14 (2) (2025) 236-244

Unnes Science Education Journal
Accredited Sinta 2

https://journal.unnes.ac.id/journals/usej

Ethnoscience E-Supplement for Critical Thinking and Cognitive Outcomes

Irfan Ihza Wardana✉, Sigit Saptono, Novi Ratna Dewi

DOI: http://dx.doi.org/10.15294/usej.v13i1.28898

Universitas Negeri Semarang, Indonesia

Article Info

Submitted 2025-06-15
Revised 2025-07-30
Accepted 2025-08-30

Keywords

Cognitive Learning Outcomes; Critical Thinking Skills; Ethnoscience; E-supplement

Abstract

Most education systems have not fully supported the development of students' critical thinking skills, partly due to the limitations of teaching materials that only refer to textbooks. Complex material such as Earth Structure requires a more contextual and meaningful approach. One strategy that can be used is the development of ethnoscience-laden e-supplementary teaching materials that link the material with local wisdom. This study aims to analyze the validity, practicality, effectiveness, and characteristics of Ethnoscience-Laden E-Supplement Teaching Materials to improve students' critical thinking skills and cognitive learning outcomes. The research used the ADDIE development model with instruments in the form of questionnaires, validation sheets, pretests, and posttests. The results showed that the E-Supplement was feasible to use in learning, with material validity of 94% and media of 95% (very valid category). The E-Supplement was also effective in improving critical thinking skills (average 69%, high category) and cognitive learning outcomes (N-Gain 61%, moderately effective category). Practicality was rated very well by teachers (97.67%) and students (85%). The characteristics of the E-Supplement are contextual, practical, and easy to use, and they raise the ethnoscience of the Sikidang Crater legend to increase student involvement and understanding in learning.

How to Cite

Wardana, I. I., Saptono, S., & Dewi, N. R. (2025). Ethnoscience E-Supplement for Critical Thinking and Cognitive Outcomes. *Unnes Science Education Journal*, 14(2), 236-244.

✉ Correspondence Author:
E-mail: Irfanwardana97@students.unnes.ac.id

p-ISSN 2252-6617
e-ISSN 2502-6232

INTRODUCTION

The 21st century skills are demanded in the curriculum at all levels of education to prepare students for the world of work (Muttaqiin, 2023). In formal education, students are expected to master the 4C skills: critical thinking, communication, collaboration, and creativity (Subarkah et al., 2024). Understanding the concept of the 21st century is closely related to social changes in the Information Age and the Industrial Revolution 4.0 (Saputra et al., 2024). This revolution has brought major changes, including in the field of education (Yanti et al., 2024). Technology opens up new opportunities in learning, expanding access to information, increasing teacher-student interaction, and encouraging active, creative, and interesting learning (Rahayu et al., 2023). Therefore, the use of technology is an important tool in supporting learning while developing 21st century skills, especially critical thinking.

It is important for students to have 21st century competencies, one of which is the ability to think critically. Nantara (2021) mentioned that this ability involves analyzing ideas in depth based on evidence and facts. However, most education systems have not fully supported its development (Mirfaka & Kumala, 2023). The observation results show that students' critical thinking skills are still low, with an average pretest score of class VIII G of 40% and VIII H of 35%. Maslakhatunni'mah et al., (2019) also found that 40% of students were still confused about understanding the material. Many students still tend to memorize, so they consider science a difficult subject. This is reinforced by Allanta & Puspita (2021), who stated that the biology learning model at school is not optimal in training critical thinking skills.

Research by Hesy et al., (2023) shows that many students do not understand science material, so it has an impact on low critical thinking skills, characterized by scores below KKM 75. A similar thing was found by Sarip et al., (2022), who reported that students' critical thinking skills were still low, with an inference indicator of only 23.98%. This low ability is due to the lack of critical thinking-based question practice and unsupportive learning habits. Fajari & Chumdari, (2021) also found that only 10% of students scored above the passing score. The contributing factors include errors in answering questions and ineffective teaching methods. (Kartika et al., 2020). added that the teacher's dominance in learning also contributed to students' weak critical thinking skills.

The low critical thinking ability of students is caused by ineffective teaching materials, such as LKS and printed books with conventional approaches (Suryaningsih & Nurlita, 2021). Interviews with three science teachers showed that learning resources were still limited to the Ministry of Education and Culture's package books. The questionnaire results also show that learning is still dominated by the teacher and the use of the blackboard. Conventional textbooks are considered less relevant to real life, so they do not train the application of critical thinking Anggitasari & Widyaningrum (2021). For this reason, innovative teaching materials are needed, one of which is an ethnoscience-laden e-supplement that integrates science with local wisdom.

Zaky et al., (2023) argue that e-supplementary teaching materials are digital learning materials that support the teaching and learning process. According to Arfianawati et al., (2016), the use of local culture can improve the quality of learning. E-supplement with ethnoscience content is an innovation that combines scientific knowledge with local wisdom. The material is presented digitally so that it is easily accessible, flexible, and interactive. E-supplements also function as a complement to conventional teaching materials to deepen and strengthen student understanding (Nafi'ah, 2021).

Ethnoscience e-supplements not only provide easy access, but also integrate cultural context and daily life into the learning process. This approach plays a role in increasing the relevance and interconnectedness of science concepts, and has proven effective in developing students' critical thinking skills (Sunaryo et al., 2023). Ethnoscience refers to the transformation of local knowledge that is passed down from generation to generation, although still influenced by mythical elements, and covers various fields such as agriculture, ecology, medicine, and knowledge of flora and fauna (Ahmad et al., 2020; Khoiri & Sunarno, 2018). The application of ethnoscience in learning aims to bridge abstract science concepts, such as Earth Structure material, with local facts and phenomena in society.

Earth structure material is complex, covering topics such as the layers of the earth, the movement of tectonic plates, and their impact on natural phenomena, which are often considered abstract and difficult to understand (Costarica & Vebrianto, 2022). The legend of Sikidang Crater from Banjarnegara, which tells the story of Shinta Dewi and Kidang Garungan, can be a contextual introduction to science learning. Based on an interview with Mr. Rohmat, Dieng Kulon Village

Administration staff, the legend tells of Shinta Dewi's rejection of King Kidang Garungan's proposal, who was then trapped in a well. The eruption of hot mud in the crater is believed to symbolize the god's anger and reflect local geothermal activity. Connecting legends with science helps students understand natural phenomena contextually while appreciating local culture (Williams & Rudge, 2019). The integration of scientific concepts into cultural contexts makes learning more relevant and meaningful. Ethnoscience not only increases student engagement but also trains critical thinking in solving culture-based problems (Gummah et al., 2023). Therefore, it is necessary to develop ethnoscience-infused e-supplement teaching materials on Earth structure material to improve students' critical thinking skills and cognitive learning outcomes. The purpose of this study was to analyze the validity, effectiveness, practicality, and characteristics of ethnoscience-loaded e-supplement teaching materials on Earth structure material. Previous research tends to focus on ethnoscience integration without developing critical thinking skills. This research presents a novelty by integrating the legend of Sikidang Crater in Earth Structure material through ethnoscience-loaded e-supplements designed at the same time to train critical thinking indicators in learning.

METHOD

This research employs the ADDIE development model, originally developed by Dick and Carey, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation Pitriani et al, (2021). This model was selected due to its detailed and flexible structure, allowing for evaluation and revision at each stage, thereby enabling the ethnoscience e-supplement to be adapted to students' needs.

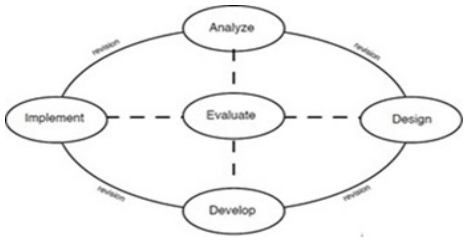

Figure 1. ADDIE Approach Dick & Carey (Pitriani, et al., 2021)

The product developed in this research is E-Supplementary Teaching Materials with Ethnoscience Content on Earth Structure Material to Improve Critical Thinking Ability and Cognitive Learning Outcomes. Critical thinking skills include interpretation, inference, analysis, evaluation, and argument (Ennis, 2018). Cognitive learning outcomes include remembering, understanding, applying, analyzing, evaluating, and creating (Anderson and Krathwohl in Setyawati et al., 2021).

This study was conducted on VIII grade students of SMP Negeri 1 Bawang with a total sample of 67 students selected randomly (random sampling). Data were obtained through cognitive learning outcomes test (pretest-posttest), critical thinking ability test, as well as questionnaires and interviews to students, teachers, and experts. The independent variable is ethnoscience E-Supplement, while the dependent variable is critical thinking ability and cognitive learning outcomes.

The initial stage of development was carried out through a needs analysis of teaching materials. Interviews with three science teachers at SMP Negeri 1 Bawang showed limited learning resources, which only relied on textbooks and optional worksheets, making it less contextualized and not training students' critical thinking, especially on Earth Structure material. In addition, the questionnaire results showed that 61% of students considered the material difficult, 88% needed ethnoscience teaching materials, and 95% agreed that e-supplements were applied in learning. These findings confirm the importance of developing teaching materials that are interesting, contextualized, and relevant to the students' environment.

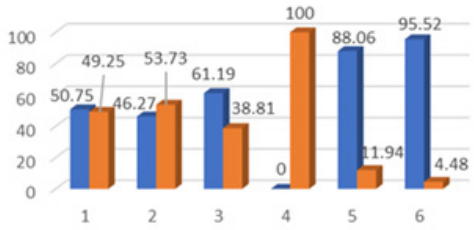

Figure 1. Results of Teaching Material Needs Questionnaire

The design stage is the planning process before product development. Researchers developed ethnoscience-laden e-supplements for Earth Structure materials using Canva to make them appear attractive and contextualized. The e-supplement was designed in flipbook format with the Heyzine application and divided into three parts: introduction, core, and cover. The content includes a cover, instructions, ethnoscience definitions, critical thinking skills, and learning outcomes, with harmonious layout, colors, and fonts.

Figure 2. Results of Teaching Material Needs Questionnaire

The development stage is the process of making e-supplements based on the design that has been prepared. At this stage, the ethnoscience e-supplement for Earth Structure material is developed thoroughly. First step is validity testing by material and media experts, including content, completeness, presentation, language, ethnoscience content, and visual appearance. Input from experts was used for product improvement.

After valid, readability test was conducted by VIII F class students who were not included in the experimental or control groups to avoid data bias. This test assessed the extent to which students understood the content of the e-supplement, including language clarity and delivery structure. The results showed an average score of 88% (very good category). Each test item received a high score, with an average above 3, indicating that the e-supplement was easy to understand.

The implementation stage is a large-scale trial of ethnoscience e-supplements to assess their effectiveness and practicality. Effectiveness is tested through improving students' critical thinking skills and cognitive learning outcomes using statistical analysis, such as homogeneity tests, normality tests, t-tests, and N-Gain. Practicality was assessed through teacher and student response questionnaires, which included ease of use, understandability, and usefulness in learning. The trial used a one-group pretest. Post-test design, which included giving a pre-test to measure initial ability, treatment in the form of learning with e-supplements, and a post-test to assess learning outcomes. Through this stage, an overview of the impact of using e-supplements on student understanding of Earth structure material was obtained.

The evaluation stage aims to assess the final quality of the ethnoscience e-supplement through formative and summative evaluation. Formative evaluation is conducted during the development process through material and media expert validation to improve the product. Meanwhile, summative evaluation is carried out after implementation to assess the effectiveness of e-supplements in improving critical thinking skills and cognitive learning outcomes, as well as their practicality based on teacher and student responses.

RESULT AND DISCUSSION

Validity of E-Supplement Teaching Materials

The results of validation by five science experts showed the level of validity of the e-supplement to be 94%, including a very valid category. The material is considered to fulfill the aspects of content, language, completeness, and ethnoscience content. However, the presentation score was the lowest (average 3 out of 4), so revisions were made by adding interactive digital quizzes to increase student attractiveness and understanding Ghifary et al., (2024).

Table 1. Revisions Based on Material Validation

Before Revision	After Revision
	
Display material in the form of text and learning videos	The material comes with interactive digital quizzes

The ethnoscience content in the material is considered relevant and supports contextual learning based on local culture. This is in line with the principles of the Merdeka Curriculum and has been proven to increase student engagement and understanding (Mukti et al., 2022; Septina et al., 2025).

The validation of media resulted in a high score of 95%, indicating that the visual design and presentation of the e-supplement were considered suitable and effective for use in learning. This score reflects the quality of the layout, color combinations, and organization of content in supporting student engagement. However, several improvements were made based on validator suggestions to further enhance its effectiveness. These included adding a culturally relevant image of the Sikidang Crater on the cover to strengthen the local wisdom aspect, revising the title to

better reflect the full scope of the material, and unifying the font style across pages to maintain consistency and readability. In addition, general videos were replaced with local traditional rituals to provide a deeper contextual experience for students. These revisions aimed not only to improve the media aesthetically but also to enrich its cultural and educational value through stronger ethnoscience integration.

Table 2. Revisions Based on Media Validation

Before Revision	After Revision
 The cover of the e-supplement has not displayed elements of local wisdom.	 The cover features an image of Sikidang Crater as a representation of ethnoscience content.
 The title only reflects one of the submaterials covered	 Title adjusted to cover the entire scope of e-supplement content
 The title font between pages (III, IV, V) inconsistent, distracting from the visual impression.	 The type and size of fonts are homogenized to improve consistency and reading comfort.
 Video showing the process of volcanic eruption in general.	 Video on traditional rituals around Sikidang Crater added to strengthen ethnoscience context

These revisions aim to strengthen the presentation aspect and ethnoscience integration. The addition of cultural elements and contextual visuals is believed to support students' understanding of scientific concepts Kumalasari et al., 2025; Wahyudin & Permatasari (2024). The revised media is not only academically valid but also more interactive, contextual, and effective to use in science learning in junior high school.

The practicality of e-supplements refers to the ease and efficiency of their use in learning, both by teachers and students. The questionnaire results show an average practicality score of 97.67% from teachers and 85% from students, both of which are in the very good category. This reflects that the e-supplement is easy to use, supports the learning process, and is in accordance with user needs. From the aspect of attractiveness, students considered the appearance of the e-supplement attractive because the design harmoniously combines letters, colors, text, and images, and is presented in the form of a flipbook which increases learning motivation. In terms of material, the content is considered complete, accurate, relevant to daily life, and encourages critical thinking. The materials are organized in a coherent, systematic, and easy-to-understand manner in the form of text, images, and videos, and are equipped with ethnoscience elements and evaluation. The language used is simple, easy to understand, and in accordance with Indonesian language rules.

From the aspect of helpfulness, e-supplements are considered practical, cost-effective, add learning resources, and help students understand science material and develop critical thinking skills. This finding is in line with the opinion of Fernando & Sarkity (2023) and Hidayat et al., (2024) who stated that practical products should be easy to use and effective in learning. In addition, the direct involvement of teachers and

students in the evaluation shows a user-centered design approach that is important to increase product effectiveness (Andriana et al., 2022).

Based on the results of questionnaires from teachers and students, the ethnoscience e-supplement obtained an average score in the Very Good category across all indicators, indicating that this product is effective and in accordance with learning needs. The first characteristic that stands out is practicality and ease of use. E-supplements are considered practical, portable, economical, and flexible because they are available in digital form that can be accessed at any time. Based on the results of questionnaires from teachers and students, the ethnoscience e-supplement obtained an average score in the Very Good category across all indicators, indicating that this product is effective and in accordance with learning needs. The first characteristic that stands out is practicality and ease of use.

E-supplements are considered practical, portable, economical, and flexible because they are available in digital form that can be accessed at any time. Pardede et al., (2025) asserted that good teaching materials should be flexible, cost-effective, and support students' learning independence which is reflected in this e-supplement. The next characteristic is its ability to expand learning resources. Teachers and students rated this e-supplement as an effective and interesting alternative in delivering the material. Kuway et al., (2023) stated that e-supplements are able to enrich the variety of learning resources tailored to student characteristics, as well as expand access to learning beyond conventional teaching materials. It also supports equal access to education, especially for students who have difficulty buying textbooks (Ningsih & Ulya, 2024; Bringman-Rodenbarger & Hortsch, 2020).

From the material aspect, the e-supplement presents content that is relevant to daily life, arranged systematically, easy to understand, and equipped with ethnoscience elements in the form of the legend of Sikidang Crater. This makes learning more contextual, interesting, and meaningful for students. Research shows that ethnoscience can strengthen the understanding of scientific concepts while instilling local cultural values (Gumilar et al., 2024; Supriatna et al., 2025; (Ogegbo & Ramnarain, 2024). In addition, e-supplements encourage independent and student-centred learning, as they invite them to explore the linkages between science and sociocultural contexts (Suryani et al., 2023; Besonia et al., 2023; Firmani & Wardani, 2022). However, device and internet connection limitations are still a challenge, but can be overcome through the provision of printed versions or offline files as well as school Wi-Fi facilities.

After applying the Ethnoscience-Infused E-Supplement, there was a significant increase in the experimental class compared to the control class, both in critical thinking skills and cognitive learning outcomes. Learning that involves the Sikidang Crater myth video, scientific analysis, and evidence-based argumentative discussions encourages students to think deeply and systematically.

Based on the pretest results, students' critical thinking skills in the experimental class only reached 40% and an average cognitive score of 60, while the control class was 35% and an average score of 58, all of which were classified as low. This is due to the limitations of teaching materials, learning approaches that have not trained critical thinking, and the lack of connection of material with everyday contexts (Chakampai, 2024).

The earlier research states that the ethnoscience approach can increase motivation, facilitate understanding of concepts, and encourage active learning because the material feels relevant to local culture and student life (Hidayati & Julianto 2025; Kharisma et al., 2023; Khoiriyah et al., 2021).

In addition, critical thinking skills have been shown to be positively correlated with cognitive learning outcomes (Raturoma & Laisnima 2023; Hamdani et al., 2022). In the control class, the increase in critical thinking was only moderate because it still used conventional methods. Meanwhile, the experimental class showed significant improvement thanks to contextual, interactive, and local culture-based learning.

The increase in critical thinking skills and cognitive learning outcomes in the experimental class shows that the ethnoscience-laden e-supplement effectively trains students' critical thinking skills. These skills do not appear instantly but through continuous practice (Putri et al., 2024). In contrast to the control class, which only experienced an average increase, the experimental class was trained to compile logical arguments and draw evidence-based conclusions in the discussion stage, in accordance with the findings of Wahdah et al., (2023)

The lack of variety and relevance of teaching materials in the control class causes students to be passive and less trained in critical thinking (Siahaan & Meilani, 2019; Dixit et al., 2021). In contrast, contextualized learning that is relevant to students' lives encourages active engagement and deep understanding. The support of diverse and meaningful learning resources is proven

to significantly strengthen critical thinking skills (Tanjung et al., 2023; Nur et al., 2023).

CONCLUSION

Based on the results of the study, it can be concluded that the E-Supplement of Ethnoscience-Infused Teaching Materials is feasible, effective, and practical to use in science learning on Earth Structure material. This product shows a very high level of validity, both from the material (94%) and media (95%) aspects. The use of e-supplements can significantly improve students' critical thinking skills and cognitive learning outcomes, with an average achievement of critical thinking skills of 69%, which is included in the high category, and an average N-Gain of 61% (moderately effective category). In terms of practicality, the e-supplement received excellent responses from teachers (97.67%) and students (85%), indicating that this product is easy to use, economical, and supports active student involvement. The characteristics of the e-supplement that integrates the local wisdom of the Sikidang Crater legend make learning more contextual, enrich the variety of learning resources, and encourage students to think critically in understanding science concepts that are close to their lives.

REFERENCES

Ahmad, L. S., Sakti, I., & Setiawan, I. (2020). Pengembangan Lembar Kerja Peserta Didik (Lkpd) Fisika Berbasis Etnosains Menggunakan Model Discovery Learning Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa SMA. *Jurnal Kumparan Fisika*, 3(2), 121–130. https://doi.org/10.33369/jkf.3.2.121-130

Allanta, T. R., & Puspita, L. (2021). Analisis keterampilan berpikir kritis dan self efficacy peserta didik: Dampak PjBL-STEM pada materi ekosistem. *Jurnal Inovasi Pendidikan IPA*, 7(2), 158–170. https://doi.org/10.21831/jipi.v7i2.42441

Andriana, Y., Kridalukmana, R., & Isnanto, R. R. (2022). Evaluasi dan Perancangan Kembali User Interface dan User Experience dengan Metode Perancangan Terpusat Pengguna pada Mobile App RS PKU CEPU Evaluation and Redesign User Interface and User Experience With User Centered Design Method on The Mobile App RS PK. *Jurnal Teknik …*, 1(3), 73–80. https://doi.org/10.14710/jtk.v1i3.36692

Anggitasari, V., & Widyaningrum, T. (2021). Pengembangan Berpikir Kritis Melalui Analisis Jurnal. *Prosiding Seminar Nasional Pendidikan Profesi Guru FKIP Universitas Ahmad Dahlan,* 1(1), 1954–1960. http://www.seminar.uad.ac.id/index.php/SemNasPPG/article/download/12105/2642

Arfianawati, S., Sudarmin, & Sumarni, W. (2016). Model Pembelajaran Kimia Berbasis Etnosains untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pengajaran MIPA*, 21, 46–51. https://doi.org/10.18269/jpmipa.v21i1.36256

Besonia, B. E. A., Espora, S. M. H., Bernardez, M. F. M., & Galagala, M. R. G. (2023). Culturally Relevant Supplemental e-Learning Materials in Teaching Purposive Communication. *TEM Journal*, 12(2), 634–639. https://doi.org/10.18421/TEM122-06

Bringman-Rodenbarger, L., & Hortsch, M. (2020). How students choose E-learning resources: The importance of ease, familiarity, and convenience. *FASEB BioAdvances*, 2(5), 286–295. https://doi.org/10.1096/fba.2019-00094

Chakampai, S. P. (2024). Design of Physics Teaching Material Based Guided Inquiry on Momentum and Impulse Materials To Support Critical Thinking Skills. *Physics Learning and Education*, 2(2), 74–80. https://doi.org/10.24036/ple.v2i2.35

Costarica, H., & Vebrianto, R. (2022). Pengembangan Media Pembelajaran Monopoli Pada Materi Struktur Bumi untuk Siswa SMP/MTs. *Journal of Natural Science Learning*, 1(1), 1–9. https://jom.uin-suska.ac.id/index.php/JNSL/article/view/5

Dixit, B., Bedekar, M., Jahagirdar, A., & Sathe, N. (2021). Role of active learning techniques in development of problem solving skills. *Journal of Engineering Education Transformations*, 34(Special Issue), 670–674. https://doi.org/10.16920/jeet/2021/v34i0/157241

Ennis, R. H. (2018). Critical Thinking Across the Curriculum: A Vision. *Topoi*, 37(1), 165–184. https://doi.org/10.1007/s11245-016-9401-4

Fajari, S. L. E. W., & Chumdari. (2021). Critical Thinking Skills And Their Impacts On Elementary School Students. *Malaysian Journal of Learning and Instruction*, 18(2), 161–187. https://doi.org/10.32890/mjli2021.18.2.6

Fernando, A., & Sarkity, D. (2023). Pengembangan Instrumen Uji Validitas dan Praktikalitas Media Pembelajaran IPA. *Pedagogi Hayati*, 6(2), 67–77. https://doi.org/10.31629/ph.v6i2.5212

Firmani, S. I., & Wardani, N. E. (2022). Implementation of Student-Centered Learning with Digital Media in Indonesian Language Learning in Junior High Schools during the COVID-19 Pandemic. *International Journal of English Literature and Social Sciences*, 7(1), 2456–7620. https://doi.org/10.22161/ijels

Ghifary, D. H. Al, Subroto, W. T., & Mustaji, M. (2024). Development of Digital Comic Interactive Media Toward Primary Students' Understanding of Concepts. *IJORER : International Journal of Recent Educational Research*, 5(1), 117–127. https://doi.org/10.46245/ijorer.v5i1.439

Gumilar, G., Hidayati, F. R. N., Mindaryani, Y., Desstya, A., & Hidayati, Y. M. (2024). Pem-

belajaran IPA Berbasis Etnosains Pada Materi Struktur Tumbuhan dan Fungsinya di Sekola Dasar. *Eduproxima: Jurnal Ilmiah Pendidikan IPA*, 2015. https://doi.org/10.29100/.v6i2.5083

Gummah, S., Fitri, M., Prayogi, S., & Asy'ari, M. (2023). The Effects of Ethnoscience Integrated Problem-Based Learning Models on Students' Critical Thinking Skills. *Lensa: Jurnal Kependidikan Fisika*, 11(2), 54. https://doi.org/10.33394/j-lkf.v11i2.10447

Hamdani, Mulyono, A., & Habiburrahman, L. (2022). Keefektifan Kemampuan Berpikir Kritis Terhadap Hasil Belajar Kognitif Siswa. *Jurnal Ilmiah Mandala Education*, 8(3), 2301–2307. https://doi.org/10.58258/jime.v8i3.3720

Hesy, H., Poluakan, C., & Rungkat, J. A. (2023). Analisis Keterampilan Berpikir Kritis Siswa Smp Dalam Pembelajaran Ipa Dengan Model Problem Based Learning Pada Materi Sistem Pencernaan Manusia. *Jurnal Genta Mulia*, 14(2). https://doi.org/10.61290/gm.v14i2.366

Hidayat, A. T., Muttakin, M., Mujtahid, Z., & Absa, M. (2024). Praktikalitas Dan Efektivitas Aplikasi Science in Al Quran (Sciqu) Sebagai Media Pembelajaran Ipa Berbasis Android. *EDUPROXIMA : Jurnal Ilmiah Pendidikan IPA*, 6(3), 1077–1084. https://doi.org/10.29100/.v6i3.4941

Hidayati, F., & Julianto. (2025). Integrasi Pendekatan Etnosains dalam Pembelajaran Sains untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Didaktika: Jurnal Pemikiran Pendidikan*, 31(1), 101–112. https://doi.org/10.30587/didaktika.v31i1.9578

Kartika, A. T., Eftiwin, L., Fitri Lubis, M., & Walid, A. (2020). Profil Kemampuan Berpikir Kritis Siswa Kelas VIII SMP Pada Mata Pelajaran IPA. *JARTIKA : Jurnal Riset Teknologi Dan Inovasi Pendidikan,* 3(1), 1–10. https://doi.org/10.36765/jartika.v3i1.46

Kharisma, V., Ilahi, P. C., & Maharani, S. (2023). Pengaruh Pembelajaran Berbasis Etnosains Terhadap Kemampuan Berpikir Kritis Siswa. *Prosiding SEMNAS BIO 2023 UIN Raden Fatah Palembang,* 1159–1167.

Khoiri, A., & Sunarno, W. (2018). Pendekatan Etnosains Dalam Tinjauan Fisafat. *SPEKTRA : Jurnal Kajian Pendidikan Sains*, 4(2), 145. https://doi.org/10.32699/spektra.v4i2.55

Khoiriyah, Z., Astriani, D., & Qosyim, A. (2021). Efektivitas Pendekatan Etnosains Dalam Pembelajaran Daring Untuk Meningkatkan Motivasi Dan Hasil Belajar Siswa Materi Kalor. *PENSA E-Jurnal : Pendidikan Sains*, 9(3), 433–442. https://ejournal.unesa.ac.id/index.php/pensa/article/view/41094

Kumalasari, L., Irianti, M., & Rumagesan, T. N. (2025). Pengembangan Video Interaktif Berbasis Etnosains Papua untuk Pengajaran IPA Terpadu. *PENDIPA: Journal of Science Education*, 9(2), 331–338. https://doi.org/10.33369/pendipa.9.2.331-338

Kuway, N. P., Muhajir, M., & Wahid, A. (2023). Meningkatkan Minat Peserta Didik dalam Mata Pelajaran IPAS melalui Pembelajaran Diferensiasi Menggunakan Bahan Ajar Digital. *Jurnal Basicedu*, 7(6), 3869–3877. https://doi.org/10.31004/basicedu.v7i6.6490

Mirfaka, A., & Kumala, F. N. (2023). Peningkatan Kemampuan Berpikir Kritis dan Sikap Kreatif Siswa Kelas V Melalui Model Pembelajaran PJBL-STEM Berbantuan Media Aplikasi Belajar Siklus Air (ABSA) pada Mata Pelajaran IPA di Sekolah Dasar. *Jurnal Pembelajaran, Bimbingan, Dan Pengelolaan Pendidikan,* 3(7), 637–652. https://doi.org/10.17977/um065v3i72023p637-652

Mukti, H., Suastra, I. W., & Aryana, I. B. P. (2022). Integrasi Etnosains dalam pembelajaran IPA. *JPGI (Jurnal Penelitian Guru Indonesia)*, 7(2), 356–362. https://doi.org/10.29210/022525jpgi0005

Muttaqiin, A. (2023). Pendekatan STEM (Science, Technology, Engineering, Mathematics) pada Pembelajaran IPA Untuk Melatih Keterampilan Abad 21. *Jurnal Pendidikan Mipa,* 13(1), 34–45. https://doi.org/10.37630/jpm.v13i1.819

Nafi'ah, J. (2021). Adaptasi Pembelajaran E-Learning dan Blended Learning di Era New Normal pada Peserta Didik Madrasah Ibtidaiyah. *Jurnal Auladuna*, 3(1), 37–49. https://doi.org/10.36835/au.v3i1.476

Nantara, D. (2021). Menumbuhkan Berpikir Kritis pada Siswa melalui Peran Guru dan Peran Sekolah. *Jurnal Teladan: Jurnal Ilmu Pendidikan Dan Pembelajaran*, 6(1), 25–34. https://doi.org/10.55719/jt.v6i1.222

Ningsih, F. S., & Ulya, H. K. (2024). Pemanfaatan E-book sebagai Sumber Belajar pada Kurikulum Merdeka. Revorma: Jurnal Pendidikan Dan Pemikiran, 4(1), 45–53. https://doi.org/10.62825/revorma.v4i1.98

Nur, A. H., Syamsir, S., & Akmal, A. (2023). Pengaruh Problem Based Learning Dan Kemandirian Belajar Terhadap Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Al-Ilmi: Jurnal Riset Pendidikan Islam*, 4(1), 1–18. https://doi.org/10.47435/al-ilmi.v4i1.2228

Ogegbo, A. A., & Ramnarain, U. (2024). A Systematic Review of Pedagogical Practices for Integrating Indigenous Knowledge Systems in Science Teaching. *African Journal of Research in Mathematics, Science and Technology Education*, 7295. https://doi.org/10.1080/18117295.2024.2374133

Pardede, E. R. M., Ruslan, D., & Arwansyah. (2025). Development of Flipbook-Based E-Module Teaching Materials to Enhance Independence and Learning Outcomes of High School Students. *Jurnal Paedagogy,* 12(2), 434–441. https://e-journal.undikma.ac.id/index.php/pedagogy/index

Pitriani, N. R. V., Wahyuni, I. G. A. D., & Gunawan, I. K. P. (2021). Penerapan Model Addie Dalam

Pengembangan Media Pembelajaran Interaktif Menggunakan Lectora Inspire Pada Program Studi Pendidikan Agama Hindu. *Cetta: Jurnal Ilmu Pendidikan*, 4(3), 515–532. https://doi.org/10.37329/cetta.v4i3.1417

Putri, I. T. A., Agusdianita, N., & Desri. (2024). Literasi dalam Meningkatkan Kemampuan Berpikir Kritis Peserta Didik Sekolah Dasar Era Digital. *Social, Humanities, and Educational Studies*, 7(3), 2057–2066. https://jurnal.uns.ac.id/shes

Rahayu, I. T., Pramuswari, M. F., Santya, M., Oktariani, R., & Fatimah, S. (2023). Analisis Hasil Pengaruh Perkembangan Iptek Terhadap Hasil Belajar Siswa Sd/Mi. *HYPOTHESIS : Multidisciplinary Journal Of Social Sciences*, 2(01), 97–110. https://doi.org/10.62668/hypothesis.v2i01.645

Raturoma, T. L. R., & Laisnima, L. (2023). Hubungan Keterampilan Berpikir Kritis dengan Hasil Belajar Kognitif Peserta Didik pada Materi Bentuk Molekuk Kelas X di SMA Kristen YABT Manokwari. *ARFAK CHEM: Chemistry Education Journal,* 3(1), 186–192. https://doi.org/10.30862/accej.v6i1.441

Saputra, H. N., Abdulkarim, A., & Fitriasari, S. (2024). Analisis Penerapan Kurikulum Merdeka dalam Pembelajaran Abad ke-21 di SMP Daarut Tauhiid Boarding School. *Sanskara Pendidikan Dan Pengajaran,* 2(02), 86–96. https://doi.org/10.58812/spp.v2i02.309

Sarip, N., Kaharuddin, K., & Palloan, P. (2022). Analisis Keterampilan Berpikir Kritis Peserta Didik Kelas X Di Sman 10 Makassar. *Jurnal Sains Dan Pendidikan Fisika*, 18(3), 291. https://doi.org/10.35580/jspf.v18i3.31668

Septina, E. A., Widianingrum, O. L., & Cahyaningrum, D. (2025). Korelasi Budaya , Potensi Lokal dan Kearifan Lokal pada Pembelajaran IPA Berbasis Etnosains. *Journal of Science Education Research and Innovation*, 1(1), 25–32. https://journal.innoscientia.org/index.php/joseri/article/view/149

Setyawati, E., Ngadiman, & Diah Susanti, A. (2021). Penerapan Model Explicit Instruction (Ei) Berbantu Media Jobsheet Untuk Meningkatkan Hasil Belajar Komputer Akuntansi Kelas Xi Akl. *Tata Arta: Jurnal Pendidikan Akuntansi,* 7(1), 115–127.

Siahaan, Y. L. O., & Meilani, R. I. (2019). Sistem Kompensasi dan Kepuasan Kerja Guru Tidak Tetap di Sebuah SMK Swasta di Indonesia. *Jurnal Pendidikan Manajemen Perkantoran*, 4(2), 141. https://doi.org/10.17509/jpm.v4i2.18008

Subarkah, M. D., Alrahmadani, R., & Mardiyana, S. (2024). Analysis of the Role of Professional Teachers in Building Student Competencies in 21st Century Learning. *Social, Humanities, and Educational Studies (SHES): Conference Series,* 7(3), 1083–1089. https://doi.org/10.20961/shes.v7i3.91807

Sunaryo, P. R., Hutajulu, M., & Kadarisma, G. (2023). Systematic Literature Review: Analisis Kemampuan Berpikir Kritis Siswa Melalui Pembelajaran Kontekstual. *Jurnal Pembelajaran Matematika Inovatif,* 6(5), 1865–1872. https://doi.org/10.22460/jpmi.v6i5.20448

Supriatna, A. Y., Hernawati, D., Badriah, L., & Ruganda, E. (2025). Profil Pengembangan Modul Ajar IPA Terintegrasi Etnosains sebagai Upaya Penguatan Konsep Ilmiah : Systematic Literature Review. *Jurnal Pendidikan Matematika Dan Sains*, 13(1), 157–171. DOI:10.21831/jpms.v13i1.84652

Suryani, D., Fajar Sidik, R., Hadi, W. P., Yasir, M., & Sutarja, M. C. (2023). Pengembangan Media Web Mobile Learning Berbasis Etnosains Pada Materi Konduktivitas. *Jurnal Pendidikan IPA*, 12(1), 1–14. https://doi.org/10.20961/inkuiri.v12i1.64060

Suryaningsih, S., & Nurlita, R. (2021). Pentingnya Lembar Kerja Peserta Didik Elektronik (E-LKPD) Inovatif dalam Proses Pembelajaran Abad 21. *Jurnal Pendidikan Indonesia (Japendi),* 2(7), 1256–1268. DOI:10.36418/japendi.v2i7.233

Tanjung, A. W. S., Bektiarso, S., & Lesmono, A. D. (2023). Pengaruh Model Pembelajaran Berbasis Masalah Disertai Sumber Belajar Lingkungan Terhadap Hasil Belajar Fisika dan Kemampuan Berpikir Kritis Peserta Didik. *JPF (Jurnal Pendidikan Fisika) Universitas Islam Negeri Alauddin Makassar*, 11(1), 67–75. https://doi.org/10.24252/jpf.v11i1.35163

Wahdah, S. R., Hernawati, D., & Diella, D. (2023). Hubungan Keterampilan Interpretasi Data dengan Keterampilan Mengomunikasikan Peserta Didik Materi Sistem Eksresi. *Bioed : Jurnal Pendidikan Biologi*, 11(2), 136. https://doi.org/10.25157/jpb.v11i2.10856

Wahyudin, H., & Permatasari, N. R. R. (2024). Pengembangan Lembar Kerja Peserta Didik Berbasis Etnosains Untuk Melatih Keterampilan Literasi Sains Peserta Didik SMP. *Pancasakti Science Education Journal,* 9(1), 39–57. https://doi.org/10.24905/psej.v9i1.204

Williams, C. T., & Rudge, D. W. (2019). Effects of Historical Story Telling on Student Understanding of Nature of Science. *Science and Education*, 28(9-10), 1105–1133. https://doi.org/10.1007/s11191-019-00073-x

Yanti, D., Prastawa, S., Utomo, W. F., Wiliyanti, V., & Utomo, B. (2024). Pendidikan di Revolusi Industri 4 . 0 : Studi Kasus Evaluasi Kurikulum Merdeka di Indonesia. *Edu Cendikia: Jurnal Ilmiah Kependidikan*, 4(02), 380–390. https://doi.org/10.47709/educendikia.v4i02.

Zaky, A., Kresnadi, H., Pranata, R., & Elektronik, B. A. (2023). Suplemen Bahan Ajar Elektronik Tema 2 Subtema 1 Pembelajaran 5 Kelas Iii Sekolah Dasar 58 Sungai. *Jurnal Review Pendidikan Dan Pengajaran*, 6(2), 1556–1561.