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Integrating Local Culture into Biology E-Module: The Perceptions of Teachers and Students

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Abstract

Integrating local culture into science education is a strategic effort to enhance the relevance of learning to students' lives while fostering appreciation for regional heritage. In the context of biology education, incorporating culturally-rooted examples can make abstract concepts more tangible and relatable. This study investigates teachers' and students' perceptions of a digital biology e-module integrating golok tarisi local heritage within an Ethno-STEAM approach supported by Augmented Reality (AR). The module connects biodiversity, ecology, and sustainable resource use concepts with cultural practices. This research employed a mixed-method (qualitative–quantitative descriptive) design involving 16 biology teachers and 60 eleventh-grade students selected purposively. Data were collected through Likert-scale questionnaires, semi-structured interviews, and classroom observations, and analyzed using descriptive statistics and thematic analysis. Results show highly positive perceptions. A total of 87% of teachers considered the e-module highly relevant, and 82% found it easy to use. Among students, 85% reported increased engagement and 78% higher learning motivation. The e-module also supported digital literacy development through the use of multimedia and AR features, although 18% of teachers experienced technical challenges. Students reported improved conceptual understanding of biodiversity and ecological balance, supported by AR visualization of the golok tarisi production process. Observations confirmed increased interaction and critical thinking. The findings demonstrate that the Ethno-STEAM-based digital e-module is pedagogically effective and well-accepted by both teachers and students. It enhances engagement, learning motivation, digital literacy, and conceptual understanding of abstract biological concepts through AR-supported visualization. Despite minor technical constraints, the module fosters interactive, critical, and culturally meaningful biology learning. This study contributes to the development of contextual, interactive, and sustainable models for biology education.

Keywords: e-module; *golok tarisi*; local culture; perception; STEAM

INTRODUCTION

Biology education at the secondary school level plays a crucial role in helping students understand life, the environment, and the interrelationship between humans and nature. However, the learning process in many Indonesian schools remains dominated by conventional lecture-based and textbook-centered approaches, which tend to emphasize memorization rather than meaningful understanding (Roesmawati *et al.*, 2022). Such practices often result in low student motivation, limited engagement, and underdeveloped critical thinking skills. Therefore, there is a growing need for learning innovations that are contextual, interactive, and relevant to students' real-life experiences (Afza *et al.*, 2022; Wini *et al.*, 2022). Learning innovation in this study refers to the integration of local cultural content and digital technology into biology learning through the development of an interactive e-module (Ali & Zaini, 2023; Khovia, 2021). This approach aims not only to enhance students' conceptual understanding but also to

strengthen their connection with local identity and environmental values through technology-enhanced learning.

Local wisdom can be a valuable source of learning in biology. The values, knowledge and cultural practices passed down through the generations are often closely related to the use of natural resources, biodiversity and environmental management. For instance, the *golok tarisi* crafts from Jasinga reflect the cultural identity of the Sundanese-Chinese community and demonstrate their understanding of local materials and engineering techniques, as well as their relationship with the environment. The *golok tarisi* is a type of machete that reflects the craftsmanship, engineering knowledge, and environmental ethics of the Sundanese-Chinese community. The process of creating a *golok tarisi* from selecting the raw materials, such as iron, wood, and natural adhesives, to forging and finishing demonstrates a deep understanding of natural resources and their sustainable use. The *golok tarisi* thus represents a form of local ecological wisdom that embodies biological, chemical, and physical principles within cultural practices. Unlike many cultural artifacts that serve merely as symbols, the *golok tarisi* integrates utilitarian, artistic, and ecological values, making it an ideal medium for contextual learning in biology. Integrating local culture into biology education can foster pride, environmental awareness, and a more contextualised scientific understanding (Haka *et al*., 2024; Lestari & Arsih, 2024; Putri & Arsih, 2024; Suanda *et al*., 2024).

The Ethno-STEAM (Science, Technology, Engineering, Arts, Mathematics based on ethnography) approach facilitates the integration of local wisdom into learning (Sari *et al*., 2023). The integration of biological concepts with cultural practices has been demonstrated to facilitate a more meaningful learning experience for students. This integration is also believed to increase motivation, creativity, and critical thinking skills (Nayazik, 2024). The advent of technological advancements has rendered digital e-modules a promising medium for the integration of local wisdom within the domain of biology education (Lathifah *et al.*, 2024). In comparison to printed teaching materials, e-modules facilitate enhanced interactivity through multimedia, animation, and Augmented Reality (AR) (Syamsinar & Yusuf, 2019; Aisyah *et al*., 2020; Giawa, 2023). Digital visualisation has been demonstrated to facilitate students' comprehension of abstract concepts, such as the material structure of the *golok tarisi* or its relationship to ecology. The main point of using *golok tarisi* in this context lies in its pedagogical potential to connect abstract biological concepts such as biodiversity, material structure, and ecological balance to tangible cultural practices. By learning the process of *golok tarisi* production, students can relate biology topics like ecosystem interaction, conservation, and sustainable material use to real-world cultural phenomena. This link enhances conceptual understanding and fosters environmental awareness rooted in local identity.

The success of this innovation largely depends on how teachers and students perceive it. Teachers serve as designers and facilitators of learning, while students are the primary participants experiencing the learning process. The use of e-modules in the classroom is determined by teachers' views on their ease of use, relevance, and benefits. Conversely, students' perceptions of the attractiveness and meaningfulness of the e-modules serve as key indicators of their effectiveness. When students find learning materials relevant and enjoyable, it has been shown to increase motivation and conceptual understanding (Santa *et al.*, 2024). Therefore, understanding these perceptions is crucial for the successful implementation of educational innovations. Continuous feedback from both teachers and students can help refine the e-module to better meet learning needs and challenges.

The results of the observation indicate that many teachers still have low digital literacy, with a significant number having never developed an e-module and many not yet understanding AR. This situation underscores the importance of researching how teachers and students respond to the integration of local culture into digital biology e-modules. The integration of local culture with biology e-modules is implemented through the Ethno-STEAM framework. In this model, cultural artifacts such as *golok tarisi* are incorporated into digital modules that include multimedia explanations, AR-based visualizations of materials and ecological cycles, and project-based learning tasks. These elements encourage students to observe, analyze, and reflect on the scientific concepts embedded within local culture. Therefore, integrating local culture through digital e-modules not only contextualizes biological concepts but also promotes innovation, cultural appreciation, and sustainability. This study explores teachers' and students'

perceptions of this integration to better understand its relevance, effectiveness, and potential challenges in supporting 21st century biology education and achieving Sustainable Development Goals (SDGs) 4 and 9. Grounded in this contextual background, the present study is deemed significant. Accordingly, it seeks to investigate teachers' and students' perceptions of an e-module that integrates *golok tarisi*, a representation of local cultural heritage, within the framework of biology education.

METHOD

This study employed a qualitative descriptive approach supported by quantitative data to analyze teachers' and students' perceptions regarding the integration of local cultural heritage into biology learning through digital e-modules. The mixed method approach was chosen to gain a deep understanding of user experiences while providing quantitative data as a solid foundation for comprehensive analysis (Jason *et al.*, 2016; Sharma *et al*., 2023). This method allows for detailed explanation of the phenomena as well as supporting quantitative evidence. Such an approach is essential considering the complex learning context involving cultural, motivational, and technological aspects. By combining qualitative and quantitative data, the study ensures a balanced perspective on both subjective experiences and measurable outcomes. This approach also enhances the validity and reliability of the research findings.

The participants consisted of 16 biology teachers and 60 eleventh-grade students who had used a digital e-module based on *golok tarisi* local culture. Participants were selected purposively based on their direct involvement with the e-module during the research period. The sample size of 60 students was determined considering the total population of eleventh graders using the e-module and aligned with Creswell (2014) guidelines emphasizing data richness and representativeness over large sample sizes in qualitative descriptive studies. This number was adequate to generate reliable descriptive statistics and allow for detailed qualitative exploration. The purposive sampling technique helped ensure that participants had relevant experience, making the data more meaningful. Furthermore, this approach allowed the researchers to focus on those most affected by the e-module's implementation.

Data were collected using several key instruments, including a five point Likert scale questionnaire to measure perceptions of relevance, ease of use, engagement, learning motivation, digital literacy, and conceptual understanding of the e-module. Semi-structured interviews were conducted to gain deeper insights from teachers about their experiences and views on the e-module's use in learning. Observation sheets were also employed to document students' responses during classroom activities. The observation focused on specific indicators, including student interaction during group discussions, active participation in project-based tasks, engagement with AR features, demonstration of critical thinking, collaboration skills, and the ability to relate biological concepts to local cultural and environmental contexts. These indicators allowed researchers to monitor student interactions and learning engagement more systematically and objectively. These multiple data sources enabled triangulation, increasing the credibility of the findings. The combination of self-reported and observed data provided a more holistic view of the learning environment and user experiences.

The research procedure was carried out in three main phases. The first phase involved instrument validation by subject matter experts and preliminary testing to ensure the appropriateness of the tools before wider deployment. The second phase consisted of implementing the research activities, including distributing questionnaires to teachers and students, conducting interviews with teachers, and observing classroom sessions during e-module usage. The third phase was data analysis, where quantitative data were analyzed using descriptive statistics such as percentages and means, while qualitative data underwent reduction, display, and conclusion drawing. These systematic procedures ensured the data's accuracy and consistency throughout the study. The careful sequencing of steps also facilitated thorough examination and interpretation of the data collected.

This comprehensive approach is expected to provide an in-depth overview of teachers' and students' perceptions of integrating local culture into biology learning through digital e-modules. The study also aims to identify factors that facilitate or hinder the implementation of this learning innovation. Findings from this research are expected to inform educational policy development and provide strategies

for more effective and contextualized biology education in the digital era. Ultimately, the study seeks to contribute to the broader goal of improving student engagement and learning outcomes by leveraging culturally relevant resources. The insights gained could serve as a model for similar educational innovations in other subject areas and regions.

RESULT AND DISCUSSION

The results of the study indicate that teachers' perceptions of the use of local wisdom-based e-modules in biology learning are very positive. From a questionnaire distributed to 16 biology teachers at senior high school in Jasinga, data was obtained showing that 87% of teachers considered the *golok tarisi*-based e-module to be highly relevant to biology learning, particularly in the areas of biodiversity, ecology, and natural resource utilisation. Teachers assessed that the integration of local culture made the material more contextual, closer to students' lives, and easier to understand abstract concepts. In addition, 82% of teachers stated that the e-modules were easy to use because they were equipped with interactive instructions, a simple display, and supporting multimedia features. However, some teachers (around 18%) still experience technical difficulties, particularly related to inadequate equipment or limited internet connection. In-depth interviews revealed that teachers found the AR visualisation helpful as it allowed students to see the details of the *golok tarisi* making process more realistically. This not only enriches biological understanding, but also fosters awareness of the relationship between humans, culture and the environment. From the observations, teachers appeared more confident and enthusiastic when implementing e-modules, although some of them still needed assistance to optimise the use of digital features. Overall, the data indicate that teachers perceive the local wisdom-based e-module not merely as a technological innovation, but as a pedagogical strategy grounded in the STEAM framework. The module integrates Science (biodiversity and ecology concepts), Technology (digital platform and AR features), Engineering (analysis of material processing in golok tarisi production), Arts (cultural craftsmanship and aesthetic values), and Mathematics (measurement and proportional design), thereby strengthening digital literacy while instilling cultural values in biology learning.

The utilisation of digital e-modules, grounded in local wisdom, has garnered a remarkably favourable response from students. Among the 60 Year 11 students who participated in the survey, 85% stated that e-modules had made biology lessons more interesting and enjoyable than conventional lecture methods. The findings of the study indicated that the integration of multimedia features, interactive images, and AR assisted the students in comprehending ecological concepts and their correlation with local culture. For instance, in the section discussing the materials utilised in the fabrication of the *golok tarisi*, students were able to draw parallels with biodiversity, in terms of the types of wood and metal employed. Furthermore, a significant proportion of students, amounting to 78%, acknowledged that they experienced heightened motivation to learn, attributed to their sense of pride in the local culture being showcased in science lessons. The ease of access aspect obtained a mean score of 4.2 out of 5 (equivalent to 84%), indicating that most students considered the e-module practical and accessible via personal devices. However, a small number of students who did not have adequate devices encountered technical obstacles. The utilisation of digital e-modules, grounded in local wisdom, has garnered a remarkably favourable response from students. Of the 60 year 11 students who responded to the survey, 85% stated that e-modules had made biology lessons more interesting and enjoyable than conventional lecture methods. The findings of the study indicated that the integration of multimedia features, interactive images, and augmented reality AI assisted the students in comprehending ecological concepts and their correlation with local culture (Antrakusuma *et al*., 2023; Lathifah *et al*., 2025; Ouahidi, 2020). For instance, in the section discussing the materials utilised in the fabrication of the *golok tarisi*, students were able to draw parallels with biodiversity, in terms of the types of wood and metal employed. Furthermore, a significant proportion of students, amounting to 78%, acknowledged that they experienced heightened motivation to learn, attributed to their sense of pride in the local culture being showcased in science lessons. The results of the questionnaire indicated that the ease of access aspect of the e-module received a rating of 4.2 out of 5, suggesting that the majority of students found the e-module to be quite practical

to access via personal devices. However, a small number of students who did not have adequate devices encountered technical obstacles. Observations during the learning process demonstrated an increase in student interaction, both in group discussions and in working on small projects integrated into the e-module. Furthermore, some students were able to relate the material to environmental issues, such as the importance of preserving local natural resources. The findings demonstrate that the integration of local culture into the e-module was associated with higher student engagement (85%) and increased learning motivation (78%). Although quantitative measures of critical thinking and ecological awareness were not assessed separately, classroom observations consistently indicated more active participation, analytical discussion, and students' ability to connect biological concepts with local environmental contexts. These patterns suggest a positive tendency toward the development of higher-order thinking and ecological awareness within the Ethno-STEAM learning environment.

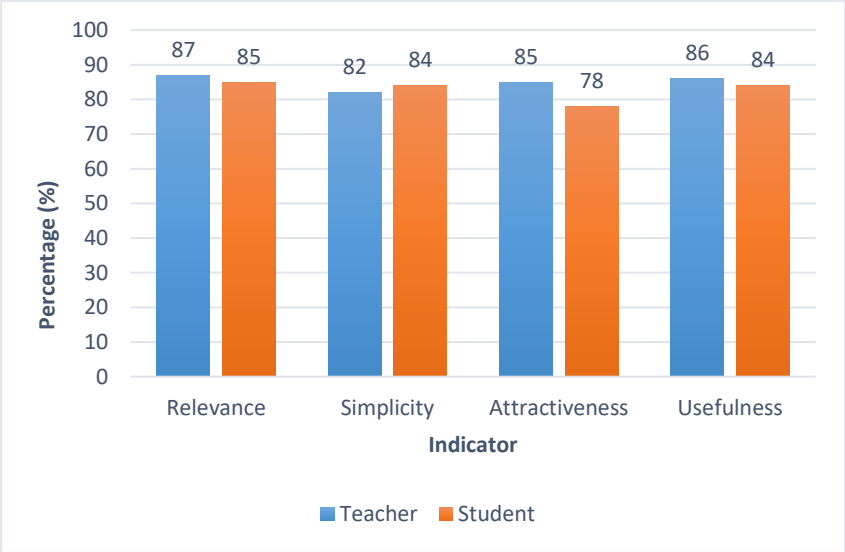

Figure 1. Comparison chart of teachers' and students' perceptions of digital e-modules based on local wisdom

A comparison of teacher and student perceptions regarding the integration of local cultural heritage in digital biology e-modules reveals a harmonious alignment which shown in Figure 1. Pedagogical aspects are emphasised by teachers, namely the increasing relevance of material and the facilitation of the explanation of abstract concepts with the help of AR visualization (Ramadhani & Rosy, 2023; Vashisht, 2024). Concurrently, students emphasise the pivotal role of motivation and cultural pride in fostering engagement in learning (Laily & Fawaida, 2024). This finding suggests that e-modules grounded in local wisdom can effectively address the pedagogical needs of teachers and the affective and cognitive needs of students. Cognitive needs refer to students' intellectual requirements for understanding, reasoning, and applying knowledge such as their ability to process information, think critically, and solve problems through meaningful learning experiences. Nevertheless, there are also some differences in perception. It has been observed that some teachers still feel less confident in their use of digital technology, while students tend to be more adaptive and enthusiastic. This underscores the significance of ongoing professional development for educators, emphasising the necessity of optimising the integration of e-modules in their pedagogical practice. This finding aligns with the Ethno-STEAM theory, which emphasises the integration of science with cultural contexts to create more relevant and meaningful learning (Yuliana *et al*., 2023; Solikha & Shofiyah, 2025). The findings of this study demonstrate that integrating innovative learning methodologies that amalgamate local culture with digital technology has the potential to enhance students' emotional connection to the subject matter (Nugraheni *et al.,* 2023;

Niman, 2025). Furthermore, it has been observed that this integration can assist educators in cultivating more creative and contextual teaching methodologies (Nurhasnah *et al*., 2022).

Despite the favorable perceptions indicated by the study's findings, there are notable challenges associated with the implementation of e-modules grounded in local wisdom. Firstly, the limited availability of digital infrastructure constitutes a significant impediment. In the course of interviews conducted in the Jasinga area, teachers revealed that the distribution of internet access is not yet uniform, and that the use of augmented reality features is often hindered by technical problems. Secondly, a digital literacy gap between teachers and students remains. Teachers require additional time to familiarize themselves with the features of the e-module, whereas students demonstrate a more rapid rate of adaptation. Thirdly, the limited availability of devices for both teachers and students remains an issue, as not everyone has a mobile device or laptop that is compatible with AR applications. Fourthly, the integration of the curriculum constitutes a considerable challenge, insofar as teachers are required to adapt the e-module material to the national curriculum structure without diminishing the value of local culture. It is evident that the effective integration of e-modules is contingent not solely on the meticulous design of instructional content, but also on the availability of system support, the adequacy of infrastructure, and the provision of sustained training. Nevertheless, these challenges can be transformed into opportunities to strengthen collaboration between educational institutions, universities, and the government in providing facilities and training to support digital-based learning and local culture innovation (Yulia & Suttrisno, 2024).

The results of this study carry significant implications for the development of biology education and innovation in learning. The novelty of this research lies in the systematic integration of local cultural heritage specifically the *golok tarisi* craft into a digital biology e-module structured within an Ethno-STEAM framework and supported by augmented reality (AR), thereby bridging traditional ecological knowledge with interdisciplinary STEAM pedagogy and digital innovation. This unique combination bridges traditional ecological knowledge with modern digital pedagogy, creating a contextual and interactive learning model that not only strengthens conceptual understanding and digital literacy but also fosters cultural identity and sustainability awareness. Pedagogically speaking, locally-based e-modules have been demonstrated to enhance students' conceptual understanding, learning motivation, and critical thinking skills (Astuti *et al*., 2024; Wahyudi, *et al.,* 2025). Secondly, from a socio-cultural perspective, the integration of local cultural heritage into learning has been demonstrated to foster a sense of identity, pride, and awareness of the importance of cultural preservation (Ritonga *et al.*, 2022; Yatim *et al.*, 2025). Thirdly, from a technological standpoint, this study demonstrates that the integration of e-modules and augmented reality (AR) has the potential to address the disparity between conventional methodologies and the demands of the 21st century (Asari *et al*., 2024; Susilawati, 2025). AR can improve learning by providing interactive and immersive visualizations that make abstract biological concepts more concrete and easier to understand. It enhances student engagement, promotes active exploration, and allows learners to connect theoretical knowledge with real-world applications. Through 3D simulations and dynamic representations, AR supports deeper cognitive processing, increases motivation, and facilitates meaningful and experiential learning. These findings are consistent with the literature on contextual teaching and learning and the Ethno-STEAM approach, which emphasizes interdisciplinary integration grounded in real cultural experiences and digital technology. In this study, the STEAM characteristics of the e-module are explicitly reflected in: (1) Science, through the exploration of biodiversity, ecology, and sustainable resource use embedded in the golok tarisi production process; (2) Technology, through the use of digital platforms and AR visualization; (3) Engineering, through analysis of material processing and design principles in traditional craftsmanship; (4) Arts, through the appreciation of cultural aesthetics and local identity; and (5) Mathematics, through measurement, proportion, and structural calculation activities integrated into learning tasks. This structured interdisciplinary design demonstrates that the module does not merely incorporate local wisdom and digital tools, but operationalizes STEAM principles within biology instruction. From the perspective of the Sustainable Development Goals (SDGs), this integration contributes to SDG 4 (Quality Education) by promoting contextual and

meaningful learning, and to SDG 9 (Industry, Innovation, and Infrastructure) through the application of digital innovation within a culturally responsive framework. Moreover, the study provides a foundation for the development of more inclusive education policies, namely a curriculum that accommodates local wisdom in science. Theoretically, these findings contribute to the existing discourse on the relationship between digital literacy, contextual learning, and cultural identity in the context of biology education (Imanuria *et al.*, 2024). Consequently, this study offers practical benefits at the school level and contributes conceptually to the development of innovative culture-based learning models in the digital age.

CONCLUSION

The findings of this study indicate that the integration of local cultural heritage into biology learning through *golok tarisi*-based digital e-modules received highly positive responses from both teachers and students. The e-modules were regarded as relevant to the curriculum, accessible in their design, and more engaging than conventional materials. Students expressed heightened interest and motivation, while classroom observations revealed greater interaction, critical thinking, and the ability to connect biological concepts with local environmental issues. Nevertheless, challenges such as limited internet infrastructure, inadequate digital devices, and gaps in digital literacy between teachers and students remain significant barriers. This study confirms that digital e-modules based on local culture effectively enhance digital literacy while fostering cultural pride, ecological awareness, and motivation to study biological sciences. It highlights the need for collaboration between educational institutions, universities, and government agencies to provide infrastructure support and continuous training for educators. The integration of local culture in digital learning offers a promising model for contextual, interactive, and sustainable education in the digital age. Despite these positive findings, the study has limitations, including its implementation in a single school and a relatively small sample size, which may affect the generalizability of results. Moreover, the evaluation focused more on perceptions rather than direct measures of learning outcomes. Future research should include larger and more diverse samples, employ experimental or longitudinal designs, and explore long-term cognitive and affective impacts on students. This research is valuable locally and globally. As education worldwide aims to integrate cultural relevance with digital innovation, this study offers insights on leveraging local culture to boost student engagement, digital skills, and sustainable education. The model can inspire similar approaches in diverse contexts, supporting global goals of quality education (SDG 4) and sustainable innovation (SDG 9).

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REFERENCES

Afza, A., Novianti, S., & Sari, L. Y. (2022). Factors caused difficulty in learning IPA for student. *Journal Of Biology Education Research (JBER)*, *3*(2), 1–10.

Aisyah, S., Noviyanti, E., & Triyanto. (2020). Bahan ajar sebagai bagian daam kajian problematika pembelajaran bahasa indonesia. *Salaka*, *2*(1), 62–65.

Ali, L. U., & Zaini, M. (2023). Development of interactive e-modules based on local wisdom using android to improve students' Higher Order Thinking Skills (HOTS). *Jurnal Penelitian Pendidikan IPA*, *9*(11), 10091–10100.

Antrakusuma, B., Nasution, N. A., Sari, M. W., Permatasari, A., Wardani, K. E., Mila, S., & Kunni, Z. (2023). Application of Ethno-STEM Learning Multimedia on the Topic of Substances and Their Changes to Improve Student Learning Outcomes. *Proceedings of the International Conference on Current Issues in Education (ICCIE 2023)* (pp. 149-159). Yogyakarta, Indonesia: The Graduate School, Universitas Negeri Yogyakarta. Retrieved from https://www.atlantis-press.com/proceedings/iccie-23/125999964.

Asari, S. M. M. K., Suaib, N. M., Abd Razak, M. H., Ahmad, M. A., & Shaleh, N. M. (2024). Empowering skill-based learning with augmented reality and virtual reality: A case study. *Proceedings of IEEE International Symposium on Consumer Technology (ISCT)*, (pp. 225–229). Bali, Indonesia: IEEE Consumer Technology Society (CTSoc). Retrieved from https://ieeexplore.ieee.org/xpl/conhome/10791071/proceeding.

Astuti, W., Nurkamto, J., Subiyantoro, S., & Rochsantiningsih, D. (2024). Exploring the potential development of digital modules for arts and culture learning based on local culture: A mixed-method study on Bedhaya Ketawang dance. *Edelweiss Applied Science and Technology*, *8*(5), 2327–2342.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Pustaka Pelajar.

Giawa, I. P. (2023). Pengembangan modul sistem fotosintesis pada tumbuhan kelas VIII untuk siswa SMP Negeri 2 Lolomatua. *FAGURU : Jurnal Ilmiah Mahasiswa Keguruan*, *2*(1).

Haka, N. B., Pamungkas, M. F., Masya, H., Rakhmawati, I., & Hidayah, N. (2024). Desain, development, and evaluation of biology e-modules website based on local wisdom of the Baduy tribe: Strengthening Pancasila student profiles on ecosystem material. *E3S Web of Conferences*, *482*, 05005.

Imanuria, C. N., Sulistyowati, P., Yulianti, Y., Ghozali, S., & Izzatif, N. (2024). Pengembangan e- modul berbasis kearifan lokal Jawa Timur. *Mindset : Jurnal Pemikiran Pendidikan Dan Pembelajaran*, *4*(2), 55–64.

Jason, Leona R. D. A., A., & Glenwick, D. S. (2016) *Handbook of methodological approaches to community-based research qualitative, quantitative, and mixed methods.* Oxford University Press.

Khovia, K. (2021). Pemanfaatan media lingkungan dalam meningkatkan motivasi belajar siswa pada pembelajaran tematik di Madrasah Ibtidaiyah Darul Ulum Sukorambi Jember. *Indonesian Journal Of Islamic Teaching*, *4*(1), 79–91.

Laily, N. N. N., & Fawaida, U. (2024). Implementation of the Ethno-STEM approach (Science, Technology, Engineering, and Mathematics) in science learning to improve critical thinking skills and interest of students. *Jurnal Tarbiyatuna: Jurnal Kajian Pendidikan, Pemikiran dan Pengembangan Pendidikan Islam*, *5*(1), 70–85.

Lathifah, S. S., Safitri, N., Purnamasari, R., & Marlina, R. (2025). A STEM-oriented digital mentoring approach to enhance teachers' digital literacy in primary education. *Pedagogia: Jurnal Ilmiah Pendidikan*, *17*(1), 69–75.

Lathifah, S. S., Widodo, A., Kaniawati, I., & Sriyati, S. (2024). Local wisdom in agriculture of Urug Indigenous Village as an Alternative biology learning resource. *Proceedings of International Joint Seminar on Education, Social Science and Applied Science (IJESAS),* (pp. 322-332). Lombok Timur, Indonesia: Universitas Hamzanwadi. Retrieved from https://kneopen.com/issue/kne-social/462/.

Lestari, Y., & Arsih, F. (2024). Analisis respon guru terhadap pengembangan booklet pembelajaran biologi pada materi permasalahan lingkungan dan upaya mengatasinya terintegrasi budaya lokal masyarakat paninjauan, tanah datar. *Edusainstika: Jurnal Pembelajaran MIPA*, *4*(2), 73.

Nayazik, A. (2024). The validity of student worksheets based on ETHNO-STEM material on volume of rotating objects. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *8*(2), 313.

Niman, E. M. (2025). Embedding local culture in social studies: Pathways to strengthen social-emotional learning in primary education. *Frontiers in Education*, *10*, 1655528.

Noviana Noor Laily, & Ulya Fawaida. (2024). Implementation of the Ethno-STEM approach (Science, Technology, Engineering, And Mathematics) in science learning to improve critical thinking skills and interest of students. *Jurnal Tarbiyatuna: Jurnal Kajian Pendidikan, Pemikiran Dan*

Pengembangan Pendidikan Islam, *5*(1), 70–85.
Nugraheni, F. S. A., Sari, M. W., Wati, I. K., & Suciati, Widyastuti, A. Kamaliah, K. (2023). Indigenous knowledge and its potential for junior high school ethno-STEM learning. *AIP Conference Proceedings 3rd International Conference on Science, Mathematics, Environment, and Education: Flexibility in Research and Innovation on Science, Mathematics, Environment, and Education for Sustainable Development, ICoSMEE 2021* (pp. 1-7). Surakarta, Indonesia: FKIP UNS. Retrieved from https://scholar.unair.ac.id/en/publications/indigenous-knowledge-and-its-potential-for-junior-high-school-eth/.
Nurhasnah, Nf., Azhar, M., Yohandri, Nf., & Arsih, F. (2022). Ethno-STEM insScience learning: A sistematic literature review. *Jurnal Teknologi Pendidikan*, *10*(02), 147–163.
Ouahidi, L. M. (2020). Constraints on developing digital literacy skills in higher education. *International Journal of Linguistics, Literature and Translation (IJLLT)*, *3*(2), 197–205.
Putri, Z. A., & Arsih, F. (2024). Analisis respon guru terhadap pengembangan modul praktikum bioteknologi berbasis kearifan lokal terintegrasi Al – Qur'an. *Edusainstika: Jurnal Pembelajaran MIPA*, *4*(2), 101.
Ramadhani, I. K., & Rosy, B. (2023). The development of Augmented Reality (AR) based learning modules in office technology and correspondence subjects. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, *11*(2), 99–108.
Ritonga, A. P., Andini, N. P., & Iklmah, L. (2022). Pengembangan bahan ajaran media. *Jurnal Multidisiplin Dehasen (MUDE)*, *1*(3), 343–348.
Roesmawati, L., Suprijono, A., & Yani, M. T. (2022). Pengembangan handout pembelajaran berbasis kearifan budaya lokal reog pada pembelajaran IPS untuk penguatan pendidikan karakter siswa sekolah dasar. *Jurnal Basicedu*, *6*(5), 8909–8922.
Santa, S., Lathifah, S. S., Aulia, D. N., & Meyradhia, A. G. (2024). Development of a smart module on hydrological cycle based on SDGs as a source of science studies for primary school students. *Jurnal Penelitian Pendidikan IPA*, *10*(3), 1492–1499.
Sari, M. W., Wati, I. K., Nugraheni, F. S. A., Suciati, S., Widyastuti, A., Kamaliah, K., Raihana, A. S., & Octavia, E. (2023). Development of Ethno-STEM-based science learning tools. *Journal Intellectual Sufism Research (JISR)*, *5*(2), 95–101.
Sharma, L. R., Bidari, S., Bidari, D., Neupane, S., & Sapkota, R. (2023). Exploring the mixed methods research design: Types, purposes, strengths, challenges, and criticisms. *Global Academic Journal of Linguistics and Literature, 5*(1), 3–12.
Solikha, R. A. G. B., & Shofiyah, N. (2025). Ethno-STEM-based science learning using typical foods of Sidoarjo to improve science literacy among junior high school. A*PPLICATION: Applied Science in Learning Research, 5*(2), 96–109.
Suanda, I. W., Subrata, I. M., & Rusmayanthi, K. I. (2024). Pendekatan etnopedagogi sebagai media pelestarian kearifan lokal dalam pembelajaran biologi. *SEMBIO: Prosiding Seminar Nasional Biologi Dan Pendidikan Biologi* (pp. 49-54). Bali, Indonesia: Pendidikan Biologi Universitas PGRI Mahadewa. Retrieved from https://ojs.mahadewa.ac.id/index.php/sembio/article/view/3777.
Susilawati, S. (2025). Development of e-module assisted with augmented reality integrated STEAM to improve students' creative and critical thinking abilities. *MATHEMA: Jurnal Pendidikan Matematika, 7*(1), 234-251.
Syamsinar, S., & Yusuf, M. J. (2019). Analysis of instructional material based on english for specific purposes on the needs of management students at STIE Tri Dharma Nusantara. *Exposure : Jurnal Pendidikan Bahasa Inggris*, *8*(2), 228–244.
Vashisht, S. (2024). Enhancing learning experiences through augmented reality and virtual reality in classrooms. *2024 2nd International Conference on Recent Advances in Information Technology for Sustainable Development (ICRAIS)* (pp. 12-17). Manipal, India: Department of Information and Communication Technology, MIT, Manipal. Retrieved from https://ieeexplore.ieee.org/document/10811732.
Wahyudi, A. B. E., Salimi, M., Hidayah, R., Suhartono, S., & Wahyono, W. (2025). E-module based on

local wisdom to strengthen cultural literacy and critical thinking. *Salud, Ciencia y Tecnología – Serie de Conferencias* (ID: 1310). Buenos Aires, Argentina. Retrieved from https://conferencias.ageditor.ar/index.php/sctconf/article/view/1310.

Wini, W. M., Nerita, S., & Sari, L. Y. (2022). The relationship of students learning motivation with biology learning outcomes for class XI. *Journal Of Biology Education Research (JBER)*, *3*(1), 39–44.

Yatim, H., Jamilah, J., & Prusdianto, P. (2025). Integrating cultural heritage into education: The supportive role of schools in traditional festivals in West Sulawesi. *Discover Education (Springer), 4*, 379.

Yulia, N. M., & Suttrisno, S. (2024). Developing local wisdom-based augmented reality modules for science and social studies learning in elementary schools. *AL-ISHLAH: Jurnal Pendidikan*, *16*(4).

Yuliana, Nurwahidah, I., & Widiyawati, Y. (2023). Development of Ethno-STEM learning module based on javanese gamelan. *Journal of Science Education Research*, *7*(2), 130–139.