Jurnal Pendidikan Indonesia:
Teori, Penelitian dan Inovasi
ISSN (Online): 2807-3878
DOI: 10.59818/jpi.v6i1.2618
Vol. 6, No.1, Januari 2026

Efforts to Improve Scientific Literacy Through Ethnoscience-Based Learning in Science Learning

Nurul Hidayah Nasution[1*], Irda Wahidah Nasution[2]
[1] STIT HASIBA, Indonesia
[2] Tjut Nyak Dhien University, Indonesia
E-mail: 1nnurul407@gmail.com[1], irdawahidah26@gmail.com[2]

RIWAYAT ARTIKEL
Received : 2026-01-16
Revised : 2026-01-28
Accepted : 2026-01-29

KEYWORDS
Scientific Literacy, Ethnoscience-Based Learning, Science Education, Local Culture

KATA KUNCI
Literasi Sains, Pembelajaran Berbasis Etnosains, Pembelajaran Ipa, Budaya Lokal.

ABSTRACT
Education in the 21st century demands students to possess critical and creative thinking skills, effective communication abilities, and collaborative competencies in the learning process. Science education plays a strategic role in integrating literacy skills with scientific understanding, as it examines natural phenomena through systematic scientific methods. In science learning, students are expected not only to master scientific concepts but also to develop problem-solving skills, critical thinking, and the ability to apply knowledge in real-life contexts. However, scientific literacy that integrates cultural perspectives remains insufficiently emphasized in the Indonesian education curriculum. Incorporating scientific literacy through cultural contexts is essential as an effort to strengthen students' sense of patriotism and appreciation of national cultural identity. This article employs a literature review method by analyzing and synthesizing findings from national research articles related to ethnoscience-based learning and scientific literacy. A meta-analysis approach was conducted by tracing relevant publications indexed in Google Scholar and Portal Garuda from 2023 to 2025. The selected articles were analyzed descriptively to identify patterns, key findings, and implications regarding the effectiveness of ethnoscience-based learning in enhancing students' scientific literacy. The results of the analysis indicate that ethnoscience-based learning contributes positively to students' attitudes toward science, conceptual understanding, and scientific reasoning skills. This approach emphasizes integrated understanding by connecting scientific concepts with local culture, traditional knowledge, and the surrounding environment, thereby making learning more contextual and meaningful. Furthermore, the appropriate use of learning media aligned with instructional objectives, learning materials, and students' characteristics is crucial in supporting the successful implementation of ethnoscience-based learning. Overall, ethnoscience-based learning is a promising approach to improving scientific literacy while preserving and valuing local cultural wisdom.

ABSTRAK
Pendidikan abad ke-21 menuntut peserta didik memiliki keterampilan berpikir kritis dan kreatif, kemampuan berkomunikasi secara efektif, serta keterampilan bekerja sama dalam proses pembelajaran. Pembelajaran IPA memiliki peran strategis dalam mengintegrasikan kemampuan literasi dengan pemahaman sains, karena IPA mempelajari fenomena alam melalui metode ilmiah yang sistematis. Dalam pembelajaran IPA, peserta didik tidak hanya dituntut memahami konsep,

tetapi juga mengembangkan kemampuan pemecahan masalah, berpikir kritis, dan penerapan pengetahuan dalam kehidupan sehari-hari. Namun demikian, literasi sains yang terintegrasi dengan aspek budaya masih jarang mendapat perhatian dalam kurikulum pendidikan di Indonesia. Padahal, penerapan literasi sains berbasis budaya penting sebagai upaya menumbuhkan rasa cinta tanah air melalui penguatan identitas budaya bangsa. Artikel ini menggunakan metode kajian pustaka dengan menganalisis dan menelaah artikel penelitian nasional yang relevan dengan pembelajaran berbasis etnosains dan literasi sains. Penelusuran artikel dilakukan melalui Google Scholar dan Portal Garuda pada rentang tahun 2023–2025. Data dianalisis menggunakan metode deskriptif untuk menggambarkan temuan penelitian, kemudian disintesis guna memperoleh kesimpulan mengenai peran pembelajaran berbasis etnosains dalam meningkatkan literasi sains. Hasil kajian menunjukkan bahwa pembelajaran berbasis etnosains mampu mengembangkan sikap positif terhadap sains, meningkatkan pemahaman konsep, serta memperkuat kemampuan berpikir ilmiah peserta didik. Pendekatan ini menekankan pemahaman terpadu dengan mengaitkan konsep sains dengan budaya lokal, pengetahuan tradisional, dan lingkungan sekitar sehingga pembelajaran menjadi lebih kontekstual dan bermakna. Selain itu, pemilihan media pembelajaran yang sesuai dengan tujuan, materi, dan karakteristik peserta didik menjadi faktor penting dalam mendukung efektivitas pembelajaran berbasis etnosains.

1. Introduction

Education in the 21st century expects students to have critical and creative thinking skills, be able to communicate opinions, and be able to work collaboratively in the learning process (Imaniar and Astutik, 2019). In the 21st century, science and technology are developing rapidly, allowing everything to be easily controlled. To keep pace with these developments, students must understand technological developments and be able to use them wisely. As the times become increasingly modern, society, especially students, is required to be able to compete and adapt to become more qualified human resources. A country can be said to be developed with its quality human resources. Improving human resources can be done by improving the quality of education. One way to improve educational aspects is by increasing scientific literacy in learning, as Indonesia currently ranks low in the Program for International Student Assessment (PISA, 2024). Out of 69 countries, Indonesian students' achievements still rank 62nd, 61st, and 63rd in science, reading, and mathematics, respectively. Literacy development has been widely implemented in the education sector of various countries.

One subject that can integrate literacy and science is science. Science is the study of natural phenomena through scientific methods. In science learning, students are not only required to understand concepts but also to develop problem-solving skills and critical thinking skills. In science learning, students should not only learn facts and concepts but also engage in scientific literacy to gain scientific discoveries and knowledge. However, in practice, science learning is carried out using methods that are not varied and do not emphasize students' scientific literacy. The low level of student literacy means that the quality of education in Indonesia will lag behind other countries that have begun to promote literacy programs, especially scientific literacy.

Through an invitation by UNESCO to attend the International forum on science and technological literacy for all in Paris, the realization of the workshop on scientific and technological literacy for all in Asia and the Pacific in Tokyo played a role as the beginning of the introduction of scientific literacy in Indonesia in 1993. Scientific literacy began to be accommodated in the 2006 curriculum (KTSP) and was more clearly visible in the 2013 curriculum through inquiry activities and scientific approaches. The ethnoscience approach can be integrated into various learning models, including: discovery learning models, problem-based learning (PBL), project-based learning (PjBL), constructivism approaches, contextual learning, and others. This implementation requires a shift in the learning model from teacher-centered learning to student-centered learning, from individual learning to collaborative learning and emphasizes the application of scientific knowledge, creativity and problem solving in the process of reconstructing original science (knowledge that develops in society) into scientific science.

Scientific literacy in culture is rarely included in the Indonesian education curriculum. This scientific literacy should be implemented as a form of fostering patriotism through the nation's cultural identity within the community. The need for scientific literacy in culture is a step in equipping students to cultivate a spirit of patriotism and local wisdom. Therefore, this article was written to raise awareness of the importance of ethnoscience-based learning in efforts to improve scientific literacy in junior high school science learning, especially in the 21st century.

Learning that integrates culture as a learning resource can be referred to as learning with elements of ethnoscience (Pertiwi and Langitasari, 2021). Ethnoscience is an approach that creates a learning atmosphere by connecting cultural elements as integral components of the learning process. Learning using an ethnoscience approach plays a crucial role in making student learning more meaningful and can influence improvements in student academic outcomes (Pertiwi & Rusyda Firdausi, 2019). One type of learning that aligns with the ethnoscience approach is science learning. Science learning is a teaching and learning process that focuses on the understanding and application of scientific concepts related to physics, chemistry, biology, and the environment. Science learning involves interactions between various learning elements with the goal of achieving predetermined competencies (Wisudawati and Sulistyowati, 2022). Science learning plays a crucial role in students' ability to develop scientific attitudes in observing their surroundings and develop the skills to solve problems they face. Science learning emphasizes students' ability to discover ideas and observe scientific phenomena occurring in their surroundings. Therefore, the role of educators is not only limited to being teachers who convey knowledge, but also as facilitators who help students overcome difficulties in understanding science material (Rusilowati et al., 2021).

2. Research Methods

This study employed a literature review method to comprehensively examine research findings related to ethnoscience-based learning and its role in improving students' scientific literacy. A literature review was selected as the research design to synthesize existing knowledge, identify research trends, and provide a systematic understanding of how ethnoscience approaches have been implemented in science learning contexts, particularly within Indonesian education.

The data sources consisted of national research articles obtained from reputable academic databases, namely Google Scholar and Portal Garuda. These platforms were chosen because they provide access to peer-reviewed journals that reflect current educational research developments in Indonesia. The article selection process focused on publications issued between 2023 and 2025 to ensure the relevance and timeliness of the analyzed studies. Keywords used in the search process included scientific literacy, ethnoscience-based learning, science learning, and local culture. The inclusion criteria required that articles explicitly discuss ethnoscience approaches in science education and report outcomes related to scientific literacy, learning processes, or students' attitudes toward science.

After the identification stage, selected articles were screened and reviewed to ensure their alignment with the research objectives. Articles that did not directly address ethnoscience-based learning or scientific literacy were excluded. The final set of articles was then analyzed using a descriptive qualitative approach. This approach was applied to systematically describe and interpret the findings reported in each study, including research objectives, methods, learning models applied, educational contexts, and reported impacts on scientific literacy.

The analysis process involved categorizing the findings into thematic aspects, such as the role of local culture in science learning, the influence of ethnoscience-based strategies on students' conceptual understanding and scientific attitudes, and the use of learning media to support instructional effectiveness. Data from the reviewed articles were then compared and synthesized to identify recurring patterns, similarities, and differences among the studies.

Based on the descriptive analysis, conclusions were drawn by integrating evidence from multiple sources to provide a comprehensive overview of the effectiveness of ethnoscience-based learning in enhancing scientific literacy. This method allows for a deeper understanding of how ethnoscience contributes to meaningful science learning while strengthening students' appreciation of cultural values. The results of this literature review are expected to serve as a theoretical and empirical reference for educators and researchers in developing culturally responsive science learning strategies.

3. Results and Discussion

Conceptual Foundations and Characteristics of Ethnoscience-Based Learning

Ethnoscience-based learning originates from the concept of ethnoscience, derived from the Greek term ethnos meaning nation or ethnic group and the Latin scientia meaning knowledge. Ethnoscience thus refers to a system of knowledge that is deeply rooted in the cultural practices, beliefs, and lived experiences of a particular community (Parmin, 2017). Unlike universal scientific knowledge that is often presented abstractly, ethnoscience emphasizes culturally situated cognition, highlighting how different societies construct and interpret natural phenomena through local wisdom, traditions, and empirical practices developed across generations.

In the context of science education, ethnoscience-based learning is understood as an instructional approach that integrates local culture into the learning process to create meaningful and contextual learning experiences (Sardjiyo & Pannen, 2005). This approach aligns with curriculum orientations in Indonesia that emphasize contextual learning and learner-centered pedagogy, as reflected in the KTSP framework (Depdiknas, 2006). By connecting scientific concepts with students' cultural backgrounds, ethnoscience facilitates the transition from abstract scientific explanations to concrete and relevant understanding.

One of the defining characteristics of ethnoscience-based learning is its emphasis on integrated understanding rather than fragmented or purely theoretical mastery of concepts. Krajcik et al. (1999) argue that meaningful science learning occurs when students are encouraged to connect concepts, processes, and real-world applications through inquiry-based and project-oriented experiences. Ethnoscience supports this integration by positioning culture as a bridge between students' prior knowledge and formal scientific explanations. This integration not only strengthens conceptual understanding but also enhances students' motivation and engagement in learning activities.

Furthermore, Holbrook and Rannikmae (2009) highlight that scientific literacy is not limited to cognitive achievement but also involves affective dimensions, such as attitudes toward science and its relevance to society. Ethnoscience-based learning contributes to the development of positive attitudes toward science by presenting science as a human endeavor that is closely connected to everyday life and cultural practices. When students recognize that scientific concepts are embedded in familiar cultural contexts such as traditional medicine, local food processing, or environmental management they are more likely to view science as meaningful and accessible.

This culturally responsive orientation also resonates with contemporary educational demands in the 21st century, which emphasize critical thinking, creativity, communication, and collaboration (Astuti et al., 2019). Ethnoscience-based learning naturally fosters these competencies by encouraging students to discuss cultural practices, analyze empirical evidence from their environment, and collaboratively construct scientific explanations. Such learning experiences align with inquiry-based and problem-based learning models, which have been shown to improve higher-order thinking skills and problem-solving abilities (Gunardi, 2020; Sajidan et al., 2022).

In addition, ethnoscience-based learning reflects broader educational values that emphasize character development and social responsibility. Studies on character education grounded in local wisdom demonstrate that cultural integration in learning strengthens students' moral awareness and social sensitivity (Khoiriyah et al., 2025; Fitriyah et al., 2024). Thus, ethnoscience not only supports cognitive development but also contributes to holistic education by nurturing students' identity, values, and sense of belonging.

Ethnoscience-based learning represents a pedagogical framework that bridges scientific knowledge and cultural context. By integrating local wisdom into science instruction, this approach fosters integrated understanding, positive attitudes toward science, and the development of essential 21st-century skills, thereby laying a strong foundation for enhancing scientific literacy.

The Role of Ethnoscience in Enhancing Scientific Literacy and Learning Processes

Scientific literacy is widely recognized as a key outcome of science education, encompassing the ability to understand scientific concepts, apply scientific knowledge, evaluate evidence, and make informed decisions related to science and technology (Holbrook & Rannikmae, 2009; OECD, 2024). In the Indonesian context, efforts to enhance scientific literacy remain a significant challenge, particularly due to the dominance of teacher-centered instruction and limited contextualization of learning materials (Wisudawati & Sulistyowati, 2022). Ethnoscience-based learning offers a strategic response to this challenge by situating science learning within students' cultural and environmental contexts.

According to Atmojo (2012), ethnoscience-based learning encourages a shift from Teacher-Centered Learning (TCL) to Student-Centered Learning (SCL). Through direct engagement with cultural phenomena, students actively observe, investigate, and interpret natural processes, thereby constructing knowledge through experiential learning. This process is consistent with inquiry-based learning principles, which emphasize exploration, questioning, and evidence-based reasoning (Gunardi, 2020; Syafruddin et al., 2025).

Empirical studies consistently demonstrate that ethnoscience-based learning improves students' scientific literacy. Pertiwi and Firdausi (2019) found that integrating local cultural practices into science instruction significantly enhanced students' ability to explain scientific phenomena and apply scientific concepts in real-life situations. Similarly, research by Rahayu et al. (2006) showed that learning based on traditional knowledge of medicinal plants resulted in deeper understanding and stronger retention of scientific concepts because the learning experience was meaningful and relevant to students' daily lives.

Ethnoscience-based learning also supports the development of core scientific literacy competencies outlined in international frameworks, such as identifying scientific questions, explaining phenomena scientifically, and using scientific evidence to draw conclusions (OECD, 2024). Through direct observation of cultural practices such as food fermentation, traditional agriculture, or environmental conservation students engage in authentic scientific inquiry. These activities enable them to connect empirical observations with theoretical explanations, thereby strengthening their reasoning and argumentation skills (Hadianto et al., 2021).

Moreover, the integration of culture in science learning fosters critical and creative thinking. When students are encouraged to analyze cultural practices through a scientific lens, they engage in higher-order thinking processes, such as comparing traditional knowledge with modern scientific explanations and evaluating the effectiveness of local practices. This process aligns with research showing that contextual and problem-based learning enhances creativity and problem-solving skills (Boom-Cárcamo et al., 2024; Elsa Dian et al., 2024).

Ethnoscience-based learning also has implications for character and value education. By recognizing the scientific value of local wisdom, students develop respect for cultural heritage and a sense of responsibility toward their environment and community. This aligns with studies emphasizing the integration of ethical and critical thinking dimensions in education, including Islamic and cultural perspectives (Junoh et al., 2021; Suyadi, 2021; Sofiatil et al., 2024).

In summary, ethnoscience-based learning plays a crucial role in enhancing scientific literacy by promoting active learning, contextual understanding, and critical inquiry. By bridging scientific concepts with cultural experiences, this approach not only improves cognitive outcomes but also nurtures attitudes, values, and skills essential for scientifically literate citizens.

Learning Media, Instructional Strategies, and the Effectiveness of Ethnoscience-Based Implementation

The effectiveness of ethnoscience-based learning is strongly influenced by the selection of appropriate learning media and instructional strategies. Learning media serve as a bridge between abstract scientific concepts and students' concrete experiences, making them an essential component of effective instruction (Latip, 2022). In ethnoscience-based learning, media should be designed to reflect local culture and environmental contexts while aligning with learning objectives and students' characteristics.

One widely used medium in ethnoscience-based instruction is ethnoscience-themed student worksheets (LKPD). Research by Pertiwi et al. (2021) demonstrates that LKPD integrating local cultural contexts significantly improves students' scientific literacy, particularly in terms of conceptual understanding and evidence-based reasoning. Through structured activities such as observation, discussion, and experimentation, students actively engage with scientific content while relating it to familiar cultural practices.

The use of ethnoscience-based worksheets also fosters collaborative learning and communication skills. Group discussions and presentations encourage students to articulate their ideas, evaluate peers' arguments, and collectively construct scientific explanations. These processes are consistent with collaborative learning models shown to enhance engagement and learning outcomes (Sajidan et al., 2022; Rusilowati et al., 2021). Furthermore, incorporating assessment strategies such as quizzes and group rewards can motivate students and promote accountability within learning groups.

Advancements in educational technology further expand the potential of ethnoscience-based learning media. Multimedia resources, augmented reality, and digital platforms can be utilized to visualize cultural practices and scientific processes, thereby enhancing

students' understanding and creativity (Sahronih et al., 2024; Zamzami et al., 2023). Additionally, the integration of emerging technologies such as artificial intelligence offers new opportunities for personalized and adaptive learning in science education (Mustofa et al., 2025).

From a scientific literacy perspective, effective learning media should highlight the interaction between science, technology, and society. Allchin (2014) emphasizes that scientific literacy involves understanding how science influences and is influenced by social and technological contexts. Ethnoscience-based media exemplify this interaction by illustrating how traditional knowledge contributes to technological innovation and societal well-being.

In conclusion, the successful implementation of ethnoscience-based learning depends on the strategic use of learning media and instructional strategies that are culturally responsive, pedagogically sound, and technologically supported. When well-designed, these elements enhance students' scientific literacy, engagement, and appreciation of cultural wisdom, thereby reinforcing the relevance of science learning in contemporary education.

4. Conclusion

Improving scientific literacy is a crucial priority in enhancing the quality of education, particularly in Indonesia, where students' literacy levels are still relatively low. Scientific literacy is not only related to the mastery of scientific concepts but also to the ability to think critically, solve problems, and apply scientific knowledge in everyday life. This study highlights that ethnoscience-based learning represents a relevant and effective approach to addressing these challenges. By integrating cultural values, local wisdom, and students' lived experiences into science learning, ethnoscience-based instruction creates a more contextual, meaningful, and student-centered learning environment that supports the development of scientific understanding and reasoning skills.

Ethnoscience-based learning positions local culture and the surrounding environment as valuable learning resources, enabling students to connect scientific concepts with real-world phenomena familiar to them. This approach enhances students' engagement, positive attitudes toward science, and academic achievement while simultaneously fostering appreciation for cultural identity and national heritage. Therefore, ethnoscience-based learning can serve as a strategic reference for educators and curriculum developers in designing science instruction aimed at improving scientific literacy. Its implementation is expected to contribute not only to improved learning outcomes but also to the development of scientifically literate individuals who are culturally grounded and capable of responding critically to scientific and technological developments in society.

5. References

Allchin, D. (2014). From science studies to scientific literacy: A view from the classroom. *Science & Education, 23*(9), 1911–1932.

Astuti, A. P., et al. (2019). Preparing 21st century teachers: Implementation of 4C character's pre-service teacher through teaching practice. *Journal of Physics*, 1–8.

Atmojo, S. E. (2012). *Profil keterampilan proses sains dan apresiasi siswa terhadap profesi pengrajin tempe dalam pembelajaran IPA.* Universitas Muhammadiyah Surakarta.

Boom-Cárcamo, C., Galleguillos, P. F., & Torres, P. (2024). The effect of gamification and problem-based learning on university students' creativity and problem-solving skills. *Thinking Skills and Creativity, 53*, 101315. doi:10.1016/j.tsc.2024.101315

Depdiknas. (2006). *Kurikulum tingkat satuan pendidikan (KTSP) untuk SMP/MTs.* Jakarta: Terbitan Depdiknas.

Elsa Dian, Mayanti, Putra, & Kurnia, A. (2024). Pengaruh game based learning dengan gamification terhadap kemampuan berpikir kreatif dan keterampilan kolaboratif siswa (Studi kasus mata pelajaran IPS di SMP N 2 Malang). *Jurnal Ekonomi, Bisnis dan Pendidikan, 3*(9), 3. doi:10.17977/um066v3i92023p3

Emdin, C. (2011). Droppin' science and dropping science: African American males and urban science education. *Journal of African American Males in Education, 2*(1), 1–15.

Fitri, G., Yunita, W., & Harahap, A. (2023). The differences on the grammar learning strategies used based on the students' gender perspective. *Linguists: Journal of Linguistics and Language Teaching, 9*(2), 272–283. doi:10.29300/ling.v9i2.3855

Fitriyah, A. W., Bahzar, M., Ningsih, I. W., & Aji, Y. A. (2024). The role of Islamic religion teachers in overcoming egocentrism among students at Madrasah Ibtidaiyah Ibrahimy. *At-Turāṡ: Jurnal Studi Keislaman, 11*(2), 193–209. doi:10.33650/at-turas.v11i2.9674

Gunardi. (2020). Inquiry based learning dapat

meningkatkan hasil belajar siswa dalam pelajaran matematika. *Social, Humanities, and Education Studies (SHEs): Conference Series, 3*(3), 2288–2294.

Hadianto, D., Damaianti, V. S., Mulyati, Y., & Sastromiharjo, A. (2021). Enhancing scientific argumentation skill through partnership comprehensive literacy. *Journal of Physics: Conference Series, 2098*(1). doi:10.1088/1742-6596/2098/1/012015

Holbrook, J., & Rannikmae, M. (2009). The meaning of scientific literacy. *International Journal of Environmental and Science Education, 4*(3), 275–288.

Junoh, N., Mohamad, A. M., Mustafa@Busu, Z., & Mat Jusoh, N. A. (2021). Islamic critical thinking: An analysis of its significance based on the Al-Quran and scholarly views. *'Abqari Journal, 25*(1), 33–48. doi:10.33102/abqari.vol24no2.377

Khoiriyah, K., Suteja, J., Rintaningrum, R., Ningrum, D. A., & Aji, Y. A. (2025). Haul as a medium for character education: Building local wisdom through kiai tradition. *Mimbar Agama Budaya, 42*(1), 44–53. doi:10.15408/mimbar.v42i1.46282

Krajcik, J. S., Czerniak, C. M., & Berger, C. (1999). *Teaching children science: A project-based approach.* Boston: McGraw-Hill.

Latip, A. (2022). Penerapan model ADDIE dalam pengembangan multimedia pembelajaran berbasis literasi sains. *DIKSAINS: Jurnal Ilmiah Pendidikan Sains, 2*(2), 102–108. doi:10.33369/diksains.2.2.102-108

Mustofa, H. A., Kola, A. J., & Owusu-Darko, I. (2025). Integration of artificial intelligence (ChatGPT) into science teaching and learning. *International Journal of Ethnoscience and Technology in Education, 2*(1), 108–118. doi:10.33394/ijete.v2i1.14195

OECD. (2024). *PISA 2026 assessment and analytical framework.* Paris: OECD Publishing.

Parmin. (2017). *Ethnosains.* Swadaya Manunggal.

Pertiwi, U. D., & Firdausi, U. Y. R. (2019). Upaya meningkatkan literasi sains melalui pembelajaran berbasis etnosains. *Indonesian Journal of Natural Science Education (IJNSE), 2*(1), 120–124.

Pertiwi, W. J., Solfarina, S., & Langitasari, I. (2021). Pengembangan lembar kerja peserta didik (LKPD) berbasis etnosains pada konsep larutan elektrolit dan nonelektrolit. *Jurnal Inovasi Pendidikan Kimia, 15*(1), 2717–2730.

Rahayu, M., Sunarti, S., Sulistiarini, D., & Prawiroatmodjo, S. (2006). Pemanfaatan tumbuhan obat secara tradisional oleh masyarakat lokal di Pulau Wawonii, Sulawesi Tenggara. *Buletin Teknologi dan Industri Pangan, 11*(2), 245–250.

Rusilowati, A. S., Khumaedi, M., & Kurniawati, D. (2021). *Strategi pembelajaran blended learning.* Semarang: Penerbit UNNES Press.

Sahronih, S., Sholeha, H. H., Reza, M. F., Wicaksono, J. W., Nurfadillah, I., & Savitri, S. (2024). Augmented reality-based learning media training to develop elementary school teachers' creativity. *Prima Abdika: Jurnal Pengabdian Masyarakat, 4*(4), 930–942. doi:10.37478/abdika.v4i4.5118

Sajidan, Suranto, Atmojo, I. R. W., Saputri, D. Y., & Etviana, R. (2022). Problem-based learning-collaboration (PBL-C) model in elementary school science learning in the industrial revolution era 4.0 and Indonesia Society 5.0. *Jurnal Pendidikan IPA Indonesia, 11*(3), 477–488. doi:10.15294/jpii.v11i3.30631

Sardjiyo, & Pannen, P. (2005). Pembelajaran berbasis budaya: Model inovasi pembelajaran dan implementasi kurikulum berbasis kompetensi. *Jurnal Pendidikan, 6*(2), 83–98.

Sayakti, L. (2003). *Implementasi konsep lingkungan hidup sebagai sumber belajar dalam pembelajaran IPS di sekolah dasar* (Tesis S2). SPs UPI, Bandung.

Sofiatil, L., Sri, J., Dian, H., Ovianti, F., Ika, I., & Sofiani, K. (2024). Pemikiran kritis terhadap pendidikan Islam: Pendekatan inovatif untuk masa depan. *QISTINA: Jurnal Multidisiplin Indonesia, 3*(2), 975–980. doi:10.57235/qistina.v3i2.2865

Suyadi. (2021). The insertion of anti-corruption education into Islamic education learning based on neuroscience. *International Journal of Evaluation and Research in Education, 10*(4), 1417–1425. doi:10.11591/IJERE.V10I4.21881

Syafruddin, S., Muhyiddin, M., Mahmudin Nst, A., Wingkolatin, W., Rintaningrum, R., & Aji, Y. A. (2025). The application of Islamic critical thinking in inquiry-based learning in traditional Islamic educational institutions. *Scaffolding: Jurnal Pendidikan Islam dan Multikulturalisme, 7*(1), 860–874. doi:10.37680/scaffolding.v7i1.7264

Wisudawati, A. W., & Sulistyowati, E. (2022). *Metodologi pembelajaran IPA.* Jakarta: Bumi Aksara.

Zamzami, M., Syarkawi, & Karimuddin. (2023). Komunikasi visual dalam konten dakwah Islam

untuk menurunkan risiko misinformasi keagamaan di media sosial. *Jurnal Komunikasi dan Penyiaran Islam, 3*(1), 70–77. doi:10.51192/ja.v3i1.2109