

# Avipedia: An electronic encyclopedia of bird diversity in Baluran National Park - Indonesia

Lina Kumalasari <sup>a,1\*</sup>, S. Suhadi <sup>b,2</sup>, Susriyati Mahanal <sup>b,3</sup>

<sup>a</sup> Department of Science Education, Faculty of Science Education, Universitas Pendidikan Muhammadiyah Sorong, Jl. KH. Ahmad Dahlan No.01, Kabupaten Sorong, Papua Barat Daya, Indonesia

<sup>b</sup> Department of Biology, Faculty of Mathematics and Science, Universitas Negeri Malang, Jl. Semarang 5, Malang, East Java 65145, Indonesia

<sup>1</sup> linakumala53@gmail.com\*; <sup>2</sup> suhadi@um.ac.id; <sup>3</sup> susriyati.mahanal.fmipa@um.ac.id

\* Corresponding author

**Abstract:** The development of information technology encourages innovation in the world of education, including in the development of electronic-based learning resources. However, developing electronic encyclopedias based on the diversity of fauna in Indonesia still needs improvement. This research aims to develop an electronic encyclopedia about bird diversity as a source of learning biology. According to the Lee and Owens developing model, this research uses five steps of the developing process. In the final step, the evaluation involved 37 Biology Education Department students at the University of Muhammadiyah Malang with a pretest-posttest group design. Data collection uses validation sheets, pretest-posttest questions, and questionnaires. Pretest and posttest data were analyzed using a gain score to measure its effectiveness in improving student learning outcomes. The effectiveness test results for each indicator item show that the average score for all aspects shows a percentage of 94.7% (very practical). Furthermore, the gain score is 0.47, which indicates that the encyclopedia is feasible, valid, and effective in improving students' cognitive learning outcomes.

**Citation:** Kumalasari, L.; Suhadi, S.; Mahanal, S. (2023). Avipedia: An electronic encyclopedia of bird diversity in Baluran National Park - Indonesia. *Research and Development in Education (RaDEn)*, 3(1), 26-36. <https://doi.org/10.22219/raden.v3i1.23939>

**Keywords:** Cognitive learning outcome; electronic encyclopedias; Indonesia bird diversity

Received: 22 December 2022

Revised: 23 December 2022

Accepted: 31 January 2023

Published: 6 February 2023



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## 1. Introduction

The development of information technology has a broad impact, including on the world of education (Doyle et al., 2016; Yaniawati, 2013). This development is not only in classical learning in the classroom but also encourages the growth of media innovation and learning resources (M. Huda et al., 2017; Miharja et al., 2019). Furthermore, various fields of study in education show that the integration of technology provides a new perspective and certainty about learning in the future (Bhattacharjee & Deb, 2016; Borleffs et al., 2018; Lase, 2019). Technology integration in 21st Century learning is not only limited to adding technological variables. However, it is also part of improving students' quality and participation in learning, guaranteeing the right to learn wherever students are, both offline and online learning (Alhassan, 2016; Criollo-C & Luján-Mora, 2019; Yaniawati, 2013).

For example, several technological innovations in biology learning are using AR-VR-based media (Rodríguez et al., 2021; Venkatesan et al., 2021; Zhang, 2021), implementing mixed learning between offline and online (Husamah, 2015; Monteiro & Morrison, 2014), and using electronic-based learning modules or resources to study the diversity of living things (Vina Serevina, Sunaryo, Raihanati, I Made Astra, 2018). However, the development of technology in learning continues to change in line with the needs in the classroom. One of them is environmental studies and natural resource conservation in Indonesia

(Fuglie & Kascak, 2001; Mcconnell, 2019). The development of media and electronic learning resources based on conservation and environmental issues still needs to be improved and requires much innovation.

The conservation area can also be used as a source of learning (Wijarini et al., 2019), one of which is Baluran National Park, a conservation area in the East Java – Indonesia (M. A. I. Huda et al., 2017; Istomo & Hartarto, 2019; Mutaqin et al., 2020; Wati et al., 2019). As a source of learning, the diversity of birds in the Baluran National Park area can be developed into learning media (Takandjandji & Sawitri, 2010). Seels and Richey (1994) said that there are five points classification of learning resources, but one of these points explains that the environment, which is a place of learning for someone, can be categorized as a source of learning. The selection of appropriate teaching materials is one effort to improve learning outcomes. Teaching materials can facilitate information delivery to students and support the success of school learning activities (Arda et al., 2015).

One of the teaching materials that can be developed electronically is an encyclopedia—an electronic encyclopedia including multimedia-based learning resources (Osborne, 2012; Noviar, 2016). Electronic encyclopedias are interactive media equipped with navigation that users can operate to allow users to choose the features they want themselves (Halim et al., 2021; Vina Serevina, Sunaryo, Raihanati, I Made Astra, 2018). Based on the results of observations of 29 students who have taken ecology courses at the University of Muhammadiyah Malang, it is known that in learning, students have used electronic learning media, but only around articles. As much as 67% of students have never used learning applications in ecology lectures. Most students use non-electronic modules (75%) and handouts (78%). It was clarified by interviews with lecturers in charge of the ecology course that electronic learning media had never been developed and only used handouts, videos, and practicum manuals. These conditions impact the achievement of cognitive learning outcomes of students who are not optimal and need to be improved.

Based on the explanation described above, it is necessary to develop media as an electronic encyclopedia based on conservation. The research aims to develop a practical conservation-based electronic encyclopedia to improve students' cognitive learning outcomes.

## 2. Materials and Methods

This study uses the Lee & Owens development model with five steps: assessment analysis, solution design, prototype development, implementation, and evaluation (Lee & Owens, 2004). First, the practicality and effectiveness of the product are determined using field trials. The field trial involved 37 students from the Biology Education Department at the University of Muhammadiyah Malang who were studying the Ecology course. The research design used was pre-experimental with a one-group pretest-posttest design, as described in Table 1.

**Table 1.** Pre-experimental design

Groups	Pretest	Treatment	Posttest
Treatment	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>

Annotation: O<sub>1</sub>: Pretest score; O<sub>2</sub>: Posttest score; and X<sub>1</sub>: learning with Avipedia

A needs analysis was carried out using interview techniques with lecturers and students. It is to explore problems, determine students' needs, and support lecturers in lectures. In the needs analysis stage, extant data analysis is carried out, namely activities to identify available materials and materials that need to be developed. The material that needs to be developed is about bird diversity in Baluran National Park.

Data collection on bird diversity in Baluran National Park uses the birdwatching method. The survey was conducted at five sample points, namely point I (seasonal forest), point II (evergreen forest), point III (savanna), point IV (mangrove forest), and point V (coastal forest). Data collection was carried out in the morning from 5 to 9 am and from 4

to 6 pm in September 2020. The population in this study were all bird species in Baluran National Park. The sample in this study was bird species. Found in all five habitat points in Baluran National Park.

Some of the tools used in the research are; a camera, telephoto lens, binoculars, tripod, GPS, field notebook, sketchbook, pen, and pencil. Product design is carried out by designing product specifications, and material structures, controlling work processes, and preparing devices used in the validation and trial processes. The development and design phase will be carried out in March-April 2021, followed by the media validation stage in April to May 2021. Initial trials will be carried out in April 2021, and implementation will be carried out in May.

The development stage is focused on realizing the product to be made, starting with making storyboards and making media. Several things are done in this stage, namely reviewing and revising the product that has been produced and then validating it for further improvement until it is considered feasible to be implemented in learning. Product evaluation is carried out to measure the quality of products that have been developed and their implementation in the learning process before and after the implementation stage. At this stage, the measurement of cognitive learning outcomes and student responses to teaching materials is carried out. The measurement instrument is an assessment questionnaire given to expert and student validators. Data from electronic encyclopedia validation (1) results by experts and students were analyzed using average score analysis (Sukmadinata, 2008).

$$\text{Validity (\%)} = \frac{T_{se}}{T_{sh}} \times 100\% \quad (1)$$

Annotation:

Tse = Total of empiric score empiric

Tsh = Total of maximum score

The results of the student response questionnaire were analyzed using percentages (2), while the pretest and posttest scores to assess the effectiveness of the electronic encyclopedia were analyzed using the gain score analysis technique (3).

$$\text{Respond (\%)} = \frac{\text{score}}{\text{total score}} \times 100\% \quad (2)$$

$$\text{n-gain} = \frac{(\text{posttest} - \text{pretest})}{(\text{maximum score} - \text{pretest})} \quad (3)$$

### 3. Results

The analysis phase is carried out by identifying various learning development needs, both from the perspective of educators and students to the potential resources involved in learning (Bray & Tangney, 2016; Suastra et al., 2017; Thangeda et al., 2016). It is intended to get a comprehensive picture of the initial learning conditions. Furthermore, this mapping will make it easier for researchers to design solutions that can be implemented in the media. This mapping of development needs includes normative needs, such as how efforts can be made to help students improve their ecological learning outcomes (McFarlane, 2013; Wicaksono et al., 2018). On the other hand, the Covid-19 pandemic also requires educators to continue to develop innovations on how to teach ecology online while still being exciting and contextual (Frolova et al., 2021). The need analysis stage is carried out by observing activities using questionnaires and interview forms with lecturers in animal ecology courses. The needs analysis results show that the teaching materials used are textbooks and research articles. The results of the interviews also show the need for improvement in the context of improving learning media.

Moreover, the need for electronic-based media in online learning is very high because it can be accessed anywhere by students and teachers (Basri et al., 2021; *Online Learning*,

*Teaching and Education Continuity Planning for Schools*, n.d.). Besides that, the environmental and natural resource conservation issue is also discussed in learning. One of them is bird conservation. In this case, birds have an essential role and function in maintaining the balance of the ecosystem (Morante-Filho & Faria, 2017). On the other hand, student literacy in bird conservation also needs to be improved and strengthened (Jepson & Ladle, 2005; Morante-Filho & Faria, 2017; Shepherd et al., 2016). The analysis results are a basis for the initial product design at the next stage.

The mapping of development needs indicates that the media must facilitate at least four things, namely helping to facilitate increased cognitive understanding (Budiarti et al., 2016; Fitriani et al., 2018), digital-based (Bray & Tangney, 2016; Mulyati et al., 2021), raising conservation issues (Kusmuriyanto & Astuti, 2020; Shrestha et al., 2021), and having relevant contextual issues (Su'udiah et al., 2016; Suryawati & Osman, 2018). The designed learning media is a research-based electronic encyclopedia in Baluran National Park. The Encyclopedia contains bird species diversity, responses and adaptations, preferences, and conservation efforts. The result of the design stage is the determination of media specifications to be developed, namely an Android-based electronic encyclopedia application. At this stage, the components designed were the Electronic Encyclopedia storyboard (referred to as Avipedia), validation questionnaires, student response questionnaires, student worksheets, lesson plans, syllabus, and questions to measure cognitive learning outcomes. The formulation of learning material structure refers to the predetermined learning achievement (Listiyani, 2018; Pebriari et al., 2019). The material's structure in this medium consists of bird morphology, response, adaptation, preferences, and conservation efforts and is equipped with a bird identification guide.

Finally, the development stage is carried out to measure the validity of the product design on the storyboard developed into an application with the help of the Android programming language. Three validators validate the media products that have been developed, material experts on ecology, learning media experts, and teaching practitioners to see the level of validity. In summary, the results of the material expert validation are presented in Table 2.

**Table 2.** Material expert validation result

No	Aspect	Average Score (%)	Categories
1	Content eligibility	100.00	Very valid
2	Presentation eligibility	100.00	Very valid
3	language eligibility	100.00	Very valid
<b>Average score of all aspects (%)</b>		<b>100.00</b>	<b>Very valid</b>

The results of the material expert validation in all aspects (Table 2) show that the feasibility of presentation, completeness, breadth, and depth, as well as the accuracy of the material are classified as very valid with a percentage of 100%. Furthermore, the validation results of media experts show that general aspects, software engineering, and visual aspects are also valid (98.9%) as shown in Table 3.

**Table 3.** Media expert validation result

No	Aspect	Percentage (%)	Categories
1	General	100.00	Very valid
2	Software engineering	97.20	Very valid
3	Visual	100.00	Very valid
<b>Average score of all aspects (%)</b>		<b>98.90</b>	<b>Very valid</b>

Validation of the practicality of media in learning shows that Avipedia is classified as very practical in all aspects with an average of 92% (Table 4). The highest average practicality score on the content and presentation aspects. The comment and suggestion from expert validator as shown in Table 5.

**Table 4.** Media practicality

No	Aspect	Average Score (%)	Categories
1	Content eligibility	91.70	Very practical
2	Presentation eligibility	91.70	Very practical
3	Language feasibility	89.30	Very practical
<b>Average score of all aspects (%)</b>		<b>92.00</b>	Very practical

**Table 5.** Comment and suggestion from expert validator

No	Comment and Suggestion	Revision
1.	Completing with a cover	It has been revised by adding a splash screen on the start page when a new application is opened
2.	Additional information on ornithological material, including morphology or anatomy.	It has been corrected by adding information regarding bird morphology, bird beak type, bird leg type, digestive system, muscles, and bird skeleton before discussing bird adaptation, preferences, and conservation.
3.	Sentences seem too dense, simplifying would be better	It has been corrected by shortening the sentence structure.
4.	As a scientific work, the photo source has not been mentioned. But it is better if using personal documentation.	Photo sources have been included, both literary photos and personal documentation
5.	The identification guide menu is more interesting when given unique facts about the species.	Each bird species has been given unique facts which can be slide on the next page

Avipedia's effectiveness in learning is measured using the pretest and posttest. The mean value of student cognitive learning results (Table 6) shows that the gain score is 0.47 (range 0.3 - 0.7). These results indicate that Avipedia is effective to improve students' cognitive learning outcomes. Product evaluation is limited to the formative evaluation stage which is carried out during the production process to improve the product so that it can be used according to suggestions and input from the validator.

**Table 6.** Average of student learning outcomes

	Average	Interpretation
<b>Pretest</b>	70.00	
<b>Posttest</b>	86.10	
<b>N-gain</b>	0.47	Medium

#### 4. Discussion

Avipedia's validation results from the media and content aspects indicate that Avipedia has been designed in such a way based on the results of the needs analysis. The review of the material aspects includes the feasibility of the content, presentation, and language. Judging from the feasibility of the content, Avipedia was developed based on the results of bird identification in Baluran National Park. Furthermore, the depth of ornithology material is complemented by morphological, anatomical characteristics, as well as an overview of its conservation. The conservation overview in Avipedia is one of the key components that differentiates it from other encyclopedias (Jepson & Ladle, 2005; Morante-Filho & Faria, 2017; Shepherd et al., 2016).

Avipedia materials are presented in slides containing a combination of photos and narration containing information on the characteristics of each species. An interesting presentation is intended to increase learning motivation and student learning outcomes (Sari et al., 2016; Wu et al., 2021). Nordin and Alias (2013) and Anggita (2021) explained that the attractive appearance of the encyclopedia influences the motivation and interest of students in learning activities. The developed encyclopedia is supported by a free inquiry learning model to train students' thinking power when applying the concepts they have learned in real life (Kuhn, 2015; Yanto et al., 2019).

The media expert validation results show that Avipedia is classified as valid in all aspects including general appearance, software engineering, and visually. The results of this validation indicate that Avipedia has a good user interface that makes it easy for students and teachers to use in learning (Chuang & Tsai, 2005; Hendrawan et al., 2015). When associated with practicality test results, using Avipedia can improve cognitive learning outcomes with an n-gain of 0.47 (moderate).

Hidayat, Saputro and Sukardjo (2015) stated that the use of encyclopedias with strong characteristic advantages has a positive impact when used in the learning process. In this case, student learning outcomes, especially in the cognitive aspect, can be increased by using encyclopedias (Noviar, 2016). Furthermore, the alignment between the learning design (Thuneberg et al., 2018; Tiantong & Teemuangchai, 2013) and the contextually of the material (Broekhuis et al., 2022; Petrie & McGee, 2012) developed in Avipedia is an advantage in improving student learning outcomes. Some researchers emphasize that the use of contextual issues is an important aspect of media development. With these media, students are not only helped to learn about a certain material, but also stimulate students to think critically in solving the context of problems from the material being studied, in this case the problem of bird conservation.

## 5. Conclusions

Based on the results of research and development, it can be concluded that according to the validation results of material experts, media experts, field practitioners, electronic encyclopedias are feasible to use. Avipedia's are practical to use, and based on the results of their effectiveness, electronic encyclopedias can improve students' cognitive learning outcomes. This can be proven by n-gain's score of 0.47 which is included in the moderate category.

**Author Contributions:** L. Kumalasari: Collecting data and writing original draft of article. S. Suhadi: Research coordinating and review article. S. Mahanal: Research directing, review, and editing article.

**Conflicts of Interest:** Declare conflicts of interest.

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