**Indonesian Journal of Education & Mathematical Science**
Vol. 6, No. 2, Mei 2025, pp. 106~113
ISSN: 2715-985X, DOI: 10.30596/ijems.v6i2.24235

# Enhancing Students' Critical Thinking through an Ethnophysics Module with a Scaffolding Approach

**Erlin Eveline**
Department of Physics Education, Faculty of Education and Teacher Training, Universitas Pattimura, Ambon, Indonesia
erlin.eveline12@gmail.com

## ABSTRACT

Contextual learning resources that follow the characteristics of students are still needed. Meanwhile, learning resources are still general and have not been adjusted to students' characteristics and learning environments. In addition, the Indonesian curriculum aims to strengthen the profile of Pancasila students. Critical thinking is one of the six main characteristics of the Pancasila student profile. The ethnophysics module with a scaffolding approach can be a learning resource that provides information in the form of physics material combined with local wisdom to contextualise it with a scaffolding approach. The scaffolding approach is used for students to achieve their potential abilities, namely critical thinking. The study aimed to determine the effect of implementing the ethnophysics module with a scaffolding approach on students' critical thinking skills. This study used an experimental method with a pretest-posttest control group design. The research subjects comprised 23 students from the experimental class and 29 from the control class. The test instrument consisted of pretest and post-test critical thinking questions. The study found a significant effect of the ethnophysics module with a scaffolding approach on students' critical thinking skills, as seen from the n-gain score and effectiveness test using Mann-Whitney U on students' critical thinking skills as seen from the n-gain score and effectiveness test using Mann-Whitney U.

**Keywords: Critical thinking, ethnophysics, scaffolding approach**

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

***Corresponding Author:***
Erlin Eveline,
Department of Physics Education,
Universitas Pattimura,
Jalan Ir. M. Putuhena, Kota Ambon, Maluku, Indonesia.
erlin.eveline12@gmail.com

## 1. INTRODUCTION

Learning resources available in schools are generally textbooks. The evidence came from interviews with physics teachers at Permata Kasih High School, who reported relying on textbooks during classroom instruction, especially physics instruction. However, these textbooks are only used during class learning and must be returned once the physics instruction ends. As a result, students only access learning resources during class hours. Furthermore, this textbook contains minimal integration of local culture or wisdom. It presents examples within global or national contexts, which may not be appropriate for Indonesian students due to their significantly different cultural backgrounds. Textbooks often ignore the cultural background and local conditions in which students live. Consequently, the content of this book is irrelevant and lacks contextual meaning for students (Makhmudah et al., 2019; Safitri et al., 2018; Widyaningrum et al., 2013). For instance, using industrial or urban contexts is unfamiliar to students from rural or culturally distinct areas.

Non-contextual material makes it difficult for students to understand the material because the content feels far from their everyday lives. It was also identified in the study by Sari et al. (2018), which found that students experienced difficulty comprehending material due to the lack of contextual relevance in the textbooks. Implementing contextual learning significantly enhances students' ability to understand and apply concepts in real-life situations (Rutumalessy et al., 2023). When the material is not linked to the environment around the students, they become less motivated to learn, as they struggle to perceive the practical benefits of what is being learned. Conversely, Rutumalessy et al. (2023) said that students feel more motivated to learn when they see the connection between the material and their daily lives. Consequently, students' engagement in learning will also be affected. Students may be unable to participate actively because they are not encouraged to relate new knowledge to their personal experiences or local culture. It leads to surface-level learning, where students tend to memorize content rather than develop meaningful conceptual understanding.

Meanwhile, Education in Indonesia is guided by the Indonesian Curriculum, which sets specific learning outcomes for students, including the Pancasila Student Profile. This profile encompasses a set

of competencies that students are expected to acquire, including critical thinking skills (Satria et al., 2022) Critical thinking, defined as the systematic analysis and evaluation of problems based on reasoned judgment and personal perspective, is a crucial skill for students to develop (Firdaus et al., 2019). Students with good critical thinking skills will find it easier to make decisions or conclusions from a problem. However, students' critical thinking skills remain relatively low. Several studies have reported students struggling to solve problems that require higher-order thinking. Therefore, it is essential for teachers to continuously innovate instructional practices by integrating subject materials with cultural contexts (ethnophysics) and adopting effective learning strategies that promote the development of students' critical thinking skills.

Ethnophysics modules offer an alternative solution for providing contextual and relevant learning resources to the students' environments. This module offers materials related to the local wisdom of the region where students reside. The module can also improve learning outcomes and student skills, and support independent learning with or without teacher guidance (Lestari & Apsari, 2022; Puspitasari, 2019; Utami et al., 2018). In addition, it helps students become more familiar with local culture and contribute to its preservation (Hidayanto et al., 2016). The module is designed systematically and engagingly as a student learning guide. Generally, module formats include a title, table of contents, information map, competency objective, an overview of the material, connection to other topics, material descriptions, assignments, summaries, glossary, final task, and index (Mudzakir, 2010). Some more specific formats incorporate learning content, methods, objectives, self-learning instructions, and practice questions. Modules are made to provide learning resources according to the characteristics, settings, and backgrounds of students' social environment and the characteristics of the teaching materials (Hamdani, 2011).

Teaching module with contextual learning material content allows students to learn according to their characteristics. However, there also needs to be a strategy that can help teacher trains students to think critically. Thus, this study aims to implement instruction through an ethnophysics module with a scaffolding approach. Scaffolding is the assistance given by a more knowledgeable individual to Help a learner complete tasks that are difficult or that the learner finds challenging. This support is provided so that the individual can achieve their potential abilities. Scaffolding can take various forms, such as structured tasks, identifying meaningful contexts, simplifying the problem, making connections, and parallel modelling (Anghileri, 2006)**.** Scaffolding has the potential to enhance student's skills, such as developing higher-order thinking skills when applied in the classroom (Eveline et al., 2019)

Integrating ethnophysics in the module aims to facilitate students' understanding of physics by linking physics concepts with local wisdom. This integration may enhance the relevance of learning. This approach is implemented by gradually training students' thinking skills. Hence, this combination of learning strategies is expected to support students in promoting their critical thinking skills. Therefore, this study aims to investigate the impact of implementing a physics module based on the local wisdom of the Dayak Keninjal tribe in Malawi Regency, West Kalimantan, and a scaffolding approach to students' critical thinking skills. The findings of this research are expected to support contextual learning and the implementation of the Indonesian Curriculum. Indonesian curriculum emphasizes designing instruction that considers the characteristics and needs of students to foster meaningful student learning experiences (Anggaena et al., 2022)

## 2. RESEARCH METHOD

This study is an experimental study with a pretest-posttest control group design. Two classes are the experimental and control classes (Table 1).

**Table 1. Research Design**

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| E | O1 | X1 | O2 |
| K | O3 | X2 | O4 |

**Indonesian Journal of Education & Mathematical Science**
Vol. 6, No. 2, Mei 2025, pp. 106~113
ISSN: 2715-985X, DOI: 10.30596/ijems.v6i2.24235

Where E is the experimental class, K is the control class, O1 is the pretest in the experimental class, O2 is the posttest in the experimental class, O3 is the pretest in the control class, and O4 is the posttest in the control class. X1 is learning using the ethnophysics module with a scaffolding approach, and X2 is learning using the lecture method without using learning media.

This design compares the initial (pretest) and the final (posttest) tests in the experimental and control classes. The test in each class is carried out twice, namely the test before treatment (pretest) and the test after treatment (posttest) (Sugiyono, 2016)**.** Experts first validated the items. The validation results indicated that the items were appropriate for assessing students' critical thinking skills. The experts evaluated the items based on content, construction, and language (Table 2). According to Aiken's V table for seven raters with four rating categories and a 1% chance of error, the minimum acceptable V value is 0,86. When compared with the V values of each test item, it was found that all items met or exceeded the minimum V value, indicating that the questions are valid for measuring students' critical thinking skills (Aiken, 1985)**.**

**Table 2. Results of Expert Validation of the Critical Thinking Test Instrument**

| Question's Number | V's Aiken | Keterangan |
|---|---|---|
| 1 | 0,95 | Valid |
| 2 | 0,95 | Valid |
| 3 | 0,90 | Valid |
| 4 | 0,95 | Valid |
| 5 | 0,90 | Valid |

The population was students from four 10th-grade classes at Permata Kasih High School. The sample consisted of students from Class X Alpha and Class X Beta, designated as the experimental and control groups. The experimental group comprised 23, while the control group comprised 29.

The experimental class learned using modules, while the control class learned using the lecture method with a whiteboard as the media. Teachers at the school often use the lecture method for the 10th-grade Science subject. The module used contains material that integrates the local wisdom of the Dayak *Keninjal* tribe, namely the concept of energy in the Dayak *sipet* (Dayak blowgun), where the blowgun bullet, commonly called *damak* when blown, will fly. The flying *damak* has energy in it. In addition, the concept of energy is also included in the activities of *nutuk* padi (pounding rice) and the *peloper* (catapult) game. Learning activities are designed as many as three: learning activities about energy, forms of energy, and the law of energy conservation. The module is also made by integrating the scaffolding approach. The scaffolding approach in the module is in the form of assistance in solving practice questions, namely instructions for solving questions (helpful tips). In addition to the module, the scaffolding approach is also applied to learning activities in the classroom. The module used can be seen in Figure 1.

After the learning process had been done in both classes, we analyzed students' critical thinking skills using the n-gain test and t-test. N-gain was used to determine the increase in students' critical thinking skills. In contrast, the t-test was used to evaluate learning effectiveness using the ethnophysics module with a scaffolding approach. The research data obtained were scores from critical thinking skill test questions with aspects of critical thinking skills measured, taken from Polya, namely interpretation, analysis, evaluation, and inference. The data were then analyzed using N-Gain. The N-Gain score was used to determine the extent to which students' critical thinking skills and learning independence had increased. The following equation was used to calculate N-Gain (Hake, 1998).

$$N - Gain = \frac{posttest\ score - \ pretest\ score}{maximum\ score\ - \ minimum\ score}$$

The N-Gain categories can be seen in Table 3.

**Indonesian Journal of Education & Mathematical Science**
Vol. 6, No. 2, Mei 2025, pp. 106~113
ISSN: 2715-985X, DOI: 10.30596/ijems.v6i2.24235

**Table 3. N-Gain Score Categories**

| Score | Pretest |
|---|---|
| 0.70-1.00 | High |
| 0.31-0.69 | Medium |
| 0-0.30 | Low |

Nonparametric statistics were used to analyze the data because the research results did not meet some of the requirements for using parametric tests. Therefore, this study conducted a nonparametric statistical test using the Mann-Whitney U Test. The Mann-Whitney U Test was used to see the effectiveness or difference between the control class and the experimental class in terms of each dependent variable (critical thinking skills and student learning independence).

Mann-Whitney Test Hypothesis

H0 There is no significant effect of the ethnophysics module with a scaffolding approach on students' critical thinking skills.

H1 There is a significant effect of the ethnophysics module with a scaffolding approach on students' critical thinking skills.

The basis for decision-making in the Mann-Whitney Test: 1. If the Asymp. Significance value (2-tailed) < 0.05, then Ho is rejected, and Ha is accepted; 2. If the Asympt. The significance value (2-tailed) is> 0.05, and then Ho is accepted, and Ha is rejected (Sugiyono, 2017).



**Pendahuluan**

Pernahkah kalian melihat alat yang disebut sumpit atau *sipet* dari suku Dayak? Sumpit suku Dayak merupakan salah satu alat yang dimanfaatkan oleh masyarakat suku Dayak untuk berburu hewan di hutan. Sumpit dilengkapi dengan anak panah atau peluru sumpit yang dinamakan sebagai *damak* atau disebut juga anak sumpit. *Damak* dilumuri dengan racun dari getah tumbuhan *ipu* atau *siren* yang berfungsi untuk mematikan hewan buruan.

*Gambar 1 Sumpit suku Dayak dan peluru sumpit (damak) (Sumber: https://www.carousell.com.my/)*

Sejauh ini, sumpit Dayak tidak hanya digunakan untuk berburu namun digunakan sebagai alat permainan atau perlombaan dalam acara khusus suku Dayak yang dikenal

1 | Modul Konsep Energi

Gawai Dayak. Kita dapat menemukan konsep fisika pada proses kerja alat sumpit Dayak. Konsep energi terdapat dalam proses kerja alat sumpit Dayak. Selain konsep energi, juga dapat dijelaskan konsep gerak parabola pada sumpit Dayak yang akan Anda dipelajari lebih lanjut pada tingkat selanjutnya.

*Gambar 2 Lomba menyumpit pada acara gawai suku Dayak di Kalimantan (Sumber: www.pariwisataindonesia.id)*

Pada modul ini, Anda akan mempelajari konsep energi pada berbagai bentuk dan contoh dalam kehidupan sehari-hari secara khusus pada kegiatan berburu menggunakan sumpit Dayak dan kegiatan *nutuk* padi. Terdapat beberapa konsep fisika yang dapat dijelaskan pada sumpit Dayak dan kegiatan *nutuk* padi. Namun, Modul ini akan berfokus pada konsep energi.

Setelah mempelajari modul ini, Anda diharapkan mampu:

Modul Konsep Energi | 2

**Fig 1. Example of Content in Ethnophysics Module**

**Indonesian Journal of Education & Mathematical Science**
Vol. 6, No. 2, Mei 2025, pp. 106~113
ISSN: 2715-985X, DOI: 10.30596/ijems.v6i2.24235

## 3. RESULTS AND DISCUSSION

### A. The Improvement of Students' Critical Thinking Skills

The improvement in students' critical thinking skills before and after using of the ethnophysics module in both the experimental and control classes was measured using the N-Gain score. The results are presented in Table 4.

**Table 4. Improvement in Students' Critical Thinking Skills and Learning Independence**

| | Class | | | |
|---|---|---|---|---|
| | Control | | Experiment | |
| Critical Thinking Skills | 0.31 | Medium | 0.52 | Medium |

As shown in Table 4, there was an increase in critical thinking skills based on the N-Gain scores. However, the critical thinking N-Gain score category remained in the "medium" range for both classes, although the experimental class achieved a higher score than the control class. Critical thinking is an aspect of learning outcomes that requires continuous effort to develop significantly. Critical thinking is in the skill domain of learning outcomes. Therefore, this skill must be trained continuously to reach a high proficiency level. This finding is consistent with Suryanti et al. (2017), who emphasized that critical thinking skills must be developed using appropriate topics and materials to achieve meaningful growth.

### B. Effectiveness of Learning Using Ethnophysics Module with Scaffolding Approach

Table 5 below presents the results of the Mann-Whitney U test for the dependent variable of critical thinking skills.

**Table 5. Results of the Mann-Whitney U Statistical Test for Critical Thinking Skills**

**Test Statistics[a]**

| | Kemampuan Berpikir Kritis |
|---|---|
| Mann-Whitney U | 170.500 |
| Wilcoxon W | 605.500 |
| Z | -3.006 |
| Asymp. Sig. (2-tailed) | .003 |

a. Grouping Variable: Kelas

The results of the Mann-Whitney U test show an Asymp. Sig. (2-tailed) value of 0.003, which is smaller than the significance level of 0.05. Therefore, the null hypothesis ($H_0$) is rejected, and the alternative hypothesis ($H_1$) is accepted. It indicates that the ethnophysics module with a scaffolding approach significantly influences students' critical thinking skills. In other words, there is a significant difference in the critical thinking skills scores between the experimental and control classes. It is evident from the difference in the average posttest scores of students' critical thinking skills between the experimental and control classes (Table 6), where the average posttest score of the experimental class ($\bar{x} = 55{,}3$) is higher than that of the control class ($\bar{x} = 36$).

**Indonesian Journal of Education & Mathematical Science**
Vol. 6, No. 2, Mei 2025, pp. 106~113
ISSN: 2715-985X, DOI: 10.30596/ijems.v6i2.24235

**Table 6. Average Posttest Score of Students' Critical Thinking Skills**

| Class | Average Posttest Score | Maximum Score | Minimum Score |
|---|---|---|---|
| Eksperiment | 55,3 | 80 | 10 |
| Control | 36 | 57,5 | 5 |

The statistical test results indicate that learning through an ethnophysics module with a scaffolding approach is more effective than learning through the conventional lecture method. Similar findings were reported by Stelzer et al. (2009), who found that students who used modules performed significantly better than those who relied on traditional textbooks. Integrating local wisdom from the Keninjal Dayak tribe into the physics module provides a contextualized learning resource that meets students' needs. This module was specifically developed to support the learning needs of students of the Keninjal Dayak tribe, aiming to facilitate a better understanding of physics concepts. The concept of energy, illustrated through examples commonly encountered in daily life, is expected to help students from the Keninjal Dayak tribe and the Melawi Regency better understand physics concepts. The material explanations are supplemented with images to assist students in relating theoretical concepts to examples from everyday life. The cognitive process involves students connecting physics concepts to familiar situations or environments. This process can improve student understanding (Dasilva et al., 2019). Presenting physics concepts with the local wisdom of the Dayak Keninjal offers an alternative approach to developing contextual learning resources for students in the Melawi Regency.

In addition, the module was developed using a scaffolding approach. This scaffolding approach in the module assists students as they engage in independent learning. Scaffolding refers to the support offered by more knowledgeable individuals or adults to help learners accomplish tasks they cannot complete independently (McDevitt & Ormrod, 2002). It is associated with Vygotsky's zone of proximal development (ZPD) concept, which plays a crucial role in developing students' cognitive and personal growth. The ZPD represents the distance between the child's actual development level, defined as the ability to solve problems independently, and their potential development level, defined as the ability to solve problems with guidance from a more capable individual. Vygotsky believed that children will experience development and achieve specific expected abilities if given assistance or guidance. Based on this concept, it can be concluded that children (in this case, students) can reach their potential skills or abilities expected by the teacher if given assistance or guidance (Margolis, 2020). Therefore, the module was developed using a scaffolding approach, a learning approach to the ZPD concept, by assisting students in achieving the expected abilities.

The scaffolding approach in the ethnophysics module offers assistance through instructions for solving questions, providing parallel examples, and explaining additional materials. Determining the assistance is guided by several examples of scaffolding from Anghileri (2006)**.** The module provides instructional guidance (instructions for solving problems) and presents additional material to support students in completing exercise tasks, which are categorized as prop scaffolds. In addition, the module provides examples of questions parallel to the task categorized as parallel modelling. Parallel modelling is a scaffolding technique that offers examples of solving or completing tasks with characteristics similar to those assigned to students (Anghileri, 2006).

Assistance is provided to help students who have difficulty understanding the material can more easily learn the material presented. For instance, the energy material in the developed module requires prerequisite knowledge, such as the concept of work, which relies on an understanding of trigonometry. The developed module assists in understanding the concept by explaining additional prerequisite material to help students understand the energy material more easily. Furthermore, when students encounter difficulties completing the practice questions, they are supported through detailed instructions and examples of parallel problems. Through the scaffolding provided in the module, it is expected that students will be able to achieve the learning objectives set by the teacher, particularly in mastering the material more effectively.

The findings of this study are relevant to the research conducted by Kurniawan & Syafriani (2021), who developed a module based on local wisdom. Their results indicated that the module was appropriate for physics instruction. Learning materials integrated with local culture provide students with new knowledge and understanding. Students may struggle to connect scientific knowledge with their cultural context or everyday life examples without linking learning materials to examples of local wisdom from the students' environment (Syahmani et al., 2022). Therefore, developing learning resources integrating scientific knowledge, particularly physics, with local wisdom plays a crucial role in enhancing students' understanding and knowledge acquisition.

## 4. CONCLUSION

Relevant and contextual learning resources are still essential in classroom-based physics education. Based on the experimental results, the finding indicates that applying an ethnophysics module integrated with a scaffolding approach impacts students' critical thinking skills. The module supports students who struggle to understand the material by presenting content through examples that are familiar and relatable examples.

## REFERENCES

Aiken, L. R. (1985). *Psychological testing and assessment* (5th ed.). Allyn and Bacon.

Anggaena, Y., Ginanto, D., Felicia, N., Andiarti, A., Herutami, I., Alhapip, L., Iswoyo, S., Hartini, Y., & Mahardika, R. L. (2022). *Panduan pembelajaran dan asesmen pendidikan anak usia dini, pendidikan dasar, dan pendidikan menengah*. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.

Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning. [Publisher information missing].

Dasilva, B. E., Ardiyati, T. K., Eveline, E., Utami, T., Nadiah, Z., & Ferty. (2019). Development of Android-based interactive physics mobile learning media (IPMLM) with scaffolding learning approach to improve HOTS of high school students. *Journal for the Education of Gifted Young Scientists, 7*(3), 659–674. https://doi.org/10.17478/jegys.610377

Eveline, E., Suparno, Ardiyati, T. K., & Dasilva, B. E. (2019). Development of interactive physics mobile learning media for enhancing students' HOTS in impulse and momentum with scaffolding learning approach. *Jurnal Penelitian & Pengembangan Pendidikan Fisika, 5*(2), 124–132. http://journal.unj.ac.id/unj/index.php/jpppf/article/view/12532/7588

Firdaus, A., Nisa, L. C., & Nadhifah, N. (2019). Kemampuan berpikir kritis siswa pada materi barisan dan deret berdasarkan gaya berpikir. *Kreano: Jurnal Matematika Kreatif-Inovatif, 10*(1), 68–77. https://doi.org/10.15294/kreano.v10i1.17822

Hake, R. R. (1998). Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64–74.

Hamdani. (2011). *Strategi belajar mengajar*. Pustaka Setia.

Hidayanto, F., Sriyono, & Ngazizah, N. (2016). Pengembangan modul fisika SMA berbasis kearifan lokal untuk mengoptimalkan karakter peserta didik. *Jurnal Pendidikan Fisika Indonesia, 9*(1), 1–9.

Kurniawan, R., & Syafriani. (2021). The validity of e-module based on guided inquiry integrated ethnoscience in high school physics learning to improve students' critical thinking. *Journal of Physics: Conference Series, 1876*(1), 012067. https://doi.org/10.1088/1742-6596/1876/1/012067

Lestari, N., & Apsari, N. (2022). E-modul ethnophysics for critical thinking skills in the Covid-19 pandemic. *Jurnal Penelitian dan Pengembangan Pendidikan Fisika, 8*(2), 193–206. https://doi.org/10.21009/1

Makhmudah, N. L., Subiki, & Supeno. (2019). Pengembangan modul fisika berbasis kearifan lokal permainan tradisional Kalimantan Tengah pada materi momentum dan impuls. *Jurnal Pembelajaran Fisika, 8*(2), 115–124.*

Margolis, A. A. (2020). Zone of proximal development, scaffolding and teaching practice. *Cultural-Historical Psychology, 16*(3), 15–26. https://doi.org/10.17759/chp.2020160303

McDevitt, T. M., & Ormrod, J. E. (2002). *Child development and education*. Pearson Education.

Mudzakir, A. (2010). Penulisan buku teks berkualitas. Universitas Pendidikan Indonesia. http://file.upi.edu/Direktori

Puspitasari, A. D. (2019). Penerapan media pembelajaran fisika menggunakan modul cetak dan modul elektronik pada siswa SMA. *Jurnal Pendidikan Fisika, 7*(1), 17–25. http://journal.uin-alauddin.ac.id/indeks.php/PendidikanFisika

Rutumalessy, M., Sudyana, I. N., Azis, A. A., Suharyatun, & Suroso, A. (2023). The implementation of contextual learning and teaching method in improving students' learning achievement. *Journal on Education, 5*(4), 16262–16267. http://jonedu.org/index.php/joe

Safitri, A. N., Subiki, & Wahyuni, S. (2018). Pengembangan modul IPA berbasis kearifan lokal kopi pada pokok bahasan usaha dan energi di SMP. *Jurnal Pembelajaran Fisika, 7*(1), 45–52.*

Sari, A. M., Rasyid, Y., & Muliastuti, L. (2018). Development of exposition text writing materials based on contextual approach. *Jurnal Pendidikan dan Pengajaran, 51*(3), 122–131.

Satria, R., Adiprima, P., Wulan, K. S., & Harjatanaya, T. Y. (2022). *Projek penguatan profil pelajar Pancasila*. Badan Standar, Kurikulum, dan Asesmen Pendidikan.

Stelzer, T., Gladding, G., Mestre, J. P., & Brookes, D. T. (2009). Comparing the efficacy of multimedia modules with traditional textbooks for learning introductory physics content. *American Journal of Physics, 77*(2), 184–190. https://doi.org/10.1119/1.3028204

Sugiyono. (2016). *Metode penelitian kombinasi (mixed methods)*. Alfabeta.

Sugiyono. (2017). *Statistika untuk penelitian*. Alfabeta.

Suryanti, Arifin, I., & Baginda, U. (2017). Application of inquiry learning to exercise critical thinking skills in light material of elementary school students. In *Proceedings of ICoSED 2017* (pp. 86–92).

Syahmani, S., Rahmatilah, J., Winarti, A., Kusasi, M., Iriani, R., & Prasetyo, Y. D. (2022). Development of guided inquiry lesson based on ethnoscience e-modules to improve students' problem-solving ability in chemistry class. *Journal of Innovation in Educational and Cultural Research, 3*(4), 670–682. https://doi.org/10.46843/jiecr.v3i4.363

Utami, T. N., Jatmiko, A., & Suherman. (2018). Pengembangan modul matematika dengan pendekatan science, technology, engineering, and mathematics (STEM) pada materi segiempat. *Desimal: Jurnal Matematika, 1*(2), 165–172. http://ejournal.radenintan.ac.id/index.php/desimal/index

Widyaningrum, R., Sarwanto, & Karyanto, P. (2013). Pengembangan modul berorientasi POE (predict, observe, explain) berwawasan lingkungan pada materi pencemaran untuk meningkatkan hasil belajar siswa. *Jurnal Inkuiri, 2*(3), 245–252.