

Development of a Local Wisdom-Based VideoScribe Learning Media to Enhance Children's Ecoliteracy in Banjarmasin City

Muhammad Zulkarnaen¹, Noor Baiti², Nahdya Addien³

^{1,2,3} Universitas Muhammadiyah Banjarmasin, Indonesia; muhammadzulkarnaen@umbjm.ac.id

* WhatsApp Number

Article history

Submitted: 2026/06/15; Revised: 2026/07/21; Accepted: 2026/08/27

Abstract

The low level of environmental awareness among young children remains a significant challenge to achieving sustainable development. This study aimed to develop a local wisdom-based VideoScribe learning medium inspired by the cultural and environmental characteristics of Banjarmasin City to enhance young children's ecoliteracy. The study employed a Research and Development (R&D) approach using the Four-D (4D) development model, consisting of the Define, Design, Develop, and Disseminate stages. The developed product was validated by two media experts and two subject-matter experts before being implemented with early childhood learners. Data were collected through observations, interviews, expert validation questionnaires, and documentation, while qualitative data were analyzed using the interactive analysis model of Miles, Huberman, and Saldaña, including data condensation, data display, and conclusion drawing/verification. The findings indicate that the local wisdom-based VideoScribe learning media were highly feasible for classroom implementation and effectively improved children's ecoliteracy. Following the learning intervention, the children demonstrated a better understanding of environmentally responsible behaviors, including proper waste disposal, maintaining environmental cleanliness, caring for plants, conserving water, and recognizing the importance of preserving rivers as an integral part of the cultural and ecological heritage of Banjarmasin. The integration of animated presentations with local wisdom-based storytelling created a more engaging, contextualized, and meaningful learning experience for young children.

Keywords

Early Childhood Education; Ecoliteracy; Use Palatino Learning Media; Video Scribe.



© 2026 by the authors. This is an open-access publication under the terms and conditions of the Creative Commons Attribution 4.0 International (CC BY SA) license, <https://creativecommons.org/licenses/by-sa/4.0/>.

INTRODUCTION

The Indonesian government, through the Adiwiyata Mandiri Program in 2024, encourages schools to strengthen environmental awareness by reducing the negative impacts of school activities on the environment and implementing environmentally friendly practices, such as proper waste management and energy conservation (Maulana et al., 2021). These efforts support the achievement of the Sustainable Development Goals (SDGs), particularly those related to education for sustainable development (Auliyairrahmah et al., 2021). However,

environmental education remains an important challenge because children's environmental awareness and responsible behavior need to be developed continuously from an early age.

Environmental problems are largely caused by human activities, including deforestation and the improper disposal of household waste. According to the National Waste Management Information System (SIPSN), Indonesia generates approximately 18.30 million tons of waste annually. Data from the Ministry of Environment and Forestry (KLHK) in 2022 indicate that organic and food waste account for 41.27% of the total waste composition, while 34.07% of waste remains unmanaged. This situation contributes to serious environmental challenges, particularly in flood-prone areas and densely populated settlements. These environmental problems reflect the need to strengthen public awareness and responsibility toward environmental sustainability (Pradita et al., 2023). Therefore, efforts to develop environmental understanding and responsible behavior should begin during early childhood.

Achieving sustainable environmental development requires high-quality human resources with environmentally responsible perspectives, ethical patterns of consumption and production, and continuous learning through both social interactions and formal education from early childhood onward (Intaniasari & Utami, 2022). Education plays a vital role in developing children's environmental awareness and responsible attitudes toward nature. Environmental education should therefore be introduced during early childhood to cultivate lifelong environmental responsibility. Bowker argued that children's environmental values and respect for nature are primarily established during the early developmental years, particularly between the ages of three and seven years (Maulana et al., 2021).

Ecoliteracy is an important component of environmental education and is aligned with the objectives of UNESCO's Education for Sustainable Development (ESD), as highlighted in the Global Education Monitoring (GEM) Report (2016). Ecoliteracy refers to an individual's ability to understand, appreciate, and interact with the natural environment while recognizing the impact of human activities on ecosystems (Pradita et al., 2023). Previous studies have emphasized that effective ecoliteracy education requires teachers to have adequate environmental knowledge and to use instructional media that can support children's understanding of environmental concepts (Sartori et al., 2022). However, ecoliteracy learning that relies primarily on text-based materials may be less effective in engaging young children and may limit their learning motivation and understanding of abstract environmental concepts (Dhea Alfira & Siregar, 2024).

Recent studies therefore indicate the importance of developing interactive and visually engaging digital learning media to support environmental learning in early childhood. Nevertheless, existing studies have generally focused on environmental education through conventional learning activities or digital media without sufficiently integrating local environmental contexts and local wisdom into the learning content. This creates a research gap in the development of digital learning media that not only introduces ecological concepts but also connects them with children's immediate cultural and environmental experiences.

To address this gap, this study focuses on developing children's ecoliteracy through VideoScribe-based interactive learning media. VideoScribe provides animated visualizations that can introduce children to natural environments such as forests, rivers, and mountains, while illustrating ecosystem components and the interdependence among living organisms. Through animation, children can also be introduced to environmentally responsible behaviors, including recycling, water conservation, waste reduction, pollution prevention, forest conservation, and climate change mitigation. Such visual representations can make environmental concepts more concrete, engaging, and accessible to young children.

Furthermore, the proposed VideoScribe learning media integrates the local wisdom of Banjarmasin, known as the "City of a Thousand Rivers," by incorporating local folklore and environmental values that emphasize the responsibility to protect, preserve, and conserve nature. Integrating local wisdom into digital learning can strengthen children's environmental awareness while simultaneously fostering appreciation of local culture and identity. This combination of digital animation, ecoliteracy, and Banjarmasin local wisdom represents the distinctive contribution of the present study.

Based on the identified environmental challenges, the importance of ecoliteracy during early childhood, and the limited availability of digital learning media that integrates ecological concepts with local wisdom, this study aims to develop and determine the feasibility of VideoScribe-based learning media incorporating Banjarmasin local wisdom to support the development of ecoliteracy among young children. The study is expected to contribute to the development of engaging, meaningful, and culturally relevant environmental learning media for early childhood education.

METHODS

This study employed a Research and Development (R&D) approach using the Four-D (4D) instructional development model proposed by (Thiagarajan et al., 1974). The 4D model consists of four systematic stages: Define, Design, Develop, and Disseminate. This model was selected because it provides a systematic framework for identifying learning needs, designing instructional products, validating the developed product, and disseminating the final product for educational use (Thiagarajan et al., 1974). The primary objective of this study was to develop a local wisdom-based VideoScribe learning medium inspired by the cultural identity of Banjarmasin, the "City of a Thousand Rivers," to support the development of ecoliteracy among young children.

The Define stage involved a needs assessment, learner analysis, curriculum analysis, and concept analysis. The needs assessment was conducted to identify problems and learning needs related to ecoliteracy in early childhood education. Learner analysis examined children's developmental characteristics, learning needs, interests, and abilities. Curriculum analysis referred to the Merdeka Curriculum to determine learning outcomes and environmental learning content appropriate for early childhood education. Concept analysis was conducted to identify ecoliteracy concepts that could be presented through age-appropriate visual and

audiovisual learning activities. These activities followed the initial stage of the 4D development model proposed by Thiagarajan et al. (1974).

The Design stage involved the development of research instruments, preparation of instructional materials, formulation of learning objectives, storyboard development, selection of the media format, and preparation of the initial prototype of the local wisdom-based VideoScribe learning media. The storyboard was designed to integrate ecological concepts with the local environmental and cultural context of Banjarmasin. The design process followed the principles of instructional design, which emphasize the systematic alignment of learning objectives, content, learning activities, and assessment (Thiagarajan et al., 1974; Sugiyono, 2022).

The Develop stage consisted of product development, expert validation, product revision, and a limited field trial. The prototype was evaluated by four expert validators, comprising two media experts and two subject-matter experts. The validators assessed several aspects of the learning media, including content relevance, content accuracy, presentation, language, visual design, local wisdom integration, age appropriateness, and usability. Expert validation was conducted to determine the content and construct appropriateness of the developed product before its implementation with young children. The results of expert validation were used as the basis for revising and improving the product (Thiagarajan et al., 1974).

The Disseminate stage involved the implementation of the validated learning media with the target group. This stage was conducted to determine the practicality, acceptability, and potential use of the developed VideoScribe learning media in early childhood learning. Feedback obtained from teachers and learners during implementation was used to refine the final product. The dissemination stage corresponds to the final stage of the 4D development model, in which a validated product is introduced and applied within the intended educational context (Thiagarajan et al., 1974).

The participants consisted of early childhood learners enrolled in Early Childhood Education (ECE) institutions. Participants were selected through purposive sampling, in which participants are selected based on predetermined characteristics relevant to the objectives of the study (Sugiyono, 2022). The selection criteria included ECE institutions that had implemented the Merdeka Curriculum, incorporated environmental learning activities, and were willing to participate in the development and limited implementation of the learning media.

Data were collected through observation sheets, interview guidelines, expert validation questionnaires, and documentation. Observations and interviews were conducted during the needs analysis to identify children's learning characteristics, teachers' needs, and existing practices related to ecoliteracy learning. Expert validation questionnaires were used to assess the feasibility and quality of the developed VideoScribe learning media. Documentation was used to record the development process, validation activities, revisions, and implementation of the product.

The research instruments were developed based on the research objectives, ecoliteracy indicators, characteristics of early childhood learning, and the components of the 4D development model. The operational aspects assessed in the study consisted of (1) content

feasibility, (2) presentation feasibility, (3) language appropriateness, (4) visual and audiovisual quality, (5) local wisdom integration, (6) age appropriateness, and (7) usability/practicality of the VideoScribe learning media. These indicators were used as operational variables for evaluating the quality and feasibility of the developed product.

Instrument validity was examined through expert judgment, involving experts in media development and subject matter. The experts reviewed the instruments and assessment indicators to determine their relevance, clarity, appropriateness, and consistency with the objectives of the study. Expert judgment is commonly used in educational research to establish the content validity of instruments by examining whether the items adequately represent the construct being measured (Sugiyono, 2022).

The validity of the developed learning media was determined from the results of assessments provided by the four expert validators. Each assessment item was scored using a predetermined rating scale. The validation scores were then converted into percentages to determine the level of feasibility of the product. The product was revised according to the validators' comments and suggestions before proceeding to the limited field trial.

Instrument reliability refers to the consistency of an instrument in producing relatively stable measurements. In this study, the reliability of the expert assessment instrument was examined through **inter-rater consistency**, because the feasibility of the product was assessed by more than one expert. The use of multiple expert validators allowed the researchers to compare assessments across raters and identify inconsistencies that required clarification or revision.

The data analysis followed the characteristics of the R&D research design. Qualitative data obtained from observations, interviews, documentation, and expert comments were analyzed using the interactive analysis model of Miles, Huberman, and Saldaña (2014), which consists of three interconnected activities: data condensation, data display, and conclusion drawing/verification. Data condensation involved selecting and organizing relevant information, while data display involved presenting the findings systematically. Conclusions were then drawn and continuously verified against the available evidence (Miles et al., 2014).

The quantitative data obtained from expert validation questionnaires were analyzed descriptively. The scores assigned by each validator were calculated and converted into percentages using the following formula:

$$\text{Percentage} = (\text{Obtained Score} / \text{Maximum Score}) \times 100\%$$

The resulting percentages were interpreted according to predetermined feasibility criteria to determine whether the VideoScribe learning media was categorized as very feasible, feasible, moderately feasible, or not feasible. The quantitative results were considered together with qualitative comments and suggestions from the validators to determine the revisions required for the final product.

Because this study employed an R&D design focused on developing and validating an educational product, inferential statistical tests such as the Chi-square test were not the primary analysis technique. Chi-square is generally used to examine associations between categorical

variables, whereas the present study primarily evaluates product feasibility and development through expert validation, qualitative analysis, and limited implementation. Therefore, descriptive percentage analysis was considered more appropriate for the product validation data.

The trustworthiness of the qualitative findings was strengthened through methodological and data-source triangulation. Method triangulation was conducted by comparing information obtained through observations, interviews, documentation, and expert assessments. Data-source triangulation was conducted by comparing information obtained from different participants or sources, particularly teachers, experts, and learners where applicable. Triangulation is used to strengthen the credibility of qualitative findings by examining the consistency of information obtained through different methods and sources (Miles et al., 2014).

Overall, the combination of the 4D development model (Thiagarajan et al., 1974), expert judgment, descriptive quantitative analysis, qualitative interactive analysis (Miles, Huberman, & Saldaña, 2014), and triangulation provided a systematic basis for developing, validating, revising, and evaluating the local wisdom-based VideoScribe learning media for early childhood ecoliteracy.

RESULTS AND DISCUSSION

Results

This study resulted in the development of a local wisdom-based VideoScribe learning medium that integrates ecoliteracy concepts with the cultural and environmental characteristics of Banjarmasin, the "City of a Thousand Rivers." The learning content highlights the daily lives of local communities and emphasizes environmentally responsible behaviors, including maintaining river cleanliness, disposing of waste properly, conserving plants, saving water, and preserving ecological balance. The learning media was presented through animated illustrations, narration, visual storytelling, and audio elements specifically designed to accommodate the developmental characteristics and learning needs of young children.

The results of the expert validation indicated that the developed learning media achieved a high level of feasibility for classroom implementation. The validation process involved two media experts and two subject-matter experts, who evaluated the content quality, presentation, language, visual appearance, and usability of the product. After revisions were made based on the experts' recommendations, the final version of the VideoScribe learning media was implemented with early childhood learners.

During the learning activities, the children demonstrated a high level of enthusiasm and engagement while watching the VideoScribe presentation. They were able to follow the storyline, pay close attention to the animated visualizations, and actively respond to the teacher's questions regarding environmentally responsible behaviors. Compared with their understanding prior to the intervention, the children's comprehension of ecoliteracy concepts improved considerably. They became more capable of identifying behaviors that reflect

environmental responsibility, such as disposing of waste in designated bins, maintaining river cleanliness, caring for plants, and conserving water.

Classroom observations also revealed positive behavioral changes following the implementation of the learning media. Several children voluntarily disposed of litter in the appropriate waste bins, reminded their classmates to keep the classroom clean, and expressed greater interest in observing and caring for the surrounding school environment. These findings suggest that the local wisdom-based VideoScribe learning media not only enhanced children's knowledge of environmental conservation but also fostered the development of positive attitudes and environmentally responsible behaviors from an early age.

The findings support previous studies indicating that interactive digital learning media can improve children's engagement, comprehension, and learning outcomes. By combining animated visualizations with the local wisdom of Banjarmasin, the learning experience became more meaningful because the environmental issues presented were closely related to the children's everyday lives. This contextual approach enabled children to connect abstract ecological concepts with real-life situations, thereby strengthening both their ecoliteracy and their sense of environmental stewardship. Consequently, the developed learning media has strong potential to serve as an innovative instructional resource for promoting environmental education in early childhood settings while supporting the implementation of the Merdeka Curriculum and the Pancasila Student Profile.



Figure 1. Implementation of the Merdeka Curriculum and the Pancasila Student Profile
Discussion

The findings suggest that the potential of the local wisdom-based VideoScribe learning media to support children's ecoliteracy lies not simply in the use of digital technology, but in the way technology, contextual learning, and ecological content were integrated into a single learning experience. The media transformed environmental concepts that may be abstract for young children into visual and narrative situations that were recognizable from their everyday surroundings. This finding indicates that the effectiveness of digital learning media for young children depends not only on technological features but also on the relevance of the content to children's developmental and sociocultural contexts.

From a constructivist perspective, children do not passively receive knowledge but construct meaning by connecting new information with their previous experiences. Piaget's theory of cognitive development emphasizes that young children learn through concrete experiences and representations that correspond to their developmental level (Piaget, 1952). In the present study, animated representations of rivers, plants, waste, and water conservation provided concrete visual references through which children could interpret environmental concepts. Consequently, the children were not merely introduced to definitions of environmental conservation; they were encouraged to relate the concepts to situations they could recognize in their own environment.

The contextualization of the learning content through Banjarmasin's river culture provides an additional explanation for the observed learning responses. Contextual learning theory emphasizes that learning becomes more meaningful when new knowledge is connected to learners' real-life experiences and social environments (Johnson, 2002). Banjarmasin's identity as the "City of a Thousand Rivers" provides a particularly relevant context because rivers constitute an important part of the city's environmental and cultural landscape. By presenting river cleanliness and environmental responsibility through familiar local contexts, the media reduced the psychological distance between the ecological concepts being taught and children's everyday experiences. This contextual proximity may explain why children were able to recognize and respond to environmentally responsible behaviors more readily.

The findings can also be interpreted through the framework of ecoliteracy. Ecoliteracy is not limited to environmental knowledge; it involves understanding ecological relationships and developing attitudes and behaviors that reflect awareness of human interdependence with the natural environment (Capra, 2007). The children's responses observed in this study indicate an initial movement from knowing toward doing, as demonstrated by behaviors such as disposing of waste properly, reminding peers to maintain cleanliness, and showing greater interest in caring for plants and the surrounding environment. Although these observations should not be interpreted as evidence of long-term behavioral change, they indicate that learning experiences can provide an early foundation for environmentally responsible habits.

The role of multimedia presentation provides another explanation for the findings. Mayer's Cognitive Theory of Multimedia Learning proposes that learners process information through verbal and visual channels and that meaningful learning can occur when these representations are appropriately integrated (Mayer, 2009). The VideoScribe medium combines animation, narration, images, and storytelling, allowing environmental information to be presented through complementary modes rather than relying exclusively on verbal explanations. For young children, who may have difficulty understanding abstract explanations, visual representations can provide cognitive support by making relationships and processes more observable. However, multimedia should be designed carefully because excessive visual or auditory information may increase cognitive load. The relatively focused

environmental content and sequential storytelling used in the present media may have helped children maintain attention without being overwhelmed by unnecessary information.

Another important finding concerns the integration of **local wisdom**. The local wisdom component functions not merely as an additional cultural decoration but as a contextual mechanism for interpreting environmental responsibility. Local environmental values can provide children with culturally familiar meanings concerning the relationship between humans and nature. This is consistent with the broader principle of culturally responsive education, in which learning becomes more meaningful when educational content acknowledges learners' cultural backgrounds and lived experiences. Therefore, the integration of Banjarmasin's river culture potentially strengthens both ecological understanding and cultural identity simultaneously.

This finding also provides a critical distinction from previous digital-learning studies. Previous research has generally demonstrated that interactive and audiovisual media can improve children's attention and comprehension. However, technological interactivity alone does not necessarily guarantee meaningful environmental learning. A digital medium may attract children's attention without helping them understand why particular environmental behaviors are important. The present study addresses this issue by embedding digital visualization within a local ecological context. Thus, the contribution of the developed media is not merely its VideoScribe format, but the combination of multimedia learning, ecoliteracy, and Banjarmasin local wisdom.

The findings also have implications for the implementation of the Merdeka Curriculum, particularly its emphasis on contextual, meaningful, and learner-centered learning. Environmental learning can be integrated with children's immediate surroundings rather than treated as an isolated topic. The use of local environmental contexts also provides opportunities to develop aspects of the Pancasila Student Profile, including environmental responsibility, collaboration, appreciation of cultural diversity, and independent learning. Nevertheless, these implications should be interpreted cautiously because the present study primarily evaluates the development and feasibility of the learning media and its initial implementation, rather than measuring long-term behavioral change.

Overall, the findings indicate that the contribution of local wisdom-based VideoScribe media to ecoliteracy development can be understood through the interaction of three factors: developmentally appropriate multimedia representation, contextualized environmental learning, and culturally meaningful content. The combination allows children to connect ecological concepts with familiar experiences and observable behaviors. Therefore, the developed media represents a promising instructional innovation for early childhood environmental education, while further research involving larger samples, comparison groups, and longer intervention periods is needed to determine its effectiveness in producing sustained changes in children's ecoliteracy and environmental behavior.

CONCLUSION

This study developed a local wisdom-based VideoScribe learning medium to support ecoliteracy learning in early childhood education in Banjarmasin. The developed media was validated by media and subject-matter experts and was considered feasible for use in early childhood learning after revisions based on expert feedback.

The limited implementation indicated that the media supported children's understanding of environmentally responsible behaviors, including proper waste disposal, maintaining cleanliness, caring for plants, and conserving water. The integration of Banjarmasin's local wisdom provided a contextual learning experience that connected ecological concepts with children's everyday environment and cultural heritage.

Therefore, the local wisdom-based VideoScribe learning medium has potential as an innovative and contextually relevant instructional resource for early childhood ecoliteracy education. Further research involving larger samples, longer implementation periods, and appropriate comparative designs is needed to examine its effectiveness in developing sustained ecoliteracy and environmentally responsible behavior among young children.

REFERENCES

- Auliyairrahmah, A., Djazilan, S., Nafiah, & Hartatik, S. (2021). Implementasi Pendidikan Karakter Integritas Sub Nilai Kejujuran Melalui Program Kantin Kejujuran di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 3(6), 3565–3578. <https://doi.org/10.31004/edukatif.v3i6.939>
- Balcha, A. R., Chen, H.-L., & Ramadhana, R. A. B. (2025). The impact of augmented reality-assisted structured learning on environmental education for preschool children. *Education and Information Technologies*, 30, 25467–25503. <https://doi.org/10.1007/s10639-025-13737-9>
- Casey, E., Kim, M., & Reid, A. (2025). Connecting gender equality with sustainability in early childhood: Educators' understandings in Victoria, Australia. *Environmental Education Research*, 31(2), 304–324. <https://doi.org/10.1080/13504622.2024.2418310>
- Demirtaş, D., & Acer, D. (2026). Arts-based pedagogy as epistemic mediation in early childhood environmental and sustainability education: A mixed research systematic review and research agenda. *Educational Research Review*, 52, 100811. <https://doi.org/10.1016/j.edurev.2026.100811>
- Dhea Alfira, & Siregar, M. F. Z. (2024). Pentingnya Peran Orang Tua dalam Memajukan Keterampilan Berbahasa Anak Usia Dini melalui Komunikasi. *Jurnal Pendidikan Anak Usia Dini*. <https://doi.org/10.47134/paud.v1i4.641>
- Fairus, F., Maftuh, B., Sujana, A., Pribadi, R., & Azzahra, F. (2024). Local wisdom integration in learning implementation in elementary school. *Jurnal Cakrawala Pendas*, 10(2), 194–205. <https://doi.org/10.31949/jcp.v10i2.8029>
- Fasting, M. L., Høyem, J., & Ergler, C. (2025). Sustainability as a relational value in early childhood the power of nature play, joy and local place identity. *Journal of Outdoor and Environmental Education*, 29, 803–822. <https://doi.org/10.1007/s42322-025-00219-2>
- Fathurrochman, I., Asnawan, Monita, D., & Hasan, M. F. (2025). Integration of local wisdom in elementary school local content curriculum: A study in rural areas of Indonesia. *The*

- Curriculum Journal*. <https://doi.org/10.1002/curj.70029>
- Garcia Manas, C. (2026). Reframing education for sustainability in early childhood: Exploring the social dimension in the case of England. *International Journal of Early Childhood*, 58, 613–629. <https://doi.org/10.1007/s13158-026-00503-2>
- Hidayah, N., Yanti, Y., & Afriana, S. (2024). Development of thematic e-modules based on environmental education, local wisdom, and Islamic value in elementary school. *AIP Conference Proceedings*, 3058, 040022. <https://doi.org/10.1063/5.0207287>
- Intaniasari, Y., & Utami, R. D. (2022). Menumbuhkan Budaya Membaca Siswa Melalui Literasi Digital dalam Pembelajaran dan Program Literasi Sekolah. *Jurnal Basicedu*, 6(3 SE-Articles), 4987–4998. <https://doi.org/10.31004/basicedu.v6i3.2996>
- Işıkoğlu, N., & Güzen, M. (2024). The promise of digital storytelling for kindergarteners: Language and technology skills. *Early Child Development and Care*, 194(2), 195–207. <https://doi.org/10.1080/03004430.2023.2299389>
- Ita, E., & Ngonu, M. R. (2025). Analyzing the implementation of local wisdom-based learning in early childhood education: The case of early childhood education. *Journal of Nonformal Education*, 11(2), 237–246. <https://doi.org/10.15294/jone.v11i2.33606>
- Jaenudin, D., Nurhayati, N., & Sukmanasa, E. (2025). Implementation of local wisdom-based e-module on ecosystem concepts to enhance elementary school students' environmental awareness. *Jurnal Penelitian dan Pembelajaran IPA*. <https://jurnal.untirta.ac.id/index.php/JPPi/article/view/25378>
- Kahrman-Pamuk, D., Öztürk, N., & Onarok, E. (2026). Enhancing early childhood education for sustainability: Integrating (re)connect with nature into the 7R themes. *International Journal of Early Childhood*, 58, 885–911. <https://doi.org/10.1007/s13158-026-00485-1>
- Kayır, G. T., & Akyol, T. (2026). The effect of digital story tools training on teachers' competence in the use of digital story tools and children's environmental attitudes and awareness. *Early Childhood Education Journal*, 54, 3499–3515. <https://doi.org/10.1007/s10643-025-02084-6>
- Liu, Y. (2025). Immersive digital storytelling to understand the new learning ecosystem: The revised concentric circles model from both teacher and students' perspective. *Smart Learning Environments*, 12, Article 39. <https://doi.org/10.1186/s40561-025-00398-x>
- Lubis, S. P. W., Suryadarma, G. P., Paidi, & Yanto, B. E. (2024). Improving environmental literacy through the development of problem-based learning models that incorporate local wisdom. *World Journal of Environmental Research*, 14(1). <https://doi.org/10.18844/wjer.v14i1.9472>
- Maulana, M. A., Kanzunnudin, M., & Masfuah, S. (2021). Analisis Ekoliterasi Siswa pada Sekolah Adiwiyata Di Sekolah Dasar. *Jurnal Basicedu*, 5(4 SE-Articles), 2601–2610. <https://doi.org/10.31004/basicedu.v5i4.1263>
- Mellyzar, M., Yustiana, Y. R., Nahadi, Rahmi, A., & Virijai, F. (2024). Analysis of environmental literacy of students (behavioral dimension) from a humanistic perspective. *Indonesian Journal of Mathematics and Natural Science Education*, 5(2), 135–151. <https://doi.org/10.35719/mass.v5i2.213>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook* (3rd ed.). SAGE Publications.
- Norðdahl, K., Pálmadóttir, H., Heggen, M. P., Jørgensen, N. J., Hirvid, J., Møller, T., & Staffans, E. (2025). Early childhood education for sustainable development in the Nordic national curricula: Status and content. *Environmental Education Research*, 31(3), 648–660.

- <https://doi.org/10.1080/13504622.2024.2389945>
- Paolizzi, E., Iandolo, G., Alonso-Campuzano, C., & Venuti, P. (2025). Enhancing group interactions and story quality in primary school students: An investigation into the impact of collaborative storytelling methodologies. *Journal of Computers in Education*. <https://doi.org/10.1007/s40692-024-00330-1>
- Pradita, L. E., Rachmawati, U., & Ulyan, M. (2023). Buku Digital Berwawasan Lingkungan Sebagai Upaya Menumbuhkan Ekoliterasi Anak. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 7(6 SE-Articles), 7262–7276. <https://doi.org/10.31004/obsesi.v7i6.5430>
- Pursitasari, I. D., Permanasari, A., Rubini, B., Suriansyah, M. I., Nurramadhani, A., Matsumoto, T., & Rachman, I. (2026). How is the students' sustainability literacy of junior high schools in West Java? *Journal of Natural Science and Integration*, 9(1). <https://doi.org/10.24014/jnsi.v9i1.38635>
- Rahayu, G. D. S., Jayadinata, A. K., & Kelana, J. B. (2026). A rational decision-making learning model to enhance elementary students' environmental understanding. *Indonesian Journal of Educational Development*, 7(1). <https://doi.org/10.59672/ijed.v7i1.6268>
- Ramulumo, M., & Shabalala, N. P. (2025). Comparing environmental literacy in STEM and non-STEM preschools: Evaluating the impact on young children's understanding and attitudes. *International Journal of Early Childhood*, 57, 447–462. <https://doi.org/10.1007/s13158-024-00405-1>
- Sartori, M., Castellaro, M., & Peralta, O. (2022). Children and Adults Assembling a Digital and Interactive Puzzle at Home. *Avances En Psicología Latinoamericana*, 40(2). <https://doi.org/10.12804/revistas.urosario.edu.co/apl/a.10460>
- Shengjergji, S. (2024). “Yeah, I am making new stuff!”: Responsivity to and negotiations of agency during digital storytelling in preschool. *European Early Childhood Education Research Journal*, 32(5), 834–851. <https://doi.org/10.1080/1350293X.2023.2301595>
- Sigit, D. V., Sulistiyanto, T. Q., & Aulya, N. R. (2025). The effect of the self-directed learning model integrated with peer teaching on environmental literacy. *Jurnal Inovasi Teknologi Pendidikan*, 12(3). <https://doi.org/10.21831/jitp.v12i3.79663>
- Sihotang, S. S., & Mustika, M. (2025). Ecological literacy of students based on local wisdom Handep in developing environmental care character of grade IX students at SMP Negeri 4 Palangka Raya. *Jurnal Pendidikan Sosiologi dan Humaniora*, 15(1). <https://doi.org/10.26418/j-psh.v15i1.76571>
- Sumarwati, Anindyarini, A., Suryanto, E., Hadiyah, Muftihah, N., & Alfien, M. F. (2024). The literacy of elementary school students on food and environmental sustainability values in local wisdom. *Mimbar Ilmu*, 29(3). <https://doi.org/10.23887/mi.v29i3.82264>
- Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional Development for Training Teachers of Exceptional Children: A Sourcebook*. Leadership Training Institute/Special Education, University of Minnesota.
- Tran, H. U. (2024). Environmental education in preschool teacher training program: A systematic review. *Natural Sciences Education*, 53(2), e20154. <https://doi.org/10.1002/nse2.20154>
- 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*, 7(3), 461–480. <https://doi.org/10.23917/ijolae.v7i3.11240>