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Development of Ethno-Vlog Integrated E-Worksheet (E-LKPD) to Enhance Students' Scientific Literacy in Biotechnology Learning

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Abstract

Scientific literacy is a crucial competency in the 21st century, enabling students to understand scientific concepts and apply them in real-life contexts. However, Indonesian students' scientific literacy remains relatively low based on international assessments. This study aims to develop an Ethno-Vlog integrated Electronic Student Worksheet (E-LKPD) on biotechnology materials and evaluate its validity, practicality, and effectiveness in improving students' scientific literacy. This research employed a Research and Development (R&D) approach using a modified 3D model (Define, Design, Develop). The participants were 47 twelfth-grade students from a senior high school in East Nusa Tenggara, Indonesia. Data were collected through expert validation sheets, student response questionnaires, and scientific literacy tests. The results indicate that the developed E-LKPD is highly valid (material expert = 81.25%; media expert = 89.71%), practical (student response = 82.72%), and moderately effective in improving scientific literacy (N-Gain = 0.63). The integration of ethnoscience and digital media enhances contextual learning and student engagement. Therefore, the developed E-LKPD is suitable for use in science learning to foster scientific literacy.

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INTRODUCTION

Scientific literacy is widely recognized as a key outcome of science education, as it enables individuals to make informed decisions and actively participate in society (Bybee, 2013; OECD, 2023). It involves not only understanding scientific concepts but also applying them in real-world contexts and evaluating scientific information critically (Holbrook & Rannikmäe, 2009). Despite its importance, Indonesian students continue to demonstrate low levels of scientific literacy. According to the PISA 2022 report, Indonesia ranked 68th out of 81 countries, indicating a significant gap compared to global standards (OECD, 2023). This issue has been consistently reported in previous studies, which highlight that students struggle to connect scientific knowledge with everyday phenomena (Sutrisna, 2021; Rustaman, 2011).

Several factors contribute to this problem, including the use of non-contextual teaching materials and teacher-centered instructional approaches (Fuadi et al., 2020; Slavin, 2015). Learning activities often emphasize memorization rather than conceptual understanding, resulting in superficial knowledge that is difficult to apply (Arends, 2012). Moreover, the lack of integration between science content and students' socio-cultural environments further limits the effectiveness of learning (Irhasyuarna & Putri, 2022; Rahmawati, 2018).

To address these challenges, ethnoscience-based learning has emerged as a promising approach. Ethnoscience integrates local cultural knowledge into science education, allowing students to construct understanding based on familiar contexts (Sumarni, 2018; Pertiwi & Firdausi, 2020). This approach is supported by constructivist learning theory, which emphasizes that knowledge is actively constructed through meaningful experiences (Jonassen, 2011). By incorporating local practices such as traditional food processing, students can better understand abstract scientific concepts (Bakhtiar, 2016; Wahyuni, 2021).

In addition to contextualization, the integration of digital technology is crucial in modern education. The use of Electronic Student Worksheets (E-LKPD) allows for interactive and flexible learning experiences that can improve student engagement (Syafitri & Tressyalina, 2020; Setiawan, 2020). Multimedia learning theory also suggests that combining text, images, and videos enhances cognitive processing and knowledge retention (Mayer, 2009). One form of digital media that has gained popularity is video blogging (vlogging), which provides a dynamic and engaging learning experience (Karamina et al., 2020; Asmaningrum et al., 2021).

The integration of ethnoscience and vlog-based media results in an innovative approach known as ethno-vlog. This approach enables students to observe real-world applications of scientific concepts while connecting them with local cultural practices (Awal, 2023). Previous studies have shown that ethnoscience-based digital learning can significantly improve students' scientific literacy and motivation (Wardani et al., 2023; Lupi et al., 2021).

However, preliminary observations conducted in a senior high school in East Nusa Tenggara revealed that existing teaching materials have not yet integrated ethnoscience or digital media effectively. As a result, students' scientific literacy remains underdeveloped. Therefore, this study aims to develop an ethno-vlog integrated E-LKPD on biotechnology materials and evaluate its effectiveness in improving students' scientific literacy.

METHOD

This study employed a Research and Development (R&D) approach, which is commonly used to develop and validate educational products (Sugiyono, 2019; Creswell, 2014). The development process was adapted from the 4D model proposed by Thiagarajan (1974), consisting of define, design, and develop stages. The dissemination stage was not conducted due to time constraints. The participants were 47 students from two classes (XII IPA 1 and XII IPA 2) at a senior high school in East Nusa Tenggara, Indonesia.

Development Procedures

Define Stage: Needs analysis through interviews, observations, and literature review.
Design Stage: Development of E-LKPD and ethno-vlog using Flip PDF Professional.
Develop Stage: Expert validation, readability testing, and field testing.
The ethno-vlog content focused on the traditional brown sugar production process, linking biotechnology concepts with local practices.

The define stage involved a comprehensive needs analysis aimed at identifying problems and gaps in current learning practices. This stage was conducted through classroom observations, interviews with biology teachers, and a review of relevant literature. The findings indicated that existing learning materials were predominantly text-based and lacked integration with local cultural contexts.

The design stage focused on developing the structure and content of the E-LKPD. At this stage, the researchers designed an electronic worksheet integrated with ethno-vlog content using Flip PDF Professional. The ethno-vlog featured the traditional process of brown sugar production, which was used to illustrate biotechnology concepts in a culturally relevant context.

The develop stage involved product validation and testing. The developed E-LKPD was evaluated by material and media experts to assess its validity. Subsequently, readability testing and field trials were conducted with students. The effectiveness of the product was measured using a pretest-posttest design to evaluate improvements in scientific literacy.

The research instruments consisted of material and media expert validation sheets, readability questionnaires, student response questionnaires, and science literacy test questions. Data were analyzed quantitatively using percentage calculations for validation and student responses, and N-Gain to measure improvements in science literacy. The N-Gain interpretation criteria were: high ($g > 0.7$), medium ($0.3 \leq g \leq 0.7$), and low ($g < 0.3$).

RESULT AND DISCUSSION

The findings of this study demonstrate that the developed ethno-vlog integrated E-LKPD fulfills the criteria of validity, practicality, and effectiveness. However, beyond these descriptive results, it is important to interpret the findings in relation to theoretical frameworks and previous empirical studies to better understand their implications.

The high level of validity, as indicated by the material expert score (81.25%) and media expert score (89.71%), suggests that the developed E-LKPD is both conceptually accurate and pedagogically appropriate. This result can be explained by the systematic integration of ethnoscience and multimedia elements, which enhances both content relevance and instructional quality. According to Mayer (2009), multimedia learning environments that combine visual and textual information can significantly improve learners' understanding by reducing cognitive load and facilitating dual-channel processing. In this study, the ethno-vlog component provided visual representations of the brown sugar production process, enabling students to better grasp abstract biotechnology concepts. This finding is consistent with Wardani et al. (2023), who reported that ethnoscience-based E-LKPD achieved high validity due to its contextual relevance and alignment with curriculum standards.

In terms of effectiveness, the moderate N-Gain score (0.63) indicates that the E-LKPD contributed to a meaningful improvement in students' scientific literacy. This improvement can be attributed to the contextual nature of the learning materials, which allowed students to connect scientific concepts with real-life experiences. Constructivist learning theory emphasizes that knowledge is constructed through active engagement with meaningful contexts (Jonassen, 2011). By incorporating local cultural practices into the learning process, students were able to construct knowledge more effectively compared to traditional learning approaches. This finding aligns with Sumarni (2018), who highlighted that ethnoscience-based learning enhances conceptual understanding by bridging gap between scientific knowledge and students' everyday experiences.

A closer examination of the scientific literacy components reveals that students showed the highest improvement in identifying scientific issues and explaining scientific phenomena, while the ability to use scientific evidence showed relatively lower gains. This pattern suggests that while contextual learning supports conceptual understanding, higher-order skills such as evidence-based reasoning may require additional instructional support. Similar findings were reported by Fuadi et al. (2020), who noted that students often struggle with analytical aspects of scientific literacy due to limited practice in reasoning and argumentation. Therefore, future implementations of E-LKPD should incorporate more activities that explicitly train students in interpreting data and constructing scientific arguments.

The integration of ethno-vlog media also played a significant role in enhancing student engagement and motivation. Video-based learning has been shown to increase attention and facilitate deeper understanding by providing dynamic and realistic representations of concepts (Karamina et al., 2020; Mayer, 2009). In this study, the ethno-vlog allowed students to observe the real process of brown sugar production, making the learning experience more authentic and meaningful. This supports the findings of Asmaningrum et al. (2021), who reported that vlog-based learning can improve students' motivation and participation. Moreover, the use of local cultural content made the learning materials more relatable, which is an important factor in increasing student engagement (Rahmawati, 2018).

Student responses further confirm the practicality of the developed E-LKPD, with a score of 82.72% indicating a very positive perception. Students reported that the E-LKPD was easy to use, visually appealing, and helpful in understanding the material. This can be linked to the flexibility and accessibility of digital learning tools, which allow students to learn at their own pace (Setiawan, 2020). In addition, the integration of interactive elements in the E-LKPD supports active learning, which is essential for developing higher-order thinking skills (Slavin, 2015).

Despite these positive findings, several limitations should be acknowledged. First, the study was conducted on a relatively small sample size within a single school, which may limit the generalizability of the results. Second, the effectiveness of the E-LKPD was measured only in the short term, and further research is needed to examine its long-term impact on scientific literacy. Third, while the ethno-vlog approach enhances contextual learning, it may require additional resources and teacher training to be implemented effectively in different educational settings.

Overall, this study provides strong evidence that integrating ethnoscience and digital media through ethno-vlog-based E-LKPD can significantly enhance students' scientific literacy. The findings contribute to the growing body of literature that emphasizes the importance of contextual and technology-enhanced learning in science education (UNESCO, 2017; Prasetyo, 2019). This approach not only improves learning outcomes but also promotes cultural awareness and relevance, which are essential for sustainable education in diverse contexts.

CONCLUSION

The ethno-vlog-integrated e-LKPD on biotechnology material developed in this study is suitable for use based on validation by material experts (81.25%) and media experts (89.71%) with a very valid category. This e-LKPD is effective in equipping students with scientific literacy with an N-Gain value of 0.63 (moderate category) and a positive response from students (82.72%). The e-LKPD has interactive, contextual characteristics by integrating local wisdom in making brown sugar, and can be accessed digitally. Further research is recommended to implement this e-LKPD on a wider scale and develop the ethno-vlog-integrated e-LKPD on other materials.

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