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Integrating Ethno-Vlog into Liveworksheet-Based E-LKPD: Developing Contextual Ecology Learning Media to Enhance Students' Science Literacy

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Abstract
The low level of Indonesian students' science literacy as reflected in the PISA 2022 results highlights the need for innovative, contextualized learning media that can bridge scientific concepts with real-life and cultural experiences. This study aimed to develop and evaluate a Liveworksheet-integrated E-LKPD enriched with an ethno-vlog of Bukit Manengteung on ecology and ecosystem material to enhance students' science literacy. Employing a research and development design with the 4D model (define, design, develop, and disseminate), the product was validated by experts, tested for readability, and implemented with seventh-grade students at SMP Negeri 2 Ciledug during the 2024/2025 academic year. Validation results indicated high feasibility with Aiken's V values above 0.87, while student responses confirmed that the media was engaging, clear, and easy to use. Effectiveness tests showed a significant improvement in students' science literacy, with pretest and posttest scores increasing from an average of 45.69 to 81.72 and an N-Gain of 0.68, categorized as medium to high. Improvements were observed across all science literacy dimensions, particularly in scientific attitudes, and the integration of ethno-vlog content enabled students to contextualize ecology concepts within their local cultural environment. These findings confirm that the developed media is valid, practical, and effective, with implications that integrating ethnoscience-based digital media into science instruction can enhance students' scientific competencies while simultaneously preserving and strengthening cultural identity.

Keywords: Digital Worksheet, Ethno-Vlog, E-LKPD, Science Literacy, Sustainable Learning

INTRODUCTION

Education systems worldwide are being reshaped by the demands of Education 4.0, which require schools to harness digital technologies and cultivate a broad set of twenty-first-century literacies most notably science literacy that enables learners to interpret evidence, apply concepts, and solve authentic problems (Ayanwale et al., 2024; González-Pérez & Ramírez-Montoya, 2022; Oliveira & De Souza, 2021). In Indonesia, persistent gaps in international assessments underscore the urgency of strengthening science literacy from lower secondary levels through instruction that is contextual, inquiry-oriented, and technologically supported (Haerani et al., 2020; PISA, 2023; Ramli et al., 2022). Science literacy is best conceived as an integrated construct encompassing content knowledge, competencies of inquiry and reasoning, attitudes toward science, and the ability to situate knowledge in relevant contexts, which together function as core life skills in contemporary society (Costa et al., 2021; Saraswati et al., 2021; Sarini et al., 2024). However, classroom observations and prior studies indicate that instruction too often relies on textbooks and conventional worksheets, with few opportunities for multiple representations, formative feedback, and authentic application conditions that suppress the development of robust scientific understanding (Darling-Hammond et al., 2020; Dominguez & Svihla, 2023; Treagust, 2008). To address these gaps, recent work has highlighted the promise of interactive learner worksheets (LKPD) and their electronic variants (E-LKPD) for structuring inquiry tasks, eliciting student thinking, and supporting self-paced practice in science (Kasmini et al., 2023; Ricky Ardiansah & Zulfiani, 2023). Digital media can further amplify these benefits: multimodal resources and

virtual/augmented experiences have been shown to improve conceptual grasp and engagement when they scaffold visualization, experimentation, and reflection (Dwivedi et al., 2022; Egunjobi & Adeyeye, 2024; Kourtesis, 2024). Equally critical is cultural relevance. Ethnoscience deriving scientific ideas from local wisdom and community practices has been argued to deepen meaning-making, foster conservation dispositions, and connect school science to students' lived environments (Febrian et al., 2024; Hamna & Muh. Khaerul Ummah BK, 2024; Yasir et al., 2024). Within this approach, ethno-vlogs (short, place-based videos capturing local phenomena) provide a narrative bridge between indigenous knowledge and formal concepts, while motivating learners through familiar, student-friendly formats (Febrian et al., 2024; Vincent-Lancrin et al., 2019; Yasir et al., 2024). Building on these strands, Liveworksheet a platform that turns worksheets into interactive, auto-gradable activities offers a practical vehicle for integrating E-LKPD with embedded media, analytics, and instant feedback, aligning well with the Merdeka curriculum's emphasis on project-based learning and local wisdom (Pradnyadari et al., 2025; Ratnawati et al., 2023; Yasir et al., 2024). Despite these advances, the literature still exhibits three weaknesses: first, many studies treat interactivity and cultural contextualization separately rather than within a single, coherent learning environment; second, few developments explicitly align tasks to the four PISA-aligned dimensions of science literacy (content, competencies, attitudes, context) while using rigorous validation and impact metrics; third, ecology and ecosystem topics are rarely anchored in a specific local site that students can observe and interpret through structured reconstruction activities (Aulia et al., 2025; Fahrizy & Fathurrahman, 2024; Pradnyadari et al., 2025). Addressing these gaps, the present study develops and evaluates a Liveworksheet-integrated E-LKPD with an ethno-vlog of Bukit Manengteung for ecology and ecosystem learning, with the dual intention of (i) ensuring pedagogical quality through expert validation and systematic design of tasks that target science-literacy content, competencies, attitudes, and contexts, and (ii) testing effectiveness through pretest–posttest comparisons and learning-gain analysis, while documenting practicality from student readability responses

Accordingly, the objectives are to design a culturally contextual, technology-enhanced learning medium that operationalizes science-literacy indicators; to establish its validity and usability via expert judgments and learner feedback; and to determine its impact on students' science literacy using inferential statistics and normalized gains, thereby contributing a model for integrating ethnoscience and interactive digital worksheets in Indonesian lower-secondary science (Fahrizy & Fathurrahman, 2024; Ratnawati et al., 2023).

METHODS

This study adopted a research and development (R&D) design employing the 4D model define, design, develop, and disseminate to systematically create and validate an interactive learning medium, namely a Liveworksheet-integrated E-LKPD enriched with an ethno-vlog of Bukit Manengteung. The R&D approach was selected because it enables the iterative development of educational products while ensuring their validity, practicality, and effectiveness (Alfan et al., 2025; Almeida, 2024; Falahat et al., 2024). The research was conducted during the even semester of the 2024/2025 academic year at SMP Negeri 2 Ciledug, with seventh-grade students as participants. All students in class VII A, comprising 29 individuals, were involved in pilot testing, while the product validation process engaged one university lecturer as a material expert and two junior high school science teachers as media experts. This combination ensured that the evaluation reflected both theoretical rigor and classroom applicability.

The development process began with the define stage, which involved curriculum analysis, task analysis, and identification of literacy indicators aligned with the Programme for International Student Assessment (PISA) framework. The design stage focused on creating the initial prototype of the Liveworksheet-integrated E-LKPD, selecting ethno-vlog content related to ecology and ecosystem material from Bukit Manengteung, and constructing research instruments. During the develop stage, the product underwent expert validation using standardized instruments, while revisions were made based on expert feedback and student readability assessments. Finally, at the disseminate stage, the refined product was introduced to a wider student group, and the results were prepared for scholarly dissemination.

Data were collected using multiple instruments to capture validity, practicality, and effectiveness.

Expert validation sheets, based on content and media feasibility criteria, were analyzed using Aiken's V index to quantify validity coefficients (Utami et al., 2024). Student questionnaires were used to evaluate readability, clarity, and usability of the media. To assess learning outcomes, a set of pretest and posttest items designed to measure science literacy competencies was administered. These items covered four key aspects of science literacy: content knowledge, context application, competency in scientific reasoning, and scientific attitudes. Reliability of the test instruments was established through internal consistency checks, while validity was confirmed through expert judgment.

The data analysis procedures combined qualitative and quantitative approaches. Aiken's V values were interpreted to determine the degree of validity, with thresholds above 0.80 considered highly valid. Normality and homogeneity tests were conducted on pretest and posttest scores to ensure the suitability of parametric testing. A paired sample t-test was then applied to identify significant differences in science literacy before and after the intervention, with a significance level set at $p < .05$. The normalized gain (N-Gain) was also calculated to measure the magnitude of improvement, with categories of low (<0.3), medium (0.3–0.7), and high (>0.7) applied to interpret results (Hake, 1999). Triangulation of validation, practicality, and effectiveness ensured comprehensive evaluation of the developed media.

Throughout the research, ethical considerations were carefully observed. Permissions were obtained from school authorities, and informed consent was sought from teachers and students' guardians prior to participation. Data were anonymized to protect student identities, and participants were assured that results would be used solely for academic purposes. This ethical rigor ensured that the study adhered to accepted standards of educational research while maintaining the reliability and credibility of its findings.

RESULTS AND DISCUSSION

Media Validity

The validity assessment conducted by one university lecturer and two junior high school science teachers indicated that the Liveworksheet-integrated E-LKPD with an ethno-vlog of Bukit Manengteung was highly feasible for use in science learning. Aiken's V index values ranged from 0.89 to 1.00, exceeding the threshold of 0.80, which is considered very high validity. These results demonstrate that the developed media fulfilled the criteria of content accuracy, curriculum alignment, graphical design, and contextual relevance. Validation results confirmed that the integration of ethnoscience elements into digital worksheets enhances pedagogical quality and cultural authenticity simultaneously, allowing the media to serve both cognitive and affective learning objectives. Each component is designed to provide a more interactive and contextual learning experience, so that learners can understand the material in depth and apply it in everyday life, as presented in Figure 1 below.

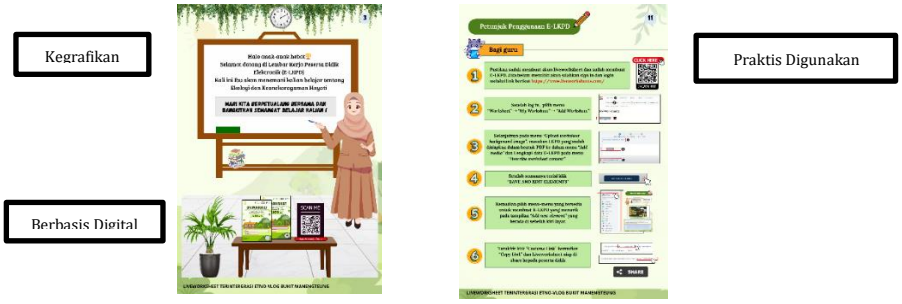

Figure 1. Cover view of E-LKPD integrated liveworksheet with Etno-Vlog Bukit Manengteung
Link E-LKPD : https://drive.google.com/drive/folders/189Tsnnd5tNxk62sSgSGMTf9V_AYdKvw8?usp=sharing

Figure 2. Intiali of E-LKPD

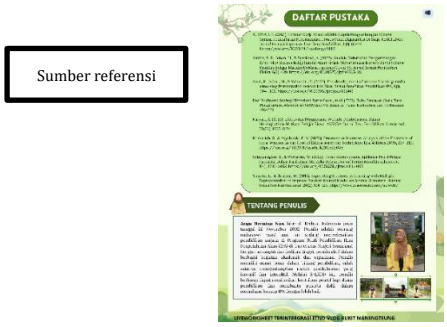

Figure 3. Core activity display of E-LKPD

Figure 4. End view of E-LKPD

The developed media also demonstrates strong characteristics for fostering science literacy, as it incorporates four key indicators attitude, content knowledge, competence, and context that enable students to develop critical thinking skills, systematically understand scientific concepts, and connect the material with the local wisdom of Bukit Manengteung, as illustrated in Figure 5.

Figure 5. Aspects of science literacy indicators in E-LKPDs

The Liveworksheet is further enhanced with an ethno-vlog video integrated into the scientific reconstruction section, serving as an exploratory tool for learners to comprehend how ecological and ecosystem concepts are applied in daily life, particularly within the cultural and environmental context

of Bukit Manengteung. The integration of scientific reconstruction and ethno-vlog content in the E-LKPD is illustrated in Figure 6.

Figure 6. Ethno-Vlog and Scientific Reconstruction of Bukit Manengteung

Practicality Based on Student Readability

The practicality test based on student readability questionnaires revealed that learners found the media easy to navigate, linguistically accessible, and visually appealing. More than 80% of students provided positive responses to the clarity of instructions, design layout, and interactive features. Students also expressed strong appreciation for the ethno-vlog content, which linked ecological concepts to their local environment, thereby improving contextual understanding and engagement. These findings suggest that integrating multimedia and cultural narratives into E-LKPD increases not only usability but also student motivation and interest.

Effectiveness of the Media on Science Literacy

The pretest results showed that the average science literacy score of students was 45.69, whereas the posttest average increased to 81.72 after the intervention. A paired sample t-test confirmed that this difference was statistically significant ($p < .05$), demonstrating that the developed media had a substantial impact on improving science literacy. The normalized gain (N-Gain) analysis yielded an average score of 0.68, placing the improvement in the medium-to-high category. This suggests that most students experienced considerable learning progress, with more than 70% achieving posttest scores above 70. The four dimensions of science literacy content, context, competencies, and attitudes—all showed measurable improvements, particularly in scientific attitudes, which achieved an N-Gain value of 0.82.

Table 1. Media Validity Results

Butir	Penilai			S1	S2	S3	ΣS	n(c-1)	V	Ket.
	I	II	III							
Butir 1	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 2	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 3	4	4	3	3	3	2	8	9	0,89	SEDANG
Butir 4	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 5	3	4	4	2	3	3	8	9	0,89	TINGGI
Butir 6	3	4	4	2	3	3	8	9	0,89	TINGGI
Butir 7	4	4	4	3	3	3	9	9	1,00	TINGGI
Butir 8	4	4	4	3	3	3	9	9	1,00	TINGGI
Butir 9	3	4	4	2	3	3	8	9	0,89	SEDANG
Butir 10	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 11	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 12	3	4	4	2	3	3	8	9	0,89	SEDANG
Butir 13	4	4	4	3	3	3	9	9	1,00	SEDANG
Butir 14	3	4	4	2	3	3	8	9	0,89	SEDANG
Butir 15	3	4	4	2	3	3	8	9	0,89	SEDANG
Butir 16	3	4	4	2	3	3	8	9	0,89	SEDANG
Butir 17	4	4	4	3	3	3	9	9	1,00	SEDANG

Butir	Penilai			S1	S2	S3	ΣS	n(c-1)	V	Ket.
	I	II	III							
Butir 1-17	61	68	67	44	51	50	145	153	0,95	TINGGI

Table 2. Paired Sample t-Test Test Results Pretest Posttest data

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Sebelum diberikan - Setelah diberikan	-36.03448	6.32163	1.17390	-38.43910	-33.62986	-30.696	28	.000

Table 3. N-Gain Test of Science Literacy Skills

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	29	.42	1.00	.6833	.15527
Valid N (listwise)	29				

The N-Gain test results based on pretest and posttest scores demonstrate a notable improvement in students' science literacy after the implementation of the media. Among the 29 participants, N-Gain values ranged from 0.42 to 1.00, with an average of 0.68 and a standard deviation of 0.156. These findings indicate that the E-LKPD–integrated Liveworksheet with Bukit Manengteung ethno-vlog effectively enhances students' understanding and skills in science literacy, enabling them to analyze and interpret scientific concepts more comprehensively. Furthermore, learners expressed strong interest in the material presented through the ethno-vlog videos, which contributed to their engagement and motivation. The detailed results of the N-Gain test for each sub-indicator are presented in the bar chart in Figure 7.

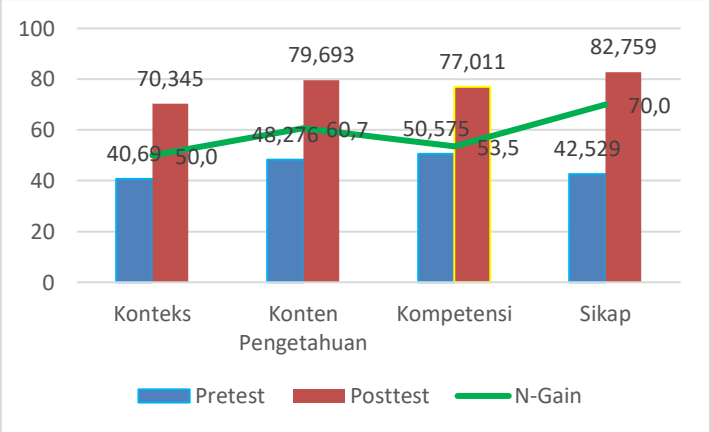

Figure 7. Achievement of each sub-indicator

Comparative Discussion with Previous Research

The findings of this study resonate with earlier research emphasizing the role of interactive digital worksheets in enhancing student learning. For instance, Febrian et al., (2024) demonstrated that problem-based learning with Liveworksheet-supported LKPD improved student engagement and active participation. Similarly, Kasmini et al. (2023) highlighted that multiple representations in digital media strengthen conceptual understanding of abstract scientific content. Beyond interactivity, the present study confirms that embedding cultural elements, as advocated by Mammadov and Çimen (2019), enables deeper learning by connecting scientific concepts to local wisdom and values. This aligns with Asmayawati et al. (2024), who reported that ethno-vlog-based media not only enhance understanding but also build cultural identity. In addition, the use of multimedia technologies echoes the work of Uriel et al. (2020), who found that virtual and augmented reality fostered meaningful learning experiences in

science classrooms. Finally, the present findings support Kumar and Choudhary (2024) and Ramli et al., (2022) both of which argue that technology-enhanced and context-based learning environments are critical for addressing the low performance of Indonesian students in international assessments such as PISA.

The novelty of this research lies in the synergistic integration of three dimensions rarely combined in prior studies: (1) Liveworksheet as a platform for interactive learning tasks, (2) E-LKPD as a structured medium for scaffolding literacy indicators, and (3) ethno-vlog as a vehicle for embedding local culture into ecological and ecosystem learning. Whereas previous research often treated technological innovation and cultural contextualization separately, this study demonstrates that their combination produces measurable gains in science literacy.

Implications

The implications of this study are both theoretical and practical. Theoretically, it expands the literature on science literacy by showing that technology-mediated ethnoscience can be operationalized through interactive worksheets aligned with international assessment frameworks. Practically, the findings suggest that educators and policymakers should consider integrating culturally responsive digital tools into the science curriculum, particularly in the context of the Merdeka Curriculum, which emphasizes project-based and context-driven learning. The positive outcomes also imply that schools in culturally rich regions can leverage local wisdom as a pedagogical resource to foster both literacy and identity formation among students.

Limitations

Despite its promising results, this study has several limitations. First, the trial was limited to one school with a relatively small sample size, which constrains the generalizability of the findings. Second, access to technology was uneven, as not all students had personal devices or stable internet connectivity, potentially affecting the consistency of engagement. Third, teacher capacity in managing digital tools varied, with some requiring additional training to fully optimize the media. Finally, the content scope was limited to ecology and ecosystems; therefore, further studies should test the model in other scientific domains and across broader populations. Future research could adopt mixed-methods approaches, combining quantitative measures with qualitative insights, to capture a more comprehensive picture of how ethnoscience-based digital media influence student learning processes.

CONCLUSION

This study concludes that the development of Liveworksheet-integrated E-LKPD enriched with an ethno-vlog of Bukit Manengteung is valid, practical, and effective in improving junior high school students' science literacy in ecology and ecosystem learning. Validation by experts confirmed high content and media feasibility, while student readability tests demonstrated that the media was engaging, easy to use, and contextually meaningful. Empirical results from pretest–posttest analysis and N-Gain calculations showed significant improvements across all dimensions of science literacy content, context, competence, and scientific attitudes indicating that the integration of interactive worksheets and local cultural elements creates more authentic and impactful learning experiences. The novelty of this study lies in its synergistic combination of ethnoscience, digital interactivity, and structured worksheets, which has not been extensively explored in previous research. These findings imply that incorporating local wisdom through ethno-vlogs within digital learning media can serve as an effective pedagogical strategy to enhance scientific understanding while fostering cultural identity, thereby offering valuable insights for educators, curriculum designers, and policymakers seeking to strengthen science education in the context of the Merdeka Curriculum and beyond.

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