/tea.20363

Hofer, S. I., Schumacher, R., & Rubin, H. (2017). The test of basic Mechanics Conceptual Understanding (bMCU): using Rasch analysis to develop and evaluate an efficient multiple choice test on Newton's mechanics. *International Journal of STEM Education*, *4*(1). https://doi.org/10.1186/s40594-017-0080-5

Jamaludin, J., & Batlolona, J. R. (2021). Analysis of Students' conceptual understanding of physics on the topic of static fluids. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 6–13. https://doi.org/10.29303/jppipa.v7ispecialissue.8

45

Kartomi, M. J. (1994). Is maluku still musicological terra incognita? an overview of the music-cultures of the province of maluku. *Journal of Southeast Asian Studies*, *25*(1), 141–171. https://doi.org/10.1017/S0022463400006718

Kavanagh, Y., & Raftery, D. (2017). Physical Physics-Learning and Assessing Light Concepts in a novel way. *MRS Advances*, *2*(63), 3933–3938. https://doi.org/10.1557/adv.2017.589

Kim, M., Cheong, Y., & Song, J. (2018). The meanings of physics equations and physics education. *Journal of the Korean Physical Society*, *73*(2), 145–151. https://doi.org/10.3938/jkps.73.145

Klieger, A. (2016). The use of social networks to employ the wisdom of crowds for teaching. *TechTrends*, *60*(2), 124–128. https://doi.org/10.1007/s11528-016-0020-0

Kola, A. J. (2017). Investigating the Conceptual Understanding of Physics through an Interactive-Lecture Engagement. *Cumhuriyet International Journal of Education*, *6*(1), 82–96. shorturl.at/jkrxP

Lam, V. L., Chaudry, F. R., Pinder, M., Sura, T., Lam, V. L., Chaudry, F. R., Pinder, M., & Sura, T. (2019). British Sikhs in complementary schooling : the role of heritage language proficiency and ' culture learning ' in ethnic identity and bicultural adaptation. *Language and Education*, *0*(0), 1–17. https://doi.org/10.1080/09500782.2019.1634095

Leasa, M., Batlolona, J. R., & Talakua, M. (2021). elementary students ' creative thinking skills in science in the Maluku Islands, Indonesia. *Creativity Studies*, *14*(1), 74–89. https://doi.org/10.3846/cs.2021.11244

Lee, S. Y. (2015). Civic education as a means of talent dissemination for gifted students. *Asia Pacific Education Review*, *16*(2), 307–316. https://doi.org/10.1007/s12564-015-9372-y

Leinonen, R., Haaranen, M., Kesonen, M., Koponen, M., Hirvonen, P. E., & Asikainen, M. A. (2020). Finnish graduated physics teachers' views about their teacher education program: The disparity between the needs and delivery. *Journal of Technology and Science Education*, *10*(1), 101–116. https://doi.org/10.3926/jotse.820

Lin, C., Huang, C., Zhang, H., Lin, C., Huang, C., & Zhang, H. (2018). Enhancing Employee Job satisfaction via E- learning : The Mediating Role of an Organizational Learning Culture Enhancing Employee Job satisfaction via E-learning : The Mediating Role of an Organizational Learning Culture. *International Journal of Human–Computer Interaction*, *00*(00), 1–12. https://doi.org/10.1080/10447318.2018.1480694

Lin, P. Y., & Schunn, C. D. (2016). The dimensions and impact of informal science learning experiences on middle schoolers' attitudes and abilities in science. *International Journal of Science Education*, *38*(17), 2551–2572. https://doi.org/10.1080/09500693.2016.1251631

Lin, T. J., Liang, J. C., & Tsai, C. C. (2015). Identifying Taiwanese University students' physics learning profiles and their role in physics learning self-efficacy. *Research in Science Education*, *45*(4), 605–624. https://doi.org/10.1007/s11165-014-9440-z

Lotter, C., Harwood, W. S., & Bonner, J. J. (2007). The influence of core teaching conceptions on teachers' use of inquiry teaching practices. *Journal of Research in Science Teaching*, *44*(9), 1318–1347. https://doi.org/10.1002/tea.20191

Majumdar, K., & Chatterjee, D. (2021). The cultural dimension of environment: Ethnoscientific study on Santhal community in eastern India. *International Journal of Anthropology and Ethnology*, *5*(1), 1–21. https://doi.org/10.1186/s41257-021-00057-2

Mansour, N. (2009). Science-Technology-Society (STS). *Bulletin of Science, Technology & Society*, *29*(4), 287–297. https://doi.org/10.1177/0270467609336307

McLaughlin, P. T., McMinn, M. R., Morse, M. K., Neff, M. A., Johnson, B., Summerer, D., & Koskela, N. (2018). The effects of a wisdom intervention in a Christian congregation*. *Journal of Positive Psychology*, *13*(5), 502–511. https://doi.org/10.1080/17439760.2017.1350739

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, *25*(6), 791–812. https://doi.org/10.1080/13504622.2017.1360842

Msuya, J. (2007). Challenges and opportunities in the protection and preservation of Indi-genous Knowledge in Africa. *The International Review of Information Ethics*, *7*(1), 346–353. https://doi.org/10.29173/irie38

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049–1079. https://doi.org/10.1080/0950069032000032199

Papadimitropoulos, N., Dalacosta, K., & Pavlatou, E. A. (2021). Teaching chemistry with arduino experiments in a mixed virtual-physical learning environment. *Journal of Science Education and Technology*, *30*(1), 550–566. https://doi.org/10.1007/s10956-020-09899-5

Phanphech, P., Tanitteerapan, T., & Murphy, E. (2019). Explaining and enacting for conceptual understanding in secondary school physics. *Issues in Educational Research*, *29*(1), 180–204. https://search.informit.org/doi/abs/10.3316/iela pa.171950763587256

Pino-Pasternak, D., & Volet, S. (2018). Evolution of pre-service teachers' attitudes towards learning science during an introductory science unit. *International Journal of Science Education*, *40*(12), 1520–1541. https://doi.org/10.1080/09500693.2018.1486521

Qhobela, M., & Moru, E. K. (2020). Understanding the use of classroom talk by newly trained physics teachers in Lesotho. *African Journal of Research in Mathematics, Science and Technology Education*, *24*(1), 81–91. https://doi.org/10.1080/18117295.2020.1733194

Ramdiah, S., Abidinsyah, A., Royani, M., Husamah, H., & Fauzi, A. (2020). South Kalimantan local wisdom-based biology learning model. *European Journal of Educational Research*, *9*(2), 639–653. https://doi.org/10.12973/eu-jer.9.2.639

Rolin, K., & Vainio, J. (2011). Gender in academia in Finland: Tensions between policies and gendering processes in physics departments. *Science Studies*, *24*(1), 26–46. https://doi.org/10.23987/sts.55268

Rusmana, A. N., Sya'bandari, Y., Aini, R. Q., Rachmatullah, A., & Ha, M. (2021). Teaching Korean science for Indonesian middle school students: promoting Indonesian students' attitude towards science through the global science exchange programme. *International Journal of Science Education*, *43*(11), 1837–1859. https://doi.org/10.1080/09500693.2021.1938278

Şahin, H., Kiliç, I., & Erkal, S. (2013). An analysis of the environmental knowledge and attitudes of university students. *International Journal of Interdisciplinary Environmental Studies*, *7*(1), 1–11. https://doi.org/10.18848/2329-1621/cgp/v07i01/63976

Salta, K., & Koulougliotis, D. (2020). Domain specificity of motivation: chemistry and physics learning among undergraduate students of three academic majors. *International Journal of Science Education*, *42*(2), 253–270. https://doi.org/10.1080/09500693.2019.1708511

Santiprasitkul, S., Sithivong, K., & Polnueangma, O. (2013). The first year nursing students' achievement and critical thinking in local wisdom course using problem based learning process. *Wireless Personal Communications*, *69*(3), 1077–1085. https://doi.org/10.1007/s11277-013-1067-2

Sarabando, C., Cravino, J. P., & Soares, A. A. (2014). Contribution of a computer simulation to students' learning of the physics concepts of weight and mass. *Procedia Technology*, *13*(1), 112–121. https://doi.org/10.1016/j.protcy.2014.02.015

Schapper, A. (2019). Build the wall!: Village fortification, its timing and triggers in southern Maluku, Indonesia. *Indonesia and the Malay World*, *47*(138), 220–251. https://doi.org/10.1080/13639811.2019.1554778

Shishigu, A., Hailu, A., & Anibo, Z. (2018). Problem-based learning and conceptual understanding of college female students in physics. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 145–154. https://doi.org/10.12973/ejmste/78035

Sholikhan, S., Degeng, I. N. S., Setyosari, P., & Handayanto, S. K. (2020). Understanding the physics concept between guided inquiry or open inquiry. *International Journal of Learning and Change*, *12*(2), 113–123. https://doi.org/10.1504/IJLC.2020.106784

Sotero, M. C., Alves, Â. G. C., Arandas, J. K. G., & Medeiros, M. F. T. (2020). Local and scientific knowledge in the school context: Characterization and content of published works. *Journal of Ethnobiology and Ethnomedicine*, *16*(1), 1–28. https://doi.org/10.1186/s13002-020-00373-5

Stott, A. (2013). South African physical sciences teachers' Understanding of force and the relationship to teacher qualification, Experience and their school's quintile. *African Journal of Research in Mathematics, Science and Technology Education*, *17*(1–2), 173–183. https://doi.org/10.1080/10288457.2013.829599

Sung, H. Y., Hwang, G. J., Chen, C. Y., & Liu, W. X. (2019). A contextual learning model for developing interactive e-books to improve students' performances of learning the Analects of Confucius. *Interactive Learning Environments*, *0*(0), 1–14. https://doi.org/10.1080/10494820.2019.1664595

Tait, C., Horsley, J., & Tait, K. (2018). The contextual teaching–learning mapping of academically successful Pasifika students. *Asia Pacific Education Review*, *19*(3), 353–361. https://doi.org/10.1007/s12564-018-9547-4

Teles, S., & Tomimatsu, K. (2014). Contextual Teaching and Learning Using a Card Game Interface. *International Journal of Asia Digital Art and Design*, *18*(2), 18–23. https://doi.org/10.20668/adada.18.2_18

Uge, S., Neolaka, A., & Yasin, M. (2019). Development of social studies learning model based on local wisdom in improving students' knowledge and social attitude. *International Journal of Instruction*, *12*(3), 375–388. https://doi.org/10.29333/iji.2019.12323a

Vachliotis, T., Salta, K., & Tzougraki, C. (2021). Developing basic systems thinking skills for deeper understanding of chemistry concepts in high school students. *Thinking Skills and Creativity*, *41*(2), 1–35. https://doi.org/10.1016/j.tsc.2021.100881

van Dijk, T. (2019). Marsela in motion: The Babar islands in eastern Indonesia and the outer world. *Indonesia and the Malay World*, *47*(138), 252–275. https://doi.org/10.1080/13639811.2019.1582937

Vlaardingerbroek, B. (1990). Ethnoscience and science teacher training in Papua New Guinea. *Journal of Education for Teaching*, *16*(3), 217–224. https://doi.org/10.1080/0260747900160302

Wu, Q., Ou, Y., & Jordan, L. (2021). Contribution of family and school factors to the health and wellbeing of cross-border, new immigrant and local students in Hong Kong. *Children and Youth Services Review*, *120*(1), 1–11. https://doi.org/10.1016/j.childyouth.2020.105775