

E-Modul Based on Educational Tourism at Kilo 5 Luwuk Beach: Development of Learning Material to Faster Environmental Awareness in Junior High School Student

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Abstract

Background: This research was initiated in response to the noticeable lack of environmental awareness among students in coastal regions, despite the area's abundant natural resources, and the absence of innovative, contextually relevant science learning tools. The research aims to develop a digital edutourism-based e-module at Kilo 5 Beach in Luwuk, designed to enhance students' conceptual understanding and foster environmental appreciation. **Methodology:** The research employs a Research and Development (R&D) approach, specifically the 4D development model (define, design, develop, and disseminate), though only three stages were executed: a preliminary study, design and validation by subject matter and media experts, and effectiveness testing with educators and students. Effectiveness was evaluated using pre- and post-tests, with data analyzed through the N-Gain formula and t-tests. **Findings:** This e-module is validated as educational resource. Expert validation confirmed the e-module's validity, with average scores exceeding 9%, indicating no revisions were needed. Practicality assessments revealed positive feedback from both teachers and students, with scores in the excellent category (above 90%), demonstrating the e-module's high practicality. The e-module's effectiveness was further evidenced by an increase in students' understanding, reflected in an N-Gain value of 0.6316 (medium category) and a significant t-test result ($0.00 < 0.05$). **Contributions:** This research provides empirical support for the use of educational tourism-based e-modules as contextual digital learning tools to improve environmental awareness and conceptual understanding among coastal junior high school students. It advances the 4D development framework by embedding local ecotourism contexts into science learning materials and evaluating their validity, practicality, and learning impact. The findings offer a transferable instructional approach that links formal science education with local environmental resources to support place-based and sustainability-focused learning.

Keywords: Environmental Awareness; Edu-tourism, E-module, Science Learning, Pantai Kilo 5



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INTRODUCTION

Environmental education is an essential component of sustainable development, particularly for an archipelagic nation such as Indonesia, which possesses the world's second-longest coastline. Luwuk City, the capital of Banggai Regency in Central Sulawesi, presents significant coastal potential that remains underutilized as an educational resource. A prominent issue is the low level of environmental awareness among junior high school students residing in coastal areas, despite their schools being situated merely a few hundred meters from the shore. [Wootton et al., \(2024\)](#) emphasize that adolescents in coastal regions frequently exhibit a limited understanding of marine environments. This deficiency in knowledge among students constitutes a substantial challenge to coastal environmental education on a global scale ([Shellock et al., 2022](#); [Yanti et al., 2024](#)). Numerous curricula, in fact, underscore the importance of contextual learning that incorporates the local environment as an educational resource ([Romli, 2022](#); [El-Aasar et al., 2024](#)). In science education, local wisdom is applied through learning indicators that integrate scientific knowledge with local practices, values, and environmental contexts, enabling students to relate scientific concepts to real-life phenomena in their surroundings ([Pertiwi et al., 2025](#); [Linda et al., 2025](#)). Consequently, the development of contextual, visual science learning media that incorporates coastal local wisdom is imperative to bridge the gap between students' environmental characteristics and the presentation of coastal ecosystem materials at the junior high school level.

Pantai Kilo 5 is a coastal tourism destination of notable educational significance, distinguished by its unique marine biodiversity, including coral reefs, mangroves, and various marine species. Despite its potential, it has yet to be systematically integrated into formal educational curricula. Science educators at junior high schools in Luwuk City have reported difficulties in delivering engaging content on coastal ecosystems, primarily due to the lack of relevant and contextual learning media. This challenge is further exacerbated by limited access to visual materials or integrated field trips ([Leininger-Frézal & Sprenger, 2022](#); [Cook et al., 2025](#)), which often hinders students' understanding of environmental issues such as degradation caused by deforestation and pollution ([Vlachopoulos et al., 2023](#); [Quijano et al., 2023](#); [Wahelo et al., 2025](#)).

The advent of digital technology has facilitated the emergence of novel opportunities for the development of educational media ([Mhlongo et al., 2023](#); [Djibrin et al., 2024](#)). These technological advancements have fundamentally transformed education, from the use of classroom computers to the implementation of

online learning, thereby enhancing the accessibility, engagement, and personalization of the learning experience (Murcia et al., 2018; Hemajothi & Jain, 2022). E-modules, as a form of digital learning media, can facilitate a more interactive, engaging, and effective educational experience (Besalti & Satici, 2022; Martín-Sómer et al., 2024; Tarigan et al., 2021; Haruna et al., 2025), significantly boosting students' motivation and conceptual understanding (Fahru et al., 2024; Martini et al., 2025). Locally contextualized e-modules serve as valuable resources that help educators enhance students' competencies through contextual and self-directed learning (Putri et al., 2025). However, existing e-modules are generally generic, and this educational potential has not been systematically integrated into the formal learning frameworks of local schools, particularly those focusing on coastal ecosystems and accommodating local distinctiveness, such as the coastal edutourism potential of Pantai Kilo 5.

Previous research has developed e-modules across various subjects; however, none have specifically focused on creating coastal edutourism-based e-modules aimed at fostering an environmentally conscious character, particularly in Banggai Regency. This study marks the first development of a digital edutourism-based e-module at Pantai Kilo 5, integrating local ecotourism, the coastal context, and science education with character education. Moreover, innovations in the community-based integration of technology and local context have yet to be systematically developed using the 4D model within the Banggai region.

The urgency of this research is highlighted by several critical factors, including the ongoing degradation of coastal environments caused by irresponsible human activities. (Asensio-Montesinos et al., 2024; Choudhary et al., 2024), the pressing need for a younger generation that cherishes the environment and can sustain coastal ecosystems, curriculum demands for contextual learning pertinent to the local environment (Könnel et al., 2025), the unrealized potential of digital technology in environmental education, and the necessity for educational innovation (Filho et al., 2018) to enhance student motivation and active participation in environmental preservation.

Several negative consequences may arise if this research is not undertaken, such as the loss of opportunity to integrate the local potential of Pantai Kilo 5 into formal learning, resulting in continued abstract and less relevant teaching. Thomaes et al., (2023) a weak internalization of environmental values among students that could limit their future participation in conservation activities. Continued degradation of coastal ecosystems due to low environmental awareness in the community, especially among youth (Murzyn et al., 2025), the underutilization of digital technology's potential to support engaging and interactive environmental learning, and lastly, limited contextual learning alternatives available for adoption by other coastal schools.

Based on the explanation above, the aim of this research is to develop a digital edutourism-based e-module at Pantai Kilo 5 as an innovative learning resource for science education in junior high schools, integrating the local coastal context to foster

environmentally loving character through interactive, reflective, and experiential learning designs, including field activities and environmental action commitments.

METHOD

This study investigates the concept of educational tourism at Kilo 5 Beach, utilizing a Research and Development (R&D) methodology, specifically the 4D development model, which encompasses the stages of define, design, develop, and disseminate, as the foundational framework for crafting a learning e-module. In this research, however, only three core stages are executed: an initial study comprising literature and field research, the creation of the e-module, and the validation and testing by subject matter experts, media specialists, educators, and students. [Bagno & Freitas \(2023\)](#) describe the R&D process as consisting of ten stages; nonetheless, this research distills these into three primary phases: information gathering and preliminary research (research and documentation), planning, and the development of the format or model (producing the initial product version). This streamlined approach is informed by [Roper et al., \(2016\)](#), who highlight the critical role of design, new product development, and the assessment of its effectiveness. By organizing the process into three stages, the research achieves greater structure and efficiency, while maintaining the integrity and quality of each step involved.

At this stage, observations are conducted to assess the school's condition, with the objective of developing a profile of the learning system's implementation, particularly emphasizing the activities or learning objects identified for quality enhancement. Subsequently, a preliminary study is undertaken through two primary activities: a literature review, which includes theoretical studies, literature related to e-modules and coastal environmental education, and findings from previous research; and a field study, which involves collecting data on the Kilo 5 Luwuk beach ecotourism in Banggai Regency. The subsequent stage entails the formulation of the initial e-module draft, which serves as the primary foundation, drawing from the preliminary study results, theoretical framework, and principles of learning model development. During this phase, the module draft is submitted to experts—specifically subject matter experts and media experts—to evaluate its feasibility concerning fundamental concepts, theoretical accuracy, and the overall viability of product development.

Validity Test Analysis

Based on the results of the validation, the e-model was revised and refined through feasibility testing by practitioners, namely one biology teacher from SMPN 1 Luwuk Timur Junior High School and 30 seventh-grade students as end users. The selection of seventh-grade students was based on the consideration that ecosystem material has not yet been taught at that level, allowing the developed e-model to be tested as an initial learning medium free from the influence of prior knowledge. The research subjects were

chosen using purposive sampling, taking into account the suitability of the subjects' characteristics with the objectives of the e-model development.

The instrument used in this study was a questionnaire administered to three groups of respondents: content experts, design experts, and practitioners. For the content experts, the aspects assessed included alignment with the curriculum, language accuracy, and the quality of the evaluation. Meanwhile, media experts evaluated aspects of the e-learning module's design and the feasibility of its content. For practitioners, the instrument used was a response questionnaire focusing on three main dimensions: attractiveness, ease of use, and the usefulness of the module in the learning process. The data collected was analyzed descriptively and quantitatively, with the results presented in percentage form as shown in Table 1 and Table 2.

Table 1. Validity Test Categories (Alhakiki & Taufina, 2020)

No.	Percentage	Validity Category
1	86-100	Valid
2	66-85	Quite Valid
3	46-65	Less valid
4	25-45	Not Valid

Table 2. Conversion of Achievement Levels (Haruna et al., 2025)

No.	Percentage (%)	Validity Category	Description
1	90 -100	Very Good	No revisions required
2	75 - 89	Good	Minor revisions
3	65 - 74	Good enough	Revisions required
4	55 - 64	Lack Good	Major revisions
5	0 - 54	Not Good	Failed product

Effectiveness Test Analysis

This study further investigated the efficacy of the developed e-module by employing a one-group pretest-posttest design, utilizing 15 questions for both the pretest and posttest assessments. The enhancement in learning outcomes was evaluated using the N-Gain formula to quantify the extent of improvement, alongside a paired sample t-test to ascertain the statistical significance of this enhancement. Prior to conducting the t-test, the data satisfied statistical assumptions, including normal distribution and homogeneity, thereby justifying the use of the t-test. The criteria for N-Gain values are presented in Table 3.

Table 3. N-Gain Categories (Hake, 1998)

No.	N-Gain Value	Classification
1	$g \geq 0.7$	High
2	$0.3 \leq g \leq 0.70$	Medium
3	$g > 0.3$	Low

RESULT AND DISCUSSION

Result

This study employs a research and development (R&D) model to create an e-learning module. The development process is executed in three stages: (1) the exploration stage, (2) the e-module development stage, and (3) the product validation stage. During the exploration stage, observations were conducted at six student of junior high schools in Banggai Regency, revealing that approximately 80 % of the learning resources and media used in teaching biology remain in textbook form, particularly for environmental topics. The available facilities and infrastructure have not been optimally utilized for digital learning media, thus failing to fully meet current curriculum requirements. This stage also involved field data collection at Kilo 5 Beach, which possesses unique characteristics that render it ideal as an educational tourism location, namely: (1) well-preserved fish and coral reef diversity, (2) safe snorkeling spots for beginners, (3) easy accessibility from the city center, and (4) adequate supporting facilities for field-based learning activities.

The subsequent stage involves the compilation and design of an eduwisata-based e-learning module for Kilo 5 Beach in Luwuk, Banggai Regency. The e-module is structured comprehensively: (1) cover (title, junior high school level, author), (2) main menu (location profile, learning module, field activities, assessment, gallery and reflection, and about the module), (3) teaching materials (summary, videos and images of the beach ecosystem, as well as evaluation questions), (4) glossary, (5) bibliography, and (6) author profile on the last page.



Figure 1. Cover design and Main Menu display

Figure 1 illustrates the cover design and main menu of the e-model, which is meticulously crafted to offer an initial orientation for learning while concurrently enhancing students' interest and motivation. The visual layout and navigation icons are organized in a straightforward and intuitive manner, thereby facilitating easy access to each learning feature. From a pedagogical perspective, the main menu serves as a guide

for the learning process, allowing students to independently select materials, videos, evaluations, and reflections. Interactivity is emphasized through responsive navigation buttons that support self-directed learning tailored to students' individual needs.

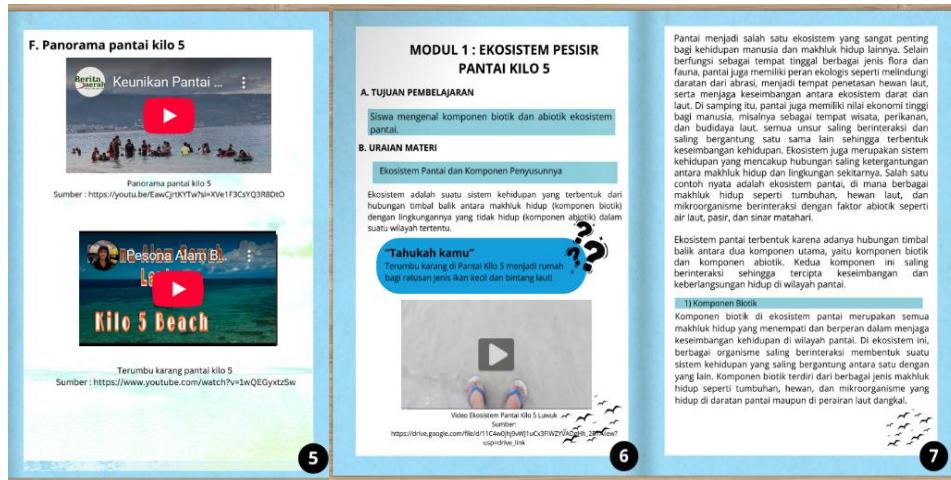


Figure 2. Video Design and Learning Materials

Figure 2 illustrates the design of the video and learning materials, which have been developed by incorporating contextual visuals of coastal environments. This design aims to facilitate students' comprehension of ecosystem concepts in a more tangible and contextualized manner through the integration of text, images, and videos. From a pedagogical perspective, the material is presented using a multimedia learning approach to enhance conceptual understanding and alleviate students' cognitive load. Interactivity is afforded through video playback controls and material navigation, allowing students to engage in independent and sequential learning.



Figure 3. Evaluation and Reflection Design

Figure 3 illustrates the design of the evaluation and reflection features, which are intended to assess learning achievement while fostering students' self-reflection. The evaluation is implemented through interactive questions that provide immediate feedback on students' responses. From a pedagogical standpoint, the reflection feature is designed to enhance students' metacognitive skills and awareness of their own learning processes. The interactivity aspect is manifested in the direct response mechanism and the active engagement of students in the evaluation and reflection process.

The final phase of the research involves the validation of the e-module product to evaluate its feasibility and significance using a systematic validation instrument. Validation was conducted by content experts and media experts. Practicality and effectiveness tests of the e-module were performed at SMPN 1 Luwuk Timur with 30 students. The evaluation results encompass content quality, design, attractiveness, and learning relevance, as presented in Table 4 through Table 9.

Table 4. Results of Expert Material Validation Test

Assessment Aspect	Percentage (%)	Category/Description
Content Feasibility	98	Valid
Language	90	Valid
Presentation	90	Valid
Aspects of an Approach to Shaping an	88	Quite
Total	366	
Average	91.5	No revisions required

Table 5. Results of Media Expert Validation Test

Assessment Aspect	Percentage (%)	Category/Description
Media Appearance/Design	93	Valid
Media Eligibility	91	Valid
Interactivity	88	Valid
Presentation of Material in Media	91	Valid
Building for Environmentally	90	Valid
Caring/Awareness Character		
Total	362	
Average	90.5	No revisions required

Based on the assessment by the subject matter expert validator (Table 4), the e-module obtained a score of 91.5 % (category: no revision needed). While some notes were provided, such as the inclusion of activities to promote environmental awareness, this e-module has been enhanced to strengthen its character-building aspect. It now incorporates a series of reflective activities and real action projects (project-based learning) within each learning module. These activities encompass post-material reflective journaling and mini environmental projects, such as creating educational posters, organizing a plastic-free school campaign, or conducting community-based beach clean-up actions.

The media expert validator (Table 5) gave a score of 90.5% (category: no revision needed) and also recommended minor revisions. In response to the suggestions from the media expert validator, an interactive navigation menu will be added on each main page of the e-module, including a learning roadmap, quick access buttons to each video feature, and breadcrumb navigation to ensure user orientation remains maintained throughout usage. In addition, all video links have been verified and updated, with inaccessible content replaced. During the development stage, the e-module was tested in practice by a Biology teacher and students at SMPN 1 Luwuk Timut. The findings are presented in Table 6 and Table 7.

Table 6. E-module Practicality Test by Teacher

Assessment Aspect	Percentage (%)	Category/Description
Content/Material	96	Very Good
Presentation	95	Very Good
Appearance & Media	100	Very Good
Engagement & Interactivity	98	Very Good
Advantages	100	Very Good
Total	489	
Average	97.8	No revisions required

Table 7. E-module Practicality Test by Students

Measurements	Statement	Percentage (%)	Category
Usability	The text and images in the E-module are easily readable and understandable	95.6	Very Good
	The instructions for use in the E-module are clear and easy to follow	95.0	Very Good
	The E-module is readily accessible on my device	88.9	Good
	E-modules are suitable for both independent and group learning	96.6	Very Good
Main Attraction	The developed E-module is both visually appealing and enjoyable	93.3	Very Good
	The content of the E-module is congruent with the current lesson under study	90.6	Very Good
	The questions and exercises within the e-module facilitate my practice and comprehension of the material	91.6	Very Good
Learning Motivation	The e-module has significantly enhanced my comprehension of environmental materials	96.3	Very Good
	I find myself more motivated to learn with the newly developed e-module	90.0	Very Good
	I would like to use this E-module in future lessons	98.3	Very Good
Total	936.2		
Average	93.62	No revisions required	

The data obtained from the analysis of the teaching e-module's effectiveness was collected through pretest and posttest results, each consisting of 15 questions administered to a cohort of 30 students. The test outcomes were classified according to the N-Gain criteria to evaluate the extent of improvement in learning outcomes. A t-test was employed to statistically assess the significance of the differences between the pretest and posttest results. These findings are detailed in Table 8 and Table 9.

Table 8. Significant Performance and N-Gain

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score	30	0.50	0.83	0.6316	0.08924
Valid N (listwise)	30				

Table 9. Effectiveness of E-modules using T-test (Paired Samples Test)

	Mean	Std. Deviation	t	df	Sig. (2-tailed)
PreTest - PostTest	-37.23333	6.96139	-29.295	29	0.000

Discussion

The present study successfully developed an educational e-module centered on educational tourism at Kilo 5 Beach, which satisfies the criteria of feasibility and meaningfulness in biology education, particularly concerning environmental topics for junior high school students. The Research and Development (R&D) methodology employed facilitated a systematic and structured product development process, encompassing comprehensive needs assessment, product design tailored to student characteristics and the local context, and stages of validation and product trials involving various stakeholders. This approach ensures that the resulting product is not only innovative but also relevant and applicable within the context of everyday classroom learning.

Observational data during the exploration phase indicated that learning media in schools remain predominantly conventional textbooks, with relatively limited integration of technology. This condition highlights a disparity between technological advancements and classroom practice, which continues to rely heavily on traditional methods. These findings align with previous research indicating that the integration of digital media in education remains suboptimal in many secondary schools, necessitating further efforts to support teacher adaptation and capacity-building, as well as the provision of adequate infrastructure (Haleem et al., 2022; Msambwa et al., 2024). Consequently, the development of an educational-tourism-based e-module that capitalizes on the unique attributes and potential of the Kilo 5 Beach location offers a practical contribution by enriching learning resources, while simultaneously enhancing student motivation and interest in learning through a more contextual and inspiring approach.

Validation by content and media experts resulted in an exceptional validation score, averaging above 90%, indicating that the developed e-module is suitable for implementation without requiring major revisions. This validation score highlights the quality of a product that aligns with instructional standards and addresses student needs, particularly in enhancing character development related to environmental stewardship through reflective activities and real-world, project-based initiatives. This outcome represents a positive response to the growing emphasis on character development within the curriculum. The incorporation of journaling activities and mini-environmental projects exemplifies a robust integration between learning content and student character development (Fahmy et al., 2015; Birhan et al., 2021). Encouraging students not only to comprehend the material theoretically but also to internalize values of environmental consciousness through experiential learning (Mahsun et al., 2025).

The results of the practicality assessment, which demonstrated excellent scores from both educators and students, suggest that this e-module is not only theoretically viable but also practical and engaging for use in the educational process. The positive perceptions expressed by students, particularly regarding ease of access, material relevance, and enhanced motivation to learn, corroborate the effectiveness of the e-module as an innovative alternative learning medium. Furthermore, favorable feedback from teachers indicates that this tool can be seamlessly integrated into existing teaching practices without imposing any significant additional burden.

The results of the e-module effectiveness test, evaluated according to the N-Gain criteria, reveal a score of 0.6316, indicating moderate effectiveness. The t-test analysis yields a value of 0.000, signifying a significant difference between pretest and posttest results. These findings suggest that the developed e-module is appropriate for implementation in biology education, particularly in environmental topics, to enhance students' appreciation for their environment. The e-module, employing a collaborative learning approach, is most effective in facilitating significant improvements in self-efficacy, motivation, and learning outcomes (Delita et al., 2022; Marzani et al., 2023). E-modules can function as a learning medium capable of enhancing 21st-century thinking skills and abilities (Wati & Syafriani, 2023; Fadhilah & Thahir, 2023; Fitriana et al., 2024).

This research significantly contributes to the development of learning media that integrate local wisdom and digital technology, aligning with students' needs and addressing curriculum demands that increasingly emphasize 21st-century competencies. The practical implication of this study is that educators can employ this e-module as an interactive learning tool to effectively cultivate environmental awareness. Additionally, learning media developers can adopt the location-based edutourism e-module development model as an innovative alternative, which can be further expanded for other educational materials.

CONCLUSION

This study has successfully developed an e-module based on the Pantai Kilo 5 Luwuk edutourism in Banggai Regency, which has been demonstrated to be valid, practical, and effective for teaching biology on environmental topics in junior high schools. This product meets eligibility criteria with expert validation scores exceeding 90%, indicating a strong alignment between academic content and the local edutourism context. The e-module significantly impacts student learning outcomes, with an N-Gain score of 0.63 (medium category). This improvement indicates that the e-module is not only effective in reinforcing concept mastery but also serves as a contextual learning tool that supports the internalization of environmental awareness values, thereby laying a foundation for cultivating a love for the environment among students. The theoretical implication of this research enriches the development model of digital learning media using an edutourism approach, while its practical implication offers an alternative solution for junior high school biology teachers—or their equivalents—who require contextual learning media. The limitation of this research lies in its trial scope, which was restricted to one school; thus, further verification is needed to generalize the findings. However, overall, this e-module product has fulfilled the criteria as an innovative learning medium that bridges biology theory with environmental conservation practices based on local wisdom.

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REFERENCES

Alhakiki, A., & Taufina, T. (2020). The Effect of Quantum Teaching Using the Tandur Framework on Mathematics Learning Outcomes in Primary Schools. *Jurnal Basicedu*, 4(3), 534-540. <https://doi.org/10.31004/basicedu.v4i3.395>. [In Indonesian language]

Asensio-Montesinos, F., Molina, R., Anfuso, G., Manno, G., & Lo Re, C. (2024). Natural and Human Impacts on Coastal Areas. *Journal of Marine Science and Engineering*, 12(11), 2017. <https://doi.org/10.3390/jmse12112017>

Bagno, R. B., & Freitas, J. S. (2023). Setting the three-stage R&D shared portfolio methodology: an innovative approach to industry–university collaboration. *Revista de Gestao*, 30(3), 282-298. <https://doi.org/10.1108/REGE-07-2021-0108>.

Besalti, M., & Satici, S. A. (2022). Online learning satisfaction and internet addiction during covid-19 pandemic: a two-wave longitudinal study. *TechTrends*, 66(5), 876-882. <https://doi.org/10.1007/s11528-022-00697-x>

Birhan, W., Shiferaw, G., Amsalu, A., Tamiru, M., & Tiruye, H. (2021). Exploring the context of teaching character education to children in preprimary and primary schools. *Social Sciences & Humanities Open*, 4(1), 100171. <https://doi.org/10.1016/j.ssaho.2021.100171>

Djibran, A. K. S., Subiyanto, P., Wakhudin, W., & Rahayu, N. S. (2024). Transforming education in the digital age: How technology affects teaching and learning methods. *Journal of Pedagogi*, 1(3), 141-155. <https://doi.org/10.62872/ksq9jc13>

Cook, M. L., Sheffield, S. L., Ryan, J. G., Bebeau, C. M., & Rodgers, M. (2025). Enhancing geoscience education through immersive virtual field trips: Student perspectives and implications for broadening participation. *Journal of Geoscience Education*, 73(4), 352–369. <https://doi.org/10.1080/10899995.2025.2537995>

Choudhary, B., Dhar, V., & Pawase, A. S. (2024). Blue carbon and the role of mangroves in carbon sequestration: Its mechanisms, estimation, human impacts and conservation strategies for economic incentives. *Journal of Sea Research*, 199, 102504. <https://doi.org/10.1016/j.seares.2024.102504>

Delita, F., Berutu, N., & Nofrion, N. (2022). Online Learning: The Effects of Using E-Modules on Self-Efficacy, Motivation and Learning Outcomes. *Turkish Online Journal of Distance Education*, 23(4), 93-107. <https://doi.org/10.17718/tojde.1182760>

El-Aasar, M., Shafik, Z., & Abou-Bakr, D. (2024). Outdoor learning environment as a teaching tool for integrating education for sustainable development in kindergarten, Egypt. *Ain Shams Engineering Journal*, 15(4), 102629. <https://doi.org/10.1016/j.asej.2024.102629>

Fadhilah, N. & Thahir R. 2023. Development of Electronic Module with Project Based Learning. *Bioeduscience*, 7(3), 350-357. <https://doi.org/10.22263/jbes/11817>

Fahmy, R., Bachtiar, N., Rahim, R., & Malik, M. (2015). Measuring student perceptions to personal characters building in education: An Indonesian case in implementing new curriculum in high school. *Procedia-Social and Behavioral Sciences*, 211, 851-858. <https://doi.org/10.1016/j.sbspro.2015.11.112>

Fahru, A. R. S., Kundera, I. N., & Bialangi, M. S. (2024). Professional Flip-Pdf-Based Interactive Modules to Enhance The Creative Thinking Skills and Collaborative Skills of High School Students. *Jurnal Penelitian dan Pengembangan Pendidikan*, 8(3), 429-438. <https://doi.org/10.23887/jppp.v8i3.76379>

Filho, W. L., Raath, S., Lazzarini, B., Vargas, V. R., de Souza, L., Anholon, R., Quelhas, O. L. G., Haddad, R., Klavins, M., & Orlovic, V. L. (2018). The role of transformation in learning and education for sustainability. *Journal of Cleaner Production*, 199, 286–295. <https://doi.org/10.1016/j.jclepro.2018.07.017>

Fitriana, E., Djono, D., & Sumaryati, S. (2024). Possibilities for Using E-Modules in Vocational High Schools to Facilitate Critical Thinking Skills. *Ijorer : International Journal of Recent Educational Research*, 5(3), 656-665. <https://doi.org/10.46245/ijorer.v5i3.595>

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable operations and computers*, 3, 275-285. <https://doi.org/10.1016/j.susoc.2022.05.004>

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64–74. <https://doi.org/10.1119/1.18809>

Haruna, M, F., Fahru, A, R, S., Marwah, S., Katili, A, S., & Odja, A,H. (2025). Research-Based Teaching E-Modules on Mangrove Diversity to Enhance Meaningful Learning in Banggai Regency. *Jurnal Penelitian Pendidikan IPA*, 11(11) <https://doi.org/10.29303/jppipa.v11i11.13084>

Hemajothi, S., & Jain, S. K. (2022). Challenges of e-learning during the pandemic and its implication in education. *Technoarete Transactions on Applications of Information and Communication Technology (ICT) in Education*, 1(4), 1-6. <https://doi.org/10.36647/TTAICTE/01.04.A001>

Könnel, E. J., Geuer, L., Schlindwein, A., Perret, S., & Ulber, R. (2025). The Effects of an Outdoor Learning Program, 'Gewässer Campus', in the Context of Environmental Education. *Education Sciences*, 15(5), 550. <https://doi.org/10.3390/educsci15050550>

Leininger-Frézal, C., & Sprenger, S. (2022). Virtual Field Trips in Binational Collaborative Teacher Training: Opportunities and Challenges in the Context of Education for Sustainable Development. *Sustainability*, 14(19), 12933. <https://doi.org/10.3390/su141912933>

Linda, E., Rakhmawati, A., & Paidi. (2025). Development of Discovery-Based Outdoor Learning Integrated with Papua Local Wisdom to Improve Cooperation and Understanding of the Biodiversity Concept of Students of Phase E of Sman Khas Papua. *Jurnal Penelitian Pendidikan IPA*, 11(8), 328–336. <https://doi.org/10.29303/jppipa.v11i8.12140>

Mahsun, S., Utaya, S., Handoyo, B., & Wibowo, N. A. (2025). Enhancing environmental awareness: Evaluating the impact of project-based hybrid learning on critical thinking for high school students. *International Journal of Environmental Impacts*, 8(01), 123-135. <https://doi.org/10.18280/ijei.080113>

Martini, N. K., Agustini, K., & Suartama, I. K. (2025). Systematic Literature Review: The Role of Interactive E-Modules in Building Student Literacy. *Didaktika: Jurnal Kependidikan*, 14(3), 5451-5464 <https://doi.org/10.58230/27454312.2532> **[In Indonesian language]**

Martín-Sómer, M., Casado, C., & Gómez-Pozuelo, G. (2024). Utilising interactive applications as educational tools in higher education: Perspectives from teachers and students, and an analysis of academic outcomes. *Education for Chemical Engineers*, 46, 1-9. <https://doi.org/10.1016/j.ece.2023.10.001>

Marzani, E., Kartikowati, S., & Gimini, G. (2023). Development of website-based learning media to improve students' self-regulated learning in economics. *Jurnal EDUCATIO: Jurnal Pendidikan Indonesia*, 9(2), 929-941. <https://doi.org/10.29210/1202323164>

Mhlongo, S., Mbatha, K., Ramatsetse, B., & Dlamini, R. (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. *Heliyon*, 9(6). <https://doi.org/10.1016/j.heliyon.2023.e16348>

Msambwa, M. M., Daniel, K., & Lianyu, C. (2024). Integration of information and communication technology in secondary education for better learning: A systematic literature review. *Social Sciences & Humanities Open*, 10, 101203. <https://doi.org/10.1016/j.ssaho.2024.101203>

Murcia, K., Campbell, C., & Aranda, G. (2018). Trends in early childhood education practice and professional learning with digital technologies. *Pedagogika*, 68(3). <https://doi.org/10.14712/23362189.2018.858>

Murzyn, D., Mroczek, T., Czyżewska, M., & Jezierska, K. (2025). Environmental Awareness and Responsibility: A Machine Learning Analysis of Polish University Students. *Sustainability*, 17(19), 8577. <https://doi.org/10.3390/su17198577>

Pertiwi, F., Siregar, H., & Maysara, S. R. (2025). Implementation of Contextual Learning Based on Local Wisdom in Non-Formal Early Childhood Education: A Phenomenological Study. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 9(6), 2691-2704. <https://doi.org/10.31004/obsesi.v9i6.7563> **[In Indonesian language]**

Putri, A. S., Sulisetijono, S., & Ibrohim, I. (2025). Development of Flower Morphology E-Module Based on Tretes Waterfall Biodiversity to Improve Botanical Literacy And Communication Skills. *Jurnal Pembelajaran dan Biologi Nukleus*, 11(3), 1202-1220. <https://doi.org/10.36987/jpbn.v11i3.7740>

Quijano, S. A., Cerón, V. A., Guevera-Fletcher, C. E., Bermúdez, I. M., Gutiérrez, C. A., & Pelegrin, J. S. (2023). Knowledge in Regard to Environmental Problems among University Students in Cali, Colombia. *Sustainability*, 15(21), 15315. <https://doi.org/10.3390/su152115315>

Roper, Stephen, Pietro Micheli, James H. Love, and Priit Vahter. (2016). The Roles and Effectiveness of Design in New Product Development: A Study of Irish Manufacturers. *Research Policy* 45(1), 319–29. <https://doi.org/10.1016/j.respol.2015.10.003>

Romli. (2022). Contextual Teaching and Learning Model in Islamic Education Lessons as One of the Innovations in Curriculum Development in Schools. *Edugama: Jurnal Kependidikan Dan Sosial Keagamaan*, 8(2), 258-269. <https://doi.org/10.32923/edugama.v8i2.2590> [In Indonesian language]

Shellock, R. J., Fullbrook, L., McKinley, E., Cvitanovic, C., Kelly, R., & Martin, V. (2024). The nature and use of ocean literacy in achieving sustainable ocean futures: A systematic map. *Ocean & Coastal Management*, 257, Article 107325. <https://doi.org/10.1016/j.ocecoaman.2024.107325>

Tarigan, W. P. L., Sipahutar, H., & Harahap, F. (2021). The effect of interactive digital learning module on student's learning activity and autonomy. *Bioedukasi: Jurnal Pendidikan Biologi*, 14(2), 196. <https://doi.org/10.20961/bioedukasi-uns.v14i2.49366>

Thomaes, S., Grapsas, S., van de Wetering, J., Spitzer, J., & Poorthuis, A. (2023). Green teens: Understanding and promoting adolescents' sustainable engagement. *One Earth*, 6(4), 352-361. <https://doi.org/10.1016/j.oneear.2023.02.006>

Vlachopoulos, D., Thorkelsdóttir, R. B., Schina, D., & Jónsdóttir, J. G. (2023). Teachers' Experience and Perceptions of Sustainable Digitalization in School Education: An Existential Phenomenological Study of Teachers in Romania, Greece, Cyprus, Iceland, and The Netherlands. *Sustainability*, 15(18), 13353. <https://doi.org/10.3390/su151813353>

Wahelo, T. T., Mengistu, D. A., & Merawi, T. M. (2025). Curbing environmental problems related to deforestation and climate change: The level of secondary school students' knowledge, attitudes and determinants in Metekel Zone, Northwest Ethiopia. *Geo: Geography and Environment*, 12(1), e70004. <https://doi.org/10.1002/geo2.70004>

Wati, W. W., & Syafriani, S. (2023). Effectiveness of E-Modules based on Inquiry Model Integrated with SETS Approach on 21st Century Skills. *Journal of Innovation in Educational and Cultural Research*, 4(4), 673-681. <https://doi.org/10.46843/jiecr.v4i4.941>

Wootton, N., Nursey-Bray, M., Holland, S., & Gillanders, B. M. (2024). Better understanding ocean awareness: Insights from young people. *Marine Policy*, 164, Article 106159. <https://doi.org/10.1016/j.marpol.2024.106159>

Yanti, F. A., Wardana, R. W., Buyung, Heryensi, E., & Khamis, N. (2025). Automatic assessment-based artificial intelligence to measure students' environmental literacy. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 7(3), 461–480. <https://doi.org/10.23917/ijolae.v7i3.11240>

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