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Digital Student Worksheet on Ecology and Biodiversity to Enhance Critical Thinking and Digital Literacy for Middle School Students

Novita Anggraini[1*], Hanum Isfaeni[1], Ratna Komala[1]

[1] Department of Magister Biology Education, Universitas Negeri Jakarta, Jakarta, Indonesia.

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Corresponding Author:
Novita Anggraini
butetnovita2@gmail.com

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Abstract: Critical thinking skills and digital literacy can be influenced by several factors, one of which is the use of LKPD learning media. LKPD can be used on Ecology and Biodiversity material. This research aims to develop digital LKPD learning media products to improve student's critical thinking and digital literacy skills at SMP Kartika X-1 Jatinegara, East Jakarta. This type of research is development research using the Hannafin and Peck model, through stages of analysis, design and implementation with evaluation and revision at each stage. The targets of this research were 106 seventh grade students at SMP Kartika X-1, Jatinegara, East Jakarta. Data analysis techniques in this research was n-gain test. The validation results for the development of digital LKPD from media experts and material experts received a score in the very good category. Based on the research results, it can be concluded that digital LKPD media can be developed and is suitable as a learning media for Ecology and Biodiversity material, and is effective enough in improving student's critical thinking skills and digital literacy.

Keywords: Critical Thinking; Digital LKPD; Digital Literacy

Introduction

The learning process is a dynamic effort by teachers and students to share information and transform insights into useful knowledge, creating the groundwork for ongoing education. Rustaman (2004), defines the learning process as an interaction activity between teachers and students that occurs in an educational setting to attain learning objectives. To remain effective in the fast changing technological and communicative landscape of the twenty-first century, as well as the era of digitalization 4.0, the learning process must adapt to these advances. Teachers are urged to innovate and create interesting, innovative, and collaborative learning material to keep students interested and make educational resources more accessible. Learning media are instruments that facilitate both classroom and extracurricular learning.

Prior to the digitalization 4.0 era, many teachers relied on pre-printed Student Worksheets (LKS) from book publishers, which frequently did not fit with the competences required during the learning process. As a result, it is crucial to innovate by converting LKS into digital Student Worksheets (known with LKPD). Digital LKPD is intended to improve students' critical thinking and digital literacy skills, making it an appropriate tool for modern educational settings.

LKPD is an instructional medium that guides students through learning activities connected to a particular subject. It promotes meaningful learning experiences and provides a framework for analytical problem-solving activities (Magdalena et al., 2020). Furthermore, research suggests that LKPD helps to develop cognitive features through demonstrations and experiments (Suwastini et al., 2022). To stay up with these developments, we require human resources with specialized abilities known as the four Cs: critical thinking, creativity, communication, and collaboration.

Understanding biology necessitates strong critical thinking skills. However, the critical thinking abilities of

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students in Indonesia, particularly in the field of biology, have not yet met expectations and are still considered competent at best (Agnafia, 2019). Consequently, it is imperative to develop teaching strategies that enhance these critical thinking skills. One effective approach is to incorporate learning resources specifically designed to focus on critical thinking (Styers et al., 2018).

Critical thinking is defined as the capacity to make logical conclusions or judgments (Zubaidah, 2010). It involves the use of reflective and rational cognitive processes for problem-solving and decision-making, along with a sense of responsibility. Experts agree that critical thinking is a crucial skill for learning in the 21st century. These qualities must be instilled in pupils at a young age through the learning process (Franco et al., 2018). In addition to critical thinking, students must develop digital literacy abilities. Digital literacy refers to the capacity to access, manage, comprehend, integrate, communicate, evaluate, and produce information in a safe and appropriate manner utilizing digital technology for work and entrepreneurship. However, Indonesian students' digital literacy remains low (A'yun, 2021; Oktavia & Hardinata, 2021).

Integrating technology into the learning process requires innovative approaches that enhance student learning. Digital LKPD, an electronic worksheet, facilitates quicker absorption of learning materials by students (Suryawati et al., 2020). Additionally, Digital LKPD enhances learning engagement and provides accessibility at any time and from any location (Sujatmika et al., 2019). The Indonesian government's School Literacy Movement (GLS) emphasizes six core literacies, including digital literacy, which encompasses creativity, critical thinking and evaluation, cultural and social awareness, collaboration, information retrieval, effective communication, digital safety, and functional skills (Afriana & Festiyed, 2022).

Recognizing the significance of technology integration in education, Canva has emerged as one of the latest tools for creating educational media. It offers a variety of resources for designing educational materials such as resumes, posters, brochures, banners, and booklets. The integration of Canva in instructional material has been shown to increase student attention and academic accomplishment (Dewi & Setyasto, 2024; Musdalifah et al., 2023; Putra et al., 2023).

Ecology and biodiversity are critical scientific disciplines that play a vital role in environmental research. These subjects are integral components of the Merdeka Curriculum's Phase D Science curriculum for Grade VII Junior High School. Students are expected to analyze interactions between living organisms and their environment, as well as to develop strategies for preventing and managing pollution and environmental changes. To improve students' critical thinking and digital literacy skills, digital learning media, such as digital LKPD, should be used.

Given the importance of critical thinking and digital literacy skills, as well as the numerous benefits of digital LKPD for students, the goal of this study is to create digital LKPD for Ecology and Biodiversity to help junior high school students improve their critical thinking and digital literacy skills. Hidayati did research on the development of Digital Student Worksheets (LKPD) to help students improve their critical thinking skills. The end outcome of this research is a Digital LKPD on Reaction Rates for high school pupils. This study followed the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). The research results show that the Digital LKPD for developing critical thinking skills is highly valid and applicable to student use (Hidayati et al., 2022).

Another development study used the 4-D paradigm to create an electronic LKPD on ecosystems to help high school students improve their critical thinking skills. The development results demonstrated that the electronic LKPD produced was valid and usable (Ariq & Fitrihidajati, 2021). Relevant research focused on creating an electronic LKPD aimed at improving digital literacy on biodiversity information for high school students. This study likewise used the 4-D development methodology (define, design, develop, and disseminate). The development findings showed that the electronic LKPD was highly valid and appropriate for application (Salsabila & Susantini, 2022).

Building on the findings of prior relevant studies, this study is unique in that it focuses on developing a Digital Student Worksheet (LKPD) to improve students' critical thinking and digital literacy skills. The significance of this study is highlighted by the growing necessity of these abilities in navigating rapid technology changes and teaching students to be responsive and proficient in the digital age.

Method

The research approach used in this study is development research, which aims to create a digital LKPD to improve students' critical thinking and digital literacy. The Hannafin and Peck development approach was employed, and it consists of three stages: (1) needs analysis, (2) design, and (3) development and implementation. This approach can be seen in Figure 1.

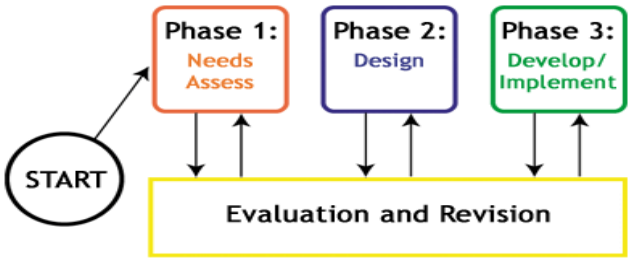

Figure 1. The Hannafin and Peck development phase

The development procedure (Figure 1) at each level is as follows: (1) Needs Analysis: During this first stage, initial observations are made on the teaching of Biology, notably the Ecology and Biodiversity elements. The goal is to collect extensive information about the unique needs of students and teachers. Through these observations, the researcher identifies and comprehends the numerous obstacles encountered by Grade VII pupils at SMP Kartika X-1 Jatinegara, particularly in terms of ecosystem subjects. (2) Design: This stage includes: 1) developing an outline for the digital LKPD, and 2) designing the layout of the digital LKPD. (3) Development and implementation: The learning objectives and flow of Phase D of the Merdeka Curriculum serve as the foundation for the creation of this digital LKPD. This entails developing validation sheets and conducting verification and validation with two experts: a media expert and a subject matter expert.

The implementation process began with a small-scale class, followed by questionnaire distribution, analysis, and evaluation. This was followed by a large-scale trial with eighth-grade students from SMP Kartika X-1 Jatinegara in East Jakarta. The trial findings were analyzed to identify areas for improvement. During deployment, surveys were used to assess the product's practicality. The product evaluation assessed the effectiveness of its application in Biology learning (Ecology and Biodiversity themes) using pre-test and post-test results.

Result and Discussion

This research attempts to create a Digital Student Worksheet (LKPD) that is valid, practical, and effective. The Hannafin and Peck development approach was employed, and it consists of three stages: (1) needs analysis, (2) design, and (3) development and implementation.

During the needs analysis stage, researchers made observations and distributed questionnaires to students and instructors about the need for a Digital LKPD in learning. To keep up with rapid technological changes, the findings suggested that students' critical thinking and digital literacy skills should be improved. Furthermore, it was discovered that extra media based on the Merdeka curriculum was required.

At the design phase, researchers successfully created a Digital LKPD with four activities aimed at improving students' learning experiences. Activity 1: Observing the Students' surroundings. Students are asked to observe their surroundings at Tebet Ecopark, which involves recognizing the environment, biotic and abiotic components, describing individuals, populations, and communities, and producing creative media like as images and movies filmed on-site. Activity 2: Creating a Food Chain. Students are asked to identify the living organisms they discover, construct a food chain based on their findings, and create creative media such as images and movies shot at the site.

Activity 3 is to measure the temperature of the surroundings. Teachers take students through the process of creating a graph that depicts the link between sunlight intensity and temperature, as well as detailing their findings. They are also challenged to forecast natural interactions between biotic and abiotic components. Activity 4: Observing Possible Interactions among Living Organisms in the Environment. Students examine the area in groups, describing competition, predation, herbivore, and symbiotic interactions. They then develop creative material, such as photographs and movies filmed on-site. Activity 5 entails researching articles about biodiversity data and facts. Students in groups use a web browser to look for articles on topics such as deforestation, forest fires, floods, and drought. They are then asked to provide feedback on potential remedies and preventative strategies.

Each criterion was thoroughly tested to guarantee that the Digital Student Worksheet (LKPD) created for this study is valid, useful, and applicable.

Validity Test Results

This research's development instruments comprised evaluation sheets (validation) by content and media experts. The content specialists evaluated the Digital LKPD based on its substance and presentation feasibility. Meanwhile, media experts evaluated the graphic and linguistic features. Table 1 shows the results of the validation tests.

Table 1. Summary of Validity Test Result

Validation Test	Score	Category
Content quality	87.50	Very Worth
Presentation quality	86.67	Very Worth
Visual appeal	86.67	Very Worth
Language	90.00	Very Worth

The results in Table 1 show that the validation of the Digital Student Worksheet (LKPD) is category very worth. Before modification, the picture design lacked

visual appeal. However, following the alteration, it became a more captivating picture. For example, the food chain, which was previously a simple chart, was transformed into an interesting diagram adorned with explanatory illustrations, making the material far more appealing and instructive. Table 2 shows several adjustments based on validation results. Once validated, the Digital Student Worksheet (LKPD) moved on to the practicality testing step.

Table 2. Product Revisions

Before	After
	
	
	

Practicality of the Digital Student Worksheet

The Digital Student Worksheet (LKPD)'s effectiveness is assessed based on its instructions and learning activities. The practicality of the Digital LKPD was evaluated by giving courses in a small group setting. The small group trial had four criteria: it was an easy-to-use learning medium, it was easy to understand and suitable for the students' learning needs, the language used was easy to understand, appropriate for the students' developmental level, and it was compliant with the Indonesian Language Dictionary (KBBI), which helped students understand their environment, related problems, and solutions. Figure 2 shows the criteria and results of this small group test.

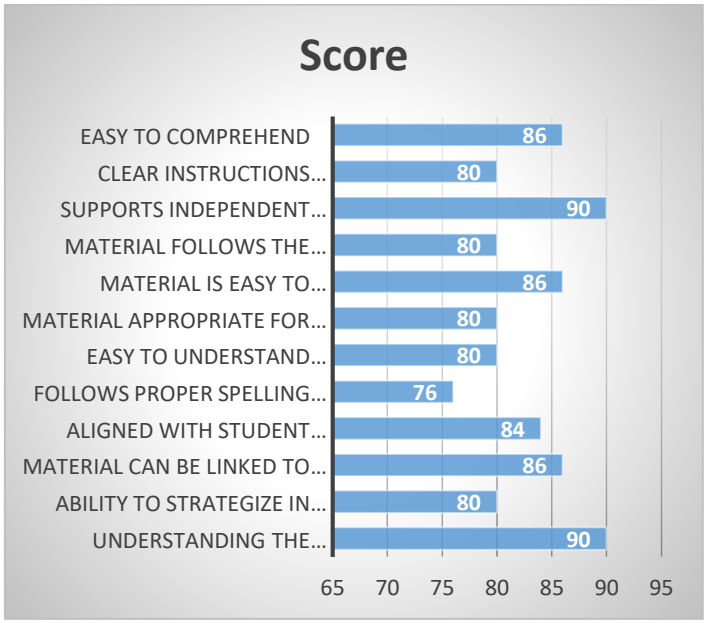

Figure 2. The result of small group test

The Digital Student Worksheet (LKPD) achieved an average score of 83.17 on a small group test, indicating that it is highly or extremely practical. As a result, this test can progress to the effectiveness stage in bigger groups. The effectiveness will be tested by improving critical thinking abilities and digital literacy during the pre-test and post-test stages.

Effectiveness Test Results

The effectiveness of the Digital Student Worksheet (LKPD) in improving critical thinking abilities and digital literacy was tested in a large group setting. The teaching was spread throughout three courses with a total of 106 students. The pre-test findings revealed an average critical thinking score of 64, which rose to 86 in the post-test. The pre-test average for digital literacy was 61, but it increased to 85 after the test. These results show a significant improvement, showing that the Digital Student Worksheet (LKPD) is helpful in improving

students' critical thinking and digital literacy. The N-gain effectiveness test results are shown in Table 3.

Table 3. Summary of Effectiveness Test Result

Variable	Pretest	Posttest	n-Gain	Category
Critical Thinking	64	86	58	Moderately effective
Digital Literacy	61	85	61	Moderately effective

Based on Table 3, the N-gain score for critical thinking skills was 58, while digital literacy was 61. The digital student worksheet on Ecology and Biodiversity is fairly effective in increasing students' critical thinking and digital literacy skills.

Research results show that this Digital LKPD meets the criteria of being valid, practical, and effective. Therefore, this Digital LKPD is suitable as a teaching medium to enhance critical thinking and digital literacy among students. According to the Hake effectiveness test, which falls into the moderately effective category (Pujiastuti & Haryadi, 2020), it indicates that this Digital LKPD can be used by other students in similar conditions.

In the 21st century, education is often associated with critical thinking, one of the four essential skills (4Cs: Critical Thinking, Creative Thinking, Collaboration, and Communication) that students must master. Thus, teachers should stimulate their students' cognitive structures to train and develop critical thinking skills, aiming to achieve one of the primary goals of education. The key to successful critical thinking is significantly influenced by the learning environment (Aini & Armanda, 2020). The Digital LKPD can create a different learning environment where students answer questions by analyzing, evaluating, solving problems, making decisions, providing explanations, and drawing conclusions.

Furthermore, the Digital LKPD can enhance students' critical thinking skills because it includes high-order thinking skills (HOTS) questions. These HOTS-based questions use real-life situations as stimuli, rather than just requiring students to remember, know, or repeat information (Bahri et al., 2021). Another skill that students can gain from the Digital LKPD is digital literacy. Digital literacy is a government program to support technological proficiency, allowing students to utilize information and communication technology effectively to find, evaluate, create, and communicate information. In education, digital literacy plays a role in developing lesson materials that encourage students' curiosity and creativity (Jamaluddin et al., 2020).

The Covid-19 pandemic has significantly impacted the use of technology in education. Both teachers and students have become familiar with various applications that support learning. However, having digital literacy skills goes beyond operating technological devices; it involves learning to use comprehensive technology features for teaching and learning activities effectively. In digital literacy, this includes elements of Learning Skills (Anggrasari, 2020; Hadi & Anggrasari, 2021). Good digital literacy skills provide numerous benefits for students, such as increased engagement and transforming previously passive students into active learners. The use of the Digital LKPD can facilitate the development and enhancement of students' digital literacy skills (Firmansyah et al., 2023; Revanza et al., 2024). The Digital LKPD on Ecology and Biodiversity can improve students' digital literacy skills because it allows students to actively participate by integrating technology with learning.

Considering the current situation, where the critical thinking and digital literacy skills of Indonesian students are still low, a concrete action is needed to enhance these skills. One alternative is using the Digital LKPD in learning. Important factors in the development process of this Digital LKPD include the implementation of the Merdeka curriculum, such as P5 (Project for Strengthening the Profile of Pancasila Students) critical reasoning dimension and digitalization of learning, which is a manifestation of Merdeka Belajar (Freedom to Learn). These two aspects support the development of the Digital LKPD aimed at improving students' critical thinking and digital literacy.

In addition to aligning with the current educational curriculum, the Digital LKPD has other supporting factors, such as ease of use, which can adapt to various student conditions. The Digital LKPD can be accessed anytime and anywhere, freeing students from time and place constraints. This allows teachers to create creative learning experiences, such as outdoor classes, which can make students more enthusiastic and motivated, as demonstrated in this study. Despite its benefits, the implementation of the Digital LKPD also faces challenges, such as the need for students to install the application on their individual smartphones, which requires adequate device specifications. However, this can be mitigated by making the Digital LKPD accessible not only on smartphones but also on computers, allowing students to use school computers if necessary.

Conclusion

The development of the Digital Student Worksheet (LKPD) on Ecology and Biodiversity was carried out using the Hannafin and Peck model, which involves three stages: basic needs analysis, design, and implementation. It is suitable as a learning medium for Ecology and Biodiversity material, aimed at enhancing

students' critical thinking and digital literacy skills. Validation results from material experts, media experts, and small group test all categorized the Digital LKPD as very valid. Upon implementation, the Digital LKPD on Ecology and Biodiversity proved to be moderately effective, significantly improving students' critical thinking and digital literacy skills. In the current era of digitalization, developing learning media is not difficult and offers a wide range of options. Canva, a widely used application, has seen tremendous improvements over the years. Initially, it only supported simple image and video formats, but it has since evolved significantly. For future research, Digital LKPD can be developed with audiovisual elements to make it more engaging for students, thereby boosting their enthusiasm for learning. This approach also helps equip students with the competencies they need to face the challenges of globalization.

Author Contributions

Research Design and Concept, N.A, H.I and R.K; field investigation and analysis, N.A; writing and drafting N.A, H.I, and R.K; editing, N.A.

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Conflicts of Interest

The authors declare no conflict of interest.

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