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DIGITAL ECOLITERACY LEARNING MODEL: DIGITAL LITERACY INNOVATIONS FOR ELEMENTARY SCHOOL STUDENTS IN INDONESIA

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Abstract

This study aims to develop innovative web-based digital eco-literacy project learning models for elementary school students as a renewal of existing learning models. The developed model must meet the criteria of validity, practicality, and effectiveness. Project-based learning was chosen because it encourages active engagement and is supported by digital applications, enhancing students' understanding of ecology, literacy, and environmental awareness. Eco-literacy is essential in elementary education because it fosters environmental responsibility from an early age. The development process includes model books, teaching modules, student worksheets, learning outcome tests, model implementation, and student responses. The Borg & Gall research method was used to ensure a systematic approach to model development. The study results indicate that the web-based digital eco-literacy project learning model meets the criteria for effectiveness, achieving a 94.8% success rate in student learning outcomes. This is because the web platform provides easy access for students to explore, understand, and apply eco-literacy concepts through hands-on projects. Furthermore, the model enhances students' awareness of environmental literacy and ecological principles, reinforcing their role in sustainable environmental practices.

Keywords: Digital, Eco-literacy, Elementary school, Project, Students.

1. Introduction

Integrating eco-literacy into elementary education addresses waste and environmental issues, applying eco-literacy principles in real-world school settings raises students' environmental consciousness and reinforces their role as responsible social beings [1]. This aligns with Natural and Social Sciences curricula, which encourage project-based learning (PjBL). PjBL fosters student exploration, collaboration, and]]]product creation, making learning engaging and effective [2, 3]. The development of digital PjBL models must keep pace with technological advancements. Digital media and internet access enhance environmental awareness, literacy, and ecological concepts [4]. Blending PjBL with digital tools offers a practical solution to common educational challenges [5]. Digitalization in eco-literacy education modernizes how information is stored, processed, and shared [6]. With web-based applications transforming conventional eco-literacy learning into a technology-driven experience [7, 8]. Teachers can integrate these platforms to create interactive and enjoyable learning experiences.

Several studies highlight the significance of web-based digital eco-literacy models. Research on service-learning and citizen science supports eco-literacy by promoting scientific thinking in students. Studies on environmental and ecological literacy emphasize their importance in education. Additionally, research on online learning environments underscores the effectiveness of technology in enhancing environmental concept comprehension. These references contribute to designing a comprehensive digital eco-literacy model.

This study employed the Borg and Gall method [9]. Following a systematic ten-stage process to develop a web-based eco-literacy model. The model serves as an interactive learning tool, featuring a web-based platform with text, images, animations, and audio accessible via a URL. The web platform enables students and teachers to easily navigate, understand, and apply eco-literacy concepts through projects. Project-based learning, integrated with digital media, is highly recommended for Natural and Social Sciences education in elementary schools. This study aims to develop a web-based digital eco-literacy model to enhance students' understanding of environmental, ecological, and literacy concepts. The model introduces a novel approach by increasing student engagement through interactive and immersive learning experiences, making eco-literacy education both effective and enjoyable.

2. Method

We employed an educational development research method using the Borg and Gall model. Detailed information regarding the method is explained elsewhere [9]. The steps used in this study are explained in Table 1. The digital project learning model for eco-literacy was validated by five experts, including three doctorate holders from Surabaya State University and two elementary school teachers from Laboratory Elementary School and Kedungturi Sidoarjo Elementary School, Indonesia.

3. Results and Discussion

Figure 1 presents a flowchart illustrating the application’s usage. It is accessible at https://ecodigpro.den.ia.co.id/. The platform includes pre-tests, post-tests, learning materials, ecodigpro videos, hypothetical books, and ecobrick content. Ideally, the

app can also be made available on the Play Store to enhance accessibility. Figure 2 showcases the web-based digital eco-literacy learning model application, designed to improve students' understanding of ecology, environmental conservation, and waste management. The developed application aims to modernize eco-literacy learning and provide interactive, engaging experiences.

To assess effectiveness, student learning outcomes were analysed. Detailed information on statistical calculation is reported elsewhere [10-12]. Pre-test scores averaged 65.3, while post-test scores improved to 83.2, demonstrating significant learning gains. A t-test analysis confirmed a t-count of 16.861 (greater than t-table: 2.160) and a Sig. (2-tailed) value of 0.000 (less than 0.05), indicating a statistically significant difference between pre-test and post-test results.

This study aimed to develop a digital project-based learning model to enhance student eco-literacy in elementary schools. The learning model was assessed for validity, practicality, and effectiveness. A well-validated learning model facilitates students' ecological intelligence and environmental literacy [13-16]. Once categorized as valid, its practicality was tested, ensuring its suitability for effective learning [17]. Teachers should continuously refine interactive and practical learning models to enhance student literacy, achievement, and outcomes [18-21]. Effectiveness was further measured through student response questionnaires and learning outcomes, with 94.8% positive responses. The post-test improvement confirms that the web-based digital project learning model effectively supports ecological and environmental education [22-25]. The study concludes that the digital eco-literacy project learning model is a relevant and effective tool for elementary school education [26-31].

Table 1. Results of the research and development of the project-based digital eco-literacy learning model.

Step 1	:	Assess the need to identify the goal.	The results of the interview obtained problems related to the lack of understanding of elementary school students in understanding the environment and utilizing waste.
Step 2	:	Conduct instructional analysis	Based on the analysis, there were findings of waste in the school environment so learning tools were needed to deal with waste and the environment.
Step 3	:	Analyse learners and contexts.	Based on the context, it is necessary to introduce learning models to introduce eco-literacy and the environment.
Step 4	:	Write performance objectives	The purpose of introducing a project-based digital literacy learning model is to facilitate aspects of understanding about building useful waste management projects.
Step 5	:	Develop assessment	The results of the assessment instrument will be presented based on the level of validity, practicality, and effectiveness.

Table 1(Continue). Results of the research and development of the project-based digital eco-literacy learning model.

Step 6	:	Develop instructional strategy	Development of valid, practical, and effective project-based digital ecoliteracy learning models.
Step 7	:	Develop and select instructional materials.	Development of a project-based digital eco-literacy learning model supported by textbooks, teaching modules, and teaching materials.
Step 8	:	Design and conduct formative evaluations of instruction	The results of the validation of the validity level trial were conducted on teachers and lecturers. The results of the practicality level test were conducted on students and teachers throughout Jombang Regency with a total of 100 selected student respondents. The results of the effectiveness level test were conducted on students throughout Jombang Regency with a total of 250 student respondents.
Step 9	:	Revise instruction	Revisions for improvements are carried out by reviewing assessments, suggestions, and input from expert validators, practitioners, and students so that the product is feasible and can be used in learning.

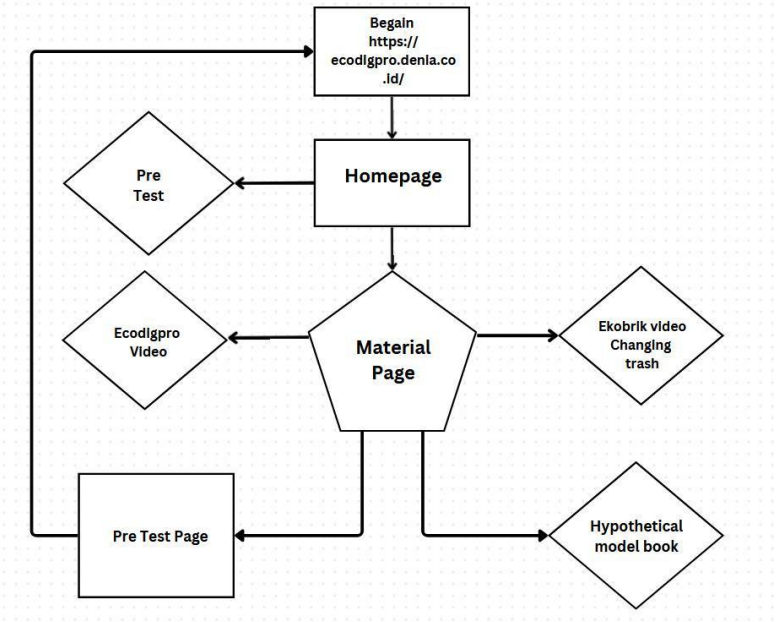

Fig. 1. Flow chart of web-based digital eco-literacy learning model.

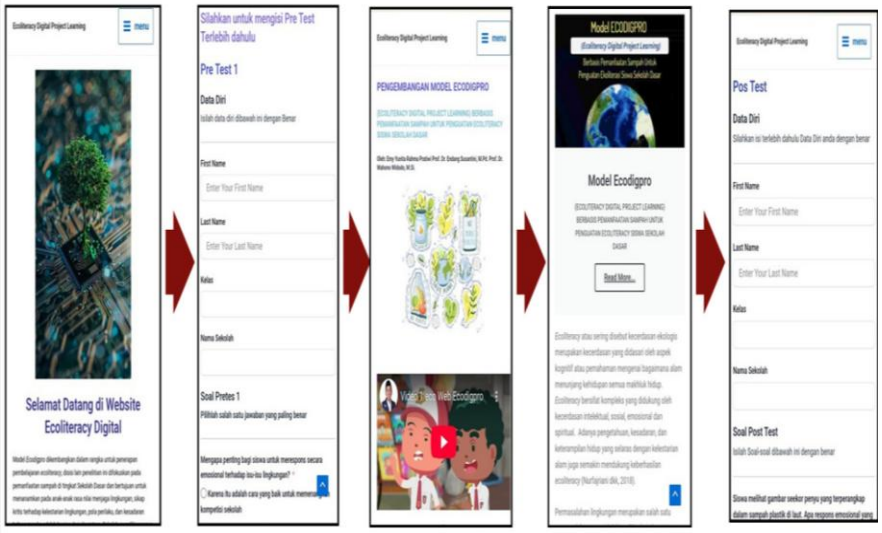

Fig. 2. Product web-based digital eco-literacy learning model.

4. Conclusion

This study has produced a digital project learning model for strengthening eco-literacy in elementary school students in Indonesia. The learning model has been tested for its validity, practicality, and effectiveness. The implications of the digital project learning model can strengthen eco-literacy and contribute to improving learning performance in elementary schools comprehensively. Students and teachers can be directly involved in the digital project learning model in improving academic and non-academic learning. This study also adds new information regarding digital literacy, as reported elsewhere [32-36].

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