



The Digital Encyclopedia of Butterflies in Jatibarang Reservoir as The Supplement of Biodiversity Teaching Material in Senior High School

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Abstract

The result of observation at SMA N 2 Semarang indicates that the biodiversity teaching material has not provided information contextually that utilizes local potential. The aims of this research are to (1) examine and describe the species of butterflies in the Jatibarang Reservoir; (2) evaluate the validity of digital encyclopedia developed based on the assessment of material and media experts; (3) evaluate the effectiveness of digital encyclopedia developed in student learning outcomes; and (4) evaluate the response of students and teachers as digital encyclopedia users. This research belongs to the Research and Development study. This research is in the form of sampling and the identification of butterflies in the Jatibarang Reservoir. The development is the compilation of digital encyclopedia which is used as a material supplement. The findings of this research showed (1) the diversity of 28 butterfly species in the Jatibarang Reservoir such as Lycaenidae, Nymphalidae, Papilionidae and Pieridae family; (2) the validity of the encyclopedia of butterflies according to the material and media experts in the average of 92.8 % using valid criteria; (3) the effectiveness test on cognitive aspect for *N-Gain* value in high category and 100% classical completeness, affective aspect for good category and psychomotor aspect for skilled category; (4) the students' response of the digital encyclopedia are 95.9% and teachers' response are 93.3% which belong to very good categories. The digital encyclopedia is suitable in the learning process.

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INTRODUCTION

The biodiversity material studied by senior high school (SHS) students in biology tenth grade odd semester. Biodiversity material to cover subject matter of biodiversity and classification of living things. The subject matter of classification of living things contained in the Basic Competence 3.3 and 4.3. Competence 3.3 is to understand the principles of classification of living things into five kingdoms, whereas 4.3 is present cladogram competence based on the principles of classification of living things.

The results of observation in SMA 2 Semarang indicate that learning biology biodiversity in particular on material not provided information contextually harness local potential in Semarang. Learning resources are used not to bring provision of contextual information that harness local potential. Students expressed having difficulty biodiversity study material. It should be of particular concern because of the material's biodiversity is important as the beginning of the study materials in the future regarding the diversity of living things into five kingdoms to ecosystems.

Learning resources should exploit the potential of local environmental education unit. Learning resources created by utilizing local potential is considered more appropriate for learning resources will have the advantage that the information provided it is equipped with the pictures clear and real, representative, informative, close to the students so that they can generate curiosity (Imaniar *et al.*, 2017). Learning resources created by utilizing local potentials can be derived from the wealth of flora and fauna around the students.

Natural state tropical Indonesia become a suitable habitat for the development of various types of flora and fauna. Fauna that was the most on this earth are insects (Haneda *et al.*, 2013) and one of the highest biodiversity in Indonesia insect is a butterfly. Butterflies that Indonesia has an estimated 2.200 species (Septianella *et al.*, 2015). The butterfly is a group of animals insect of the Lepidoptera order. Lepidoptera derived from the word "lepis" meaning scales and "ptera" which means wings. The hallmark of this nation among others have three pairs of legs, the body is

composed of three segments, has a pair of antennae, and undergo complete metamorphosis. According Syaputra (2015), the existence of a butterfly on a region can be seen as a very important thing.

Results of preliminary observations in Jatibarang Reservoir found that butterfly species richness in spite of the reservoir near the site of the final disposal (landfill). This is because around the reservoir there is the area of green belt with many types of plants from the group Annonaceae, Aracaceae, Euphorbiaceae, Poaceae, Zingiberaceae, Bombacaceae, Mimosaceae and some other groups are very supportive of their habitat and vegetation fodder for butterflies, Jatibarang reservoir with a diversity of butterflies can be developed as a learning resource based on local potential. As in the study by Ariani & Sulistiyowati (2016) showed that the potential diversity of butterflies in Mount Andong can be developed into a module teaching material for students of SMP / MTs in the subject matter of classification of living things.

One source of learning that can be set by the teacher is in the form of a supplement encyclopedia based teaching materials. According to Vanessa (2013), the encyclopedia can be used as an alternative learning resources are used to provide accurate and current information as well as to broaden their audience. Based on tests conducted by Sulistyawati & Hedianti (2015), there was information that the encyclopedia can improve students' understanding of the material being studied. The research by Faridah *et al.* (2014) also stated that the encyclopedia are well conceived can be critical to the achievement of the indicators in the learning material.

Encyclopedias are arranged in the form of a digital encyclopedia. Technology has become a tool that can help the majority of human needs. Technology has to be used by humans to simplify tasks and work one in the field of education. The important role of technology is what brought the civilization of the students of today into the digital era and millennial. Therefore, it is necessary to do development "The Digital Encyclopedia of Butterflies in Jatibarang Reservoir as The Supplement of Biodiversity Teaching Material in Senior High School".

METHODS

This research is a Research and Development (R & D) with the ADDIE models. Design science research at this stage is to identify the types of butterflies in the area Jatibarang Reservoir (Figure 1). Tools used include Jatibarang Reservoir area map, camera, insect net (net insect catcher), papilot paper, stationery, hygrometer, lux meter and key determination. Materials used in the study of all kinds of butterflies found in the study site and a butterfly habitat. Catching butterflies done in the morning at 9 a.m-3 p.m (Dewi *et al.*, 2016).

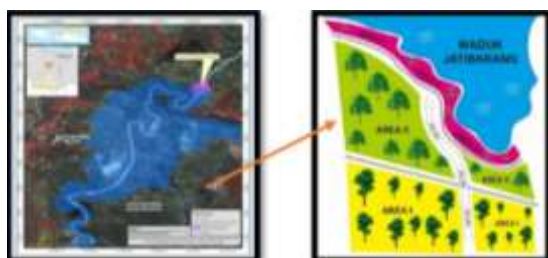


Figure 1. Map Territory of Jatibarang Reservoir and Distribution Lookouts

The method used in the capture of the butterfly is the method of cruising (cruising) at three observation areas. Three of the observation area covers the area outside the entrance to the reservoir, which is the central area of the tourist sites and flower garden, as well as the area immediately adjacent to the lip of the reservoir. The principle is the insects that fly or move in the air will be caught using insect net. Butterflies are caught with insect nets and then inserted into the paper papilot as temporary shelters. After the capture is complete, the butterflies were collected and identified with the help of Sekimura & Nijhout (2017) and Borror *et al.* (1992), determination key as well as some other reference books. Measurements are also environmental factors such as air temperature measurements done, humidity, and light intensity.

Research development is used to produce and test the effectiveness of the product. Products produced in this study is a butterfly digital encyclopedia that contains the results of research and teaching materials. Design products developed in the form of Android apps based on Adobe AIR which contains materials biodiversity subchapter classification of living things butterfly.

The subject of research is the development of tenth grade of SMA N 2 Semarang. The subject of research for small-scale product testing consisted of ten students, while for large-scale trial consists of two classes (seventy-two students). Test the validity of digital encyclopedia products include butterfly validity test materials and media. Test the validity of the product was performed using questionnaire instrument. The effectiveness of the product can be seen from the following, namely: *N-Gain* value, the cognitive learning, affective learning outcomes and psychomotor learning outcomes. Students and teacher response data to readability, practicality, as well as the use of digital learning media encyclopedia butterfly measured using a questionnaire.

RESULTS AND DISCUSSION

Wealth Type Butterfly

Based on the results of research conducted in Semarang Jatibarang Reservoir lepidoptera obtained by four families and 28 species of butterflies. Lycanidae family there is one kind, Nymphalidae there are 15 species, there are five types of families Papilionidae and Pieridae family there are seven types. The wealth of butterfly species found in reservoir Jatibarang shown in Table 1.

Table 1. Property Type Butterfly Jatibarang Reservoir Semarang

Family	Species	Total
Lycanidae	<i>Spindasis Vulcanus</i>	2
Nymphalidae	<i>Acraea terpsicore</i>	1
Nymphalidae	<i>Danaus Chrysippus</i>	3
Nymphalidae	<i>Elymnias hypermnestra</i>	1
Nymphalidae	<i>Euploea Gamelia</i>	6
Nymphalidae	<i>Euthalia Monina</i>	1
Nymphalidae	<i>Hypolimnas Bolina</i>	6
Nymphalidae	<i>Junonia almana</i>	12
Nymphalidae	<i>Junonia hedonia</i>	3
Nymphalidae	<i>Junonia iphita</i>	3
Nymphalidae	<i>Neptis Hylas</i>	6
Nymphalidae	<i>Tanaecia Palguna</i>	3
Nymphalidae	<i>Tanaecia Pelea</i>	3
Nymphalidae	<i>Tirumala limniace</i>	1
Nymphalidae	<i>Vanesa cardui</i>	1
Nymphalidae	<i>Ypthima Baldus</i>	7
Papilionidae	<i>Graphium Agamemnon</i>	9

Family	Species	Total
Papilionidae	<i>Papilio demoleus</i>	3
Papilionidae	<i>Papilio Memnon</i>	3
Papilionidae	<i>Papilio polytes</i>	6
Papilionidae	<i>Troides Helena</i>	1
Pieridae	<i>Appias olferna</i>	1
Pieridae	<i>Catopsilia pomona</i>	1
Pieridae	<i>Delias hyparete</i>	1
Pieridae	<i>Eurema blanda</i>	17
Pieridae	<i>Eurema hecabe</i>	25
Pieridae	<i>Eurema sari</i>	20
Pieridae	<i>Hebomoia glaucype</i>	1
Total		147

Priyono & Abdullah (2013) stated the large proportion of family Nymphalidae individual in kind and due to this butterfly family has more than one host. Butterfly species richness in Jatibarang Reservoir is also influenced by several factors such as air temperature, humidity, light intensity and wind speed. In addition to recount a wealth of butterfly species also conducted measurement of environmental factors on the location of the observations to determine the air temperature, humidity, light intensity, and wind speed are shown in Table 2 as well as pictures of some butterflies in Reservoir Jatibarang shown in Figure 2 .

Table 2. Results of Measurement of Environmental Factors on Reservoir Jatibarang

Environmental factor	Area Observation			Average
	Area I	Area II	Area III	
Air temperature (° C)	31.6	33.0	33.1	32.6
Humidity (%)	76.6	78.7	80.8	78.7
The light intensity (Lux)	16 780	27000	92170	45 316



Figure 2. Butterflies Jatibarang Reservoir

The validity of the Digital Encyclopedia of Butterflies

The validity of the digital encyclopedia butterfly assessed by the lecturer of skilled and experienced in their fields. Before the digital encyclopedia of butterflies used first be validated. Validation is done by subject matter experts are lecturers who are experts in the field of taxonomy and media experts are lecturers who are experts in the field of learning media. The assessment results obtained from the subject matter experts and media experts presented in Table 3.

Table 3. Validity Digital Encyclopedia of Butterflies Based on Matter Expert Assessment and Expert Media

Expert	Percentage (%)	Criteria
Matter	90	very valid
Media	95.6	very valid
Average	92.8	very valid

Table 3 shows the ratings given by two experts and media material with the average percentage of 92.8% with very valid criteria. Data from expert assessment of materials and media experts used as a basis for revising the digital encyclopedia of butterflies that developed as a digital encyclopedia component of efforts to improve the butterflies before been tested on students in the school. Advice from subject matter experts that need to display all of the material in printed form, while the advice of experts on the media that language is an assumption that some instruments still needed confirmation of the validity of the item in accordance with the subject of research. Display digital encyclopedia of butterflies found in Figure 3.

The development of digital media in the form encyclopedia butterfly Jatibarang Reservoir is best used as a supplement to high school teaching materials. This is according to research Zhou & Teo (2017) that inform school leaders in the importance of trying to use media and technology for a sustainable and innovative curriculum design, assessment, and delivery of lessons. Essel et al. (2018) also states that the use of digital technology among students at KNUST may affect the implementation and integration in the school curriculum.

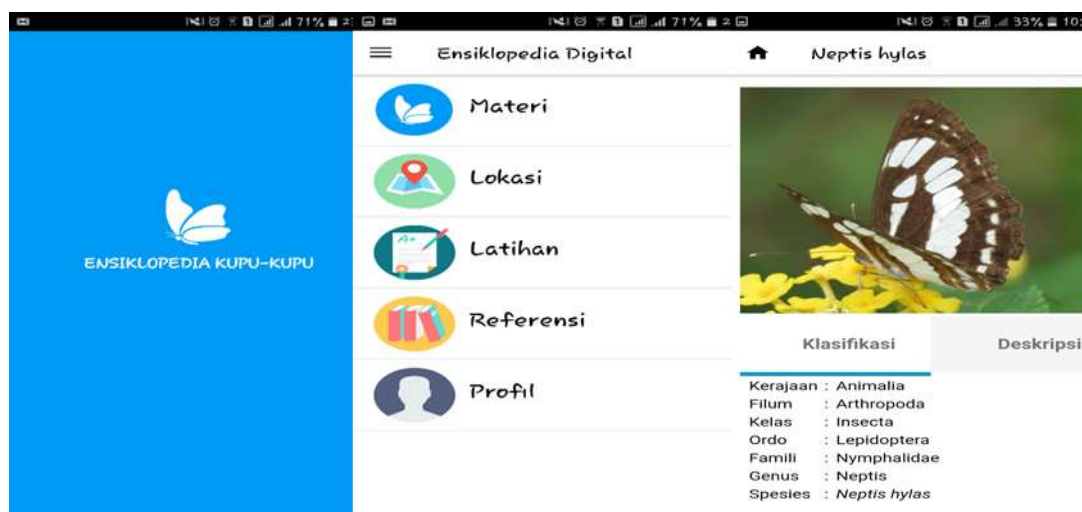


Figure 3. Display of Butterflies Digital Encyclopedia

The Effectiveness of The Use of The Butterflies Digital Encyclopedia

The effectiveness of the use of digital encyclopedia butterfly measured by student learning outcomes. Cognitive learning results obtained from the pretest and posttest. Affective learning outcomes which is the average of the value of such an attitude of cooperation, enthusiasm, ability to interact, responsible and confident. Psychomotor learning outcomes is the result of the average score value in presentation skills and activity reports. Scores of student learning outcomes of cognitive, affective, and psychomotor presented in Table 4.

Table 4. Score Learning Outcomes Cognitive, Affective, and Psychomotor

Aspect	X MIPA 9	X MIPA 10	Criteria
Learning outcomes			
- Pretest	62	50	unfinished
- Posttest	92	88	completed
Affective Learning Outcomes (%)	84.03	84.44	well
Psychomotor Learning Outcomes (%)	86.39	84.86	highly skilled
Scores <i>N-Gain</i>	0.80	0.73	High
Classical completeness (%)	100	100	completed

In Table 4 shows the average value of pretest-posttest X MIPA 9 and X MIPA 10 is different. The average value of the second pretest

showed class KKM have not reached 70. Values indicate average posttest both classes have reached more than KKM. Affective value between X MIPA 9 and X MIPA 10 both have a good percentage of the category. Value psychomotor percentage of 86.39% and 84.86% by the highly skilled category for X MIPA 9 and X MIPA 10. Obtaining *N-Gain* derived from the provision of pretest and posttest of both classes is 0.80 and 0.73, including in the high category as well as classical completeness of both classes reach 100%. In accordance with research Mulyanto *et al.* (2017), students must be encouraged to gain experience by doing activities so students are actively involved in learning so that they can construct knowledge in their minds and improve their learning outcomes.

User Response Digital Encyclopedia of Butterflies

User response digital encyclopedia of butterflies made up of students and teachers. The response of the digital encyclopedia of butterflies serve as the basis for revising the digital encyclopedia of butterflies for improvement to be better again. Response use digital encyclopedia butterfly obtained from ten students of class X MIPA selected randomly. The results of the response scores using a digital encyclopedia of butterflies from 10 students to acquire digital encyclopedia user response score butterfly small scale are listed in Table 5.

Table 5. Score User Response Digital Encyclopedia of Butterflies Small Scale

Users	Percentage (%)	Criteria
RSK01	88.33	Very good
RSK02	91.67	Very good
RSK03	86.67	Very good
RSK04	93.33	Very good
RSK05	91.67	Very good
RSK06	95.00	Very good
RSK07	90.00	Very good
RSK08	88.33	Very good
RSK09	86.67	Very good
RSK10	86.67	Very good
Average	89.93	Very good

Based on the results of the readability test response using digital encyclopedia of butterflies on 10 students of 89.8% included in the excellent category. Qualitative data from 10 students stated that the language used is easy to understand, not too much text and font and color chosen very well. Furthermore, digital encyclopedia butterfly tested on a large scale is in X MIPA 9 and X MIPA 10 tested on the teacher. The response of the two classes with 72 students and teacher listed in Table 6.

Table 6. Score User Response Digital Encyclopedia of Butterflies Big Scale

Users	Percentage (%)	Criteria
Students	95.9	Very good
Teacher	93,3	Very good
Average	94,6	Very good

Based on Table 6 student responses have averaged 95.9% are very good. Qualitative data from students that digital encyclopedia of butterflies is very good. The advice given is to be more enhanced zoom to make it more interesting and provide the back button to return to the previous question on the exercise menu. Further to the response of media use by teachers selected a biology teacher who teaches in SMA N 2 Semarang. Response of teachers is 93.3% are very good. Qualitative data from biology teacher pengampu namely digital encyclopedia of butterflies is very good. In these calculations showed that the average score obtained on the use of digital encyclopedia of butterflies by the students and teachers in the amount of 94.6% included in the excellent category for

implementation into learning. The use of digital encyclopedia teaching materials can be used as teaching material independently. Concise presentation of instructional materials and contextual it is extremely relevant in the 21st century learning because students are more interested in the knowledge that correlated to the life (Mustafa *et al.*, 2017).

CONCLUSION

The conclusions that can be drawn based on the results of research namely (1) the diversity of 28 butterfly species in the Jatibarang Reservoir such as Lycaonidae, Nymphalidae, Papilionidae and Pieridae family; (2) the validity of the encyclopedia of butterflies according to the material and media experts in the average of 92.8 % using valid criteria; (3) the effectiveness test on cognitive aspect for N-Gain value in high category and 100% classical completeness, affective aspect for good category and psychomotor aspect for skilled category; (4) the students' response of the digital encyclopedia are 95.9% and teachers' response are 93.3% which belong to very good categories. The digital encyclopedia is suitable in the learning process.

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