



DEVELOPING ENCYCLOPEDIA OF MACROZOOBENTHIC INVERTEBRATES LEARNING MODULE TO IMPROVE STUDENTS' LEARNING OUTCOME IN BIOLOGY SUBJECT

R. Teti Rostikawati¹, Lufty Hari Susanto¹, Eka Puspita Rahayu²

¹Lecturer at Biology Education Study Program, Teachers Training and Education Faculty, Universitas Pakuan, Indonesia

²Graduate Student at Science Education Master Program, Universitas Pakuan, Indonesia
Email: rostikawati@unpak.ac.id

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Abstract

This research is Research and Development (R&D) model used in the ADDIE model which was done on March until July 2019. The purpose of the study was to develop encyclopedia of macrozoobenthic invertebrates to improve student's learning outcome. The research was conducted at a High School in Bogor, for the tenth grade students of MIPA 1 as the experimental class with the total number of 37 student and used one group pretest-posttest design. The instruments used in this study consist of expert validation sheets, multiple choice questions and questionnaire sheets to collect student responses about encyclopedia of learning module. Validation data shows that the feasibility test on the content of the material, language and presentations obtain values above 81% included the validity and appropriateness category for learning. The result of the questionnaire shows that a positive response was obtained with values above 82%. The average result obtained at pretest was 43,23 while the average result obtained at posttest was 79,90. The result of the N-Gain analysis shows a medium criterion of 0,6. In conclusion, the encyclopedia of macrozoobenthic invertebrates can improve student learning outcome.

Keywords: *Encyclopedia learning module, Student learning outcomes, Invertebrated animals*

INTRODUCTION

Education in Indonesia has been evolving every year according to the need and development of the era. The Ministry of Education and Culture (2016) has made an improvement to

the 2013 Curriculum which aims to produce a generation that maintains 3 competencies; attitude, skills, and knowledge. The revised edition of the 2013 curriculum should include four important points; Reinforcement of



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Character Education (PPK), Literacy, 21st Century Skill including Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation (4C), and Higher Order of Thinking Skills (HOTS).

School Literacy Movement (GLS) is a term to understand and use something intelligently through various activities including reading, viewing, listening, writing and speaking. Literacy can be interpreted into basic literacy, library literacy, media literacy, technology literacy, and visual literacy. The purpose of GLS is to increase students' reading interest to understand the material and increase knowledge of related material (Kemendikbud, 2016).

The knowledge attained from learning Biology must be well understood, not merely by listening to the lecture or reading. This is because Biology has unique characteristic and requires its own techniques to learn. These characteristics can be seen from the amount of memorization and theories presented about living things and the issues involved therein are quite complex. In addition, Biology as a scientific knowledge is expected to develop continually. As expressed by Hidayat & Teti (2018) science is an accumulated and systematic learning of natural phenomena. The progress of science is not only about the accumulation of facts, but also by the development of scientific method and scientific attitude. Thus, science inherently involves three aspects; science as a product, science as a process, and science as a scientific attitude.

Based on the interviews done with several teachers at a school in

Bogor, it was found that one of the main problems in teaching Biology, is that textbooks were only used as a complimentary object and students had to be reminded daily to read books. The learning module used are mainly textbooks that make students feel bored. Since the laboratory is still inadequate to facilitate teaching learning process, the teacher finds it difficult to deliver material related to examples of the species, especially of invertebrated material.

The result of observation at the school shows that students' learning outcomes on Biology subject is relatively low. This was proven by the average score of 80% students was still below the minimum score. Based on an online questionnaire that has been distributed to the tenth grade of students, as many as 63.5% of students strongly agreed that learning Biology needs an innovative learning module; 52.7% of students agreed that learning module can attract students' interest in learning; 51.4% of students strongly agree that learning module can make it easier for students to understand the material, 64.9% of students sometimes read textbooks, 67.6% of students do not agree if the learning module only contain text; 55.4% of students strongly agree that learning module contain pictures and are accompanied by clear explanation that can make students understand the material.

Rostikawati & Lufty (2019) point out that the use of learning modules in high schools is mostly in the form of books which tend to contain long descriptions, few displayed pictures and colors making students feel bored. Based on the observation, the most difficult topic to

be learned by the tenth grade students is invertebrates because it is quite complex; 9 phyla to be discussed and a lot of terms to remember. The material covers the diversity of invertebrates, mostly discussed in the form of reading displaying neither attractive nor colorful pictured examples making students less interested in reading and studying them. According to Gurung (2017), students tend to enjoy reading textbooks if it is provided with lots of colorful pictures with few descriptions. Images can increase reading interest because they can help readers imagine. Imagination can help a person to improve his memory performance.

Acknowledgement of biological knowledge regarding invertebrate topic needs a realistic object from nature since there are not enough examples of living animals that can be observed by students at schools. Therefore, students need enrichment in learning module literacy in form of theory, pictures and shapes about the topic. Besides that, having laboratory activity can be helpful for students to interact directly with the diversity of invertebrates found in the surrounding environment. However, in some occasions, students find it difficult to identify invertebrates because there are no adequate learning resources when they find them elsewhere.

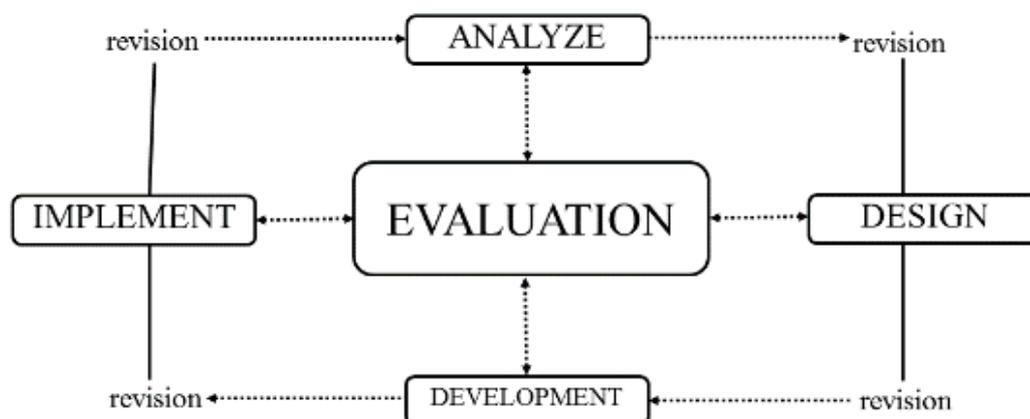


Figure 1. The ADDIE model (Retnowati, et al., 2018)

Responding to these problem, the writer concerned about finding the best type and presentation of learning modules that may not yet provided sufficiently in high schools, especially on invertebrate topic. It is necessary to have practical learning resources that allow students to learn independently. One of the learning resources that can be developed to help students understand the morphology, characteristics,

classification of invertebrates, macrozoobenthic sub-material is an Encyclopedia. According to Pallo (2006) Encyclopedia is a textbook that represents various genres of scientific literature and helps students in learning process at school. Encyclopedias have characteristics that are unique to other books; having a list of terms that are added to the explanation of these terms and are arranged alphabetically so that it is

easy to use. The contents of the invertebrate encyclopedia learning module include the of terms of the species and documented pictures taken from the actual places which can add students' insight, supported by summary explanations to help students understand easily. This goes along with the opinion of Rengel (2019) who states that the encyclopedia is arranged in A-Z format or alphabetically, containing image illustrations and photos of original specimens of the object concerned.

The source of the image in the invertebrate encyclopedia was obtained from a field study in Lake Lido, Cigombong, Bogor Regency and a literature study was carried out by looking for sources to identify specimens that have been obtained from Lake Lido in the form of books, journals and other relevant references. The writer believes that developing encyclopedia learning module on invertebrates topic, especially macrozoobenthic sub-material can improve students' learning outcomes in Biology subject.

METHODS

This is a Research and Development study with the ADDIE model (Analyze, Design, Development, Implementation and Evaluation). The experimental group of this study is the tenth grade class of

MIPA 1 in one of the Senior High Schools (SMA) in Bogor, even semester of the 2018/2019 academic year with 37 participants. The research was conducted from March to July 2019. The product developed was an encyclopedia learning module on invertebrates, macrozoobenthic sub-material. The encyclopedia teaching module being developed was based on the implementation of scientific approach, in accordance with the mandate of the 2013 curriculum. The steps for the ADDIE development model are as follows:

1. Analyze

At this stage, observations or preliminary studies are carried out in the field to determine the initial conditions; the learning process, teaching modules and learning models commonly used by teachers, as well as the average value of students' learning outcomes in Biology subject.

2. Design

The design stage aims to design an encyclopedia. Steps that must be done at this stage are: (a) Adjusting to Core Competencies and Basic Competencies; (b) Selection of encyclopedia sources; (c) Format selection in developing encyclopedia teaching module; (d) The initial design of the encyclopedia teaching module.

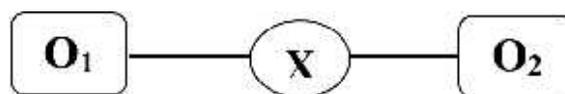


Figure 2. The One-Group Pretest-Posttest Design (Sugiyono, 2015)

Notes:

- O₁ = Pretest value (before use encyclopedia)
- O₂ = Posttest value (after use encyclopedia)
- X = Treatment use encyclopedia

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3. Development

Development focuses on the realization of the product after being conceptualized in the design stage. The created product will be validated by a team of experts to get an assessment of their feasibility. The trial was conducted in a limited manner to determine the effect of using encyclopedia teaching module to improve students' learning outcomes in Biology subject. According to Arikunto (2013) the

data on the validity of teaching module is analyzed using the following formula:

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Information:

P = Percentage of Feasibility

X = Validated Score Answer (Actual Score)

Xi = Highest Score (Expected Score)

The results obtained are then categorized in Table 1.

Table 1. Learning Tool Validity Criteria (Arikunto, 2013)

No	Average Score	Validation Criteria
1	80-100%	Valid
2	60-79%	Quite Valid
3	40-59%	Less Valid
4	0-39%	Not Valid

There are three techniques for data collection; for experts validation using validation sheets in terms of content or material feasibility, language and presentation, for students' learning outcomes using written tests with multiple choice questions and for students' responses to encyclopedia teaching module using questionnaires.

4. Implementation

The products that have passed expert validation are tested with a limited manner on a number of students studying invertebrate topic in a high school. The research design used was the One Group Pretest-Posttest design. In this study, students were given a pretest before being given the treatment and posttest after being given the treatment, thus the results of the treatment is known to be more accurate, because there can be a

comparison of the situation before and after being treated (Sugiyono, 2015). The design is shown in Figure 2. Multiple choice evaluation that is given to measure the learning outcomes of students' cognitive skill in Biology was calculated with a formula. The score calculation used the following equation:

$$Score = \frac{Attained\ Score}{Ideal\ Score} \times 100\%$$

To find out the effectivity on students' learning outcomes, it is by looking for the N- Gain score as follows:

$$N - Gain = \frac{Post\ Test\ Score - Pretest\ Score}{Maximum\ Score - Minimum\ Score}$$

The determination of the criteria for the N-Gain value is presented in Table 2.

Table 2. *N-Gain* Value Criteria (Hake, 1999)

N-gain Value	Criteria
High	$> 0,7$
Medium	$0,3 - 0,7$
Low	$< 0,3$

5. Evaluation

At this stage students respond through a questionnaire. The results of the student responses are used as an input for further improvement of the teaching module.

RESULTS AND DISCUSSION

Developing encyclopedia teaching module of macrozoobenthic sub-topic on invertebrate in Lake Lido, Sukabumi Regency as an effort to assist students in learning invertebrate, is designed interestingly to meet students' need in accordance with the demands of learning indicators and goals in 2013 curriculum. This encyclopedia can be used as a learning resource in the laboratory. As it is known that laboratories in some schools are still insufficient, and specimens of invertebrate animals are still lacking. Developing this encyclopedia can shed the light on students to broaden their knowledge in learning macrozoobenthic species. In accordance with Rosdiana & Gloria's research (2016), the more activities to be done in the laboratory (practicum), the more significant student interests to rise in learning. Besides, more evidence for the truth of theories or concepts to be learned through direct observation and experience on natural events and phenomena, that makes theory or the concept becomes more meaningful in students' cognitive structure.

The process of designing encyclopedia teaching module began with the selection of sources through a field study in Lake Lido, Cigombong, Bogor Regency to obtain documentation of invertebrates at the three research stations. The determination of stations according to Achmad (2015), first station is an area where community activity has not been found, second station is an area where there is a community activity and tourism activity and the third station is an area where fishery activity is found. Research on macrozoobenthos was carried out because previous studies had proven that the existence of Macrozoobenthos in an ecosystem was closely related to the environment around (Yunita et al, 2018). Besides, biological monitoring in waters with macrozoobenthos is more accurate and beneficial compared to other indicators, because macrozoobenthos is very sensitive to organic pollutants, easy to distribute and affordable (Pratiwi et al., 2020). By getting to know macrozoobenthos more closely through learning, it is hoped that students will understand more about the importance of also protecting the surrounding environment, especially waters so that they are not easily contaminated.

The species obtained were freshwater jaw leeches (*Glossiphonia stagnalis*), golden snails (Pomacea

canaliculata), freshwater crabs (*Parathelphusa convexa*), lagdo prawns (*Palaemon concinnus*), water scorpions (*Ranatra chinensis* and *Nepa cinerea*), dragonflies ciwet (*Pantala flavescens*), large house spiders (*Eratigena atrica*), and earthworms (*Lumbricus terrestris*).

Next, making a design of teaching module to be tested, preparation of lesson plans, LDS, instruments to measure student learning outcomes, expert validation instruments and student response questionnaires. The product of encyclopedia teaching module that has been made was assessed by experts regarding the content / material, language and its presentation. The results of the validator's assessment can be seen in Figure 3.

One of feedbacks from expert validation was to improve its content; including the identity and location of the research on its cover, improper image layout, additional material (more knowledge), writing techniques for terms and addition of material summaries.

The average result of expert validation in terms of content feasibility is 81%, language feasibility is 80% and presentation feasibility is 82%, each of these percentages is categorized as valid. In accordance with Arikunto's opinion (2013), who states that if the feasibility of learning modules obtains a score above 80%, it has been regarded as valid in qualification and does not need revision. It makes the encyclopedia as suitable to be applied in learning.

Table 3. Result Score *Pretest-Posttest*

No.	Implementation Criteria	Pretest	Posttest
1.	Total Students	37	37
2.	Total Score	1297	2397
3.	Maximum Value	60	90
4.	Minimum Value	30	70
5.	Average	43,23	79,90
	<i>N-Gain</i> Value	0,6 (sedang)	

To measure the effectiveness of encyclopedia teaching module for students, the researcher used one group pretest and posttest design. The results of the pretest and posttest on macrozoobenthic invertebrate species can be seen in Table 3. Table 3 shows that the average pretest result is 43.23 and the posttest result is 79.90. The minimum score (KKM) for the Biology subject is 72. Thus the results in the experimental class have exceeded the specified achievements. This can be seen from the learning

outcomes with an N-Gain value of 0.6 that was included in the moderate category. Based on the N-Gain value, the use of encyclopedia teaching module on macrozoobenthic sub-material invertebrate is effective in improving student learning outcomes. This is in line with the opinion of Listia (2014) who states that the use of invertebrate encyclopedia teaching module can improve students' learning outcomes.

The results of the questionnaires on students' responses

are shown in Figure 4, where students' interest in using encyclopedia teaching module was 84%, motivation in participating in learning process was 82% and understanding of invertebrate topic was 80%. The students' response questionnaires given after learning gained a positive response with an average value of 82%. From the overall responses, it shows that learning module can help students and increase student motivation, interest and enthusiasm for learning. According to Trianto (2014), learning modules are said to be effective if at least 80% of all students' answers are highly positively or positive on the final average. This is supported by Iis's research who proved that practicality

and increasing student interest in using encyclopedia teaching module can be assessed with questionnaires on students' responses with a positive response (Iis, 2005). Likewise, according to Prastowo (2012) learning module presented through a media can be a learning resource that can assist students learn to achieve learning objectives. Similar with Hernawati's research (2018), the encyclopedia used as a learning material in scientific approach can improve students' knowledge and skills. Invertebrate encyclopedia teaching module as a means to improve student learning outcomes, motivate students to learn and increase student literacy interest.

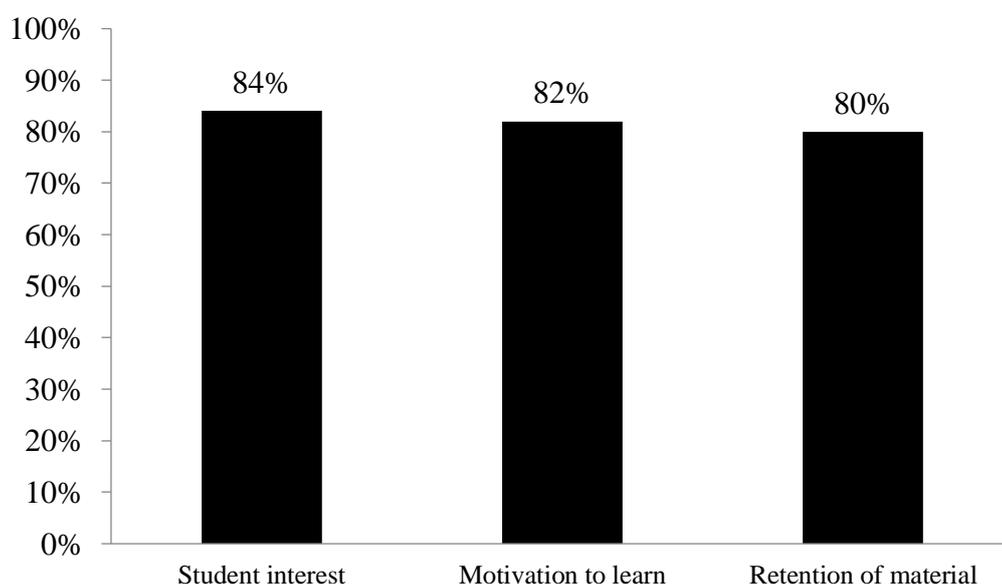


Figure 4. Student Response Questionnaire Results to Teaching Materials

Research on the development of invertebrate encyclopedia teaching module on macrozoobenthic sub-material has the advantage that the source of learning module documentation comes from the results of field studies of natural resources in

the surrounding environment, namely Lido Lake and becomes the value of local wisdom. Teaching module can help students understand the morphology, characteristics, and classification of invertebrates, macrozoobenthic sub-material.

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Specimens or native animals from the research results can be used as a learning resource in classroom and laboratory learning so that students' understanding of invertebrate material is more quickly absorbed. This is in accordance with the research of Kamaludin, et al. (2018) who state that problem-based teaching of Freshwater Biology topic can increase understanding of environmental phenomena through the result of learning.

It is hoped that the invertebrate encyclopedia teaching module on macrozoobenthos can be implemented in schools to serve as an alternative for providing material and resource books in practicum activities.

CONCLUSION

Invertebrate encyclopedia teaching module on macrozoobenthos can improve students' learning outcomes in Biology subject. This is proved by the results of the N-Gain value of 0.6 which indicates moderate criteria. The encyclopedia is valid and feasible for use in learning based on the average value of expert validation and student response questionnaires of 82%.

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