

# Development of biodiversity enrichment e-module fauna Gembira Loka Zoo for high school students

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**Abstract:** The existence of contextual learning resources that are able to accommodate students' enrichment materials independently is still not found too much. The aims of this study were to: 1) examine the diversity of fauna at Gembira Loka Zoo; and 2) developing an e-module for material enrichment on the topic of biodiversity by utilizing the results of research on faunal diversity at Gembira Loka Zoo. This Research and Development (RnD) used three main stages of the 4D model, namely define, design, and develop. The results showed that at Gembira Loka Zoo there were 88 types of fauna, including Class Gnathostomata, Class Amphibia, Reptiles, Aves, and Mammals, then the conservation agency used SEAZA guidelines for the welfare and care of the fauna. The data is then developed into an e-module for the enrichment of fauna biodiversity which has the potential as a learning resource. The e-modules that have been compiled are considered feasible by material experts, media, and educators to be used on the correctness of the concept as well as aspects of content, appearance, graphics, programming, language, and independent learning. The compiled e-modules can also be read and considered attractive by students in the aspects of content, appearance, programming, language, and independent learning. The modules that have been developed through this research are expected to be used for biology enrichment in various schools in Yogyakarta.

**Keywords:** e-module; fauna biodiversity; flipbook; Gembira Loka Zoo

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## 1. Introduction

Biology is one of the subjects studied by high school students. Through this learning, students will learn various sciences and knowledge related to living things (Shen, 2020). The material studied in Biology is close to students' daily lives because the objects of study in biology are living things and other components that are closely related to human life. In this regard, teaching biology is recommended to use contextual based learning (Cabbar & Şenel, 2020). Through contextual learning, teachers can connect phenomena and learning resources that are close to students' daily lives (Overton, 2016). With this kind of learning, various student competencies can be increasingly empowered (Ahdhianto et al., 2020; Dewi et al., 2021; Suryawati & Osman, 2018).

As with other subjects, assessment activities and follow-up of assessment results are important components in learning biology. At the time of conducting the assessment, student learning outcomes will vary. Some students can achieve the minimum score, but some other students have not been able to achieve the minimum score. For students who have not achieved the minimum score, they will take part in remedial activities (Wu, 2012). On the other hand, students who have achieved a minimum score should be given the opportunity to get quality enrichment activities. Enrichment activities are additional

learning designed to enhance students' academic experience and challenge them academically (Renzulli et al., 2021).

In accordance with the statement explained in the previous paragraph, the results of observations at a school in Yogyakarta found that a small number of students in several classes still had not achieved the minimum grades that had been set. However, the results of interviews with teachers revealed that enrichment activities were not running optimally. The teacher's limited time to prepare learning resources for enrichment activities is one of the main reasons for this condition. Accordingly, time is the factor that is reported to have the most influence on the implementation of enrichment learning (Sudiwito et al., 2018). Therefore, the teacher hopes that there will be research and development activities to produce learning resources that are able to facilitate students in obtaining learning enrichment material more optimally.

In line with the urgency of the existence of learning resources for enrichment activities, the development of such learning resources must also follow developing educational issues. One issue that needs attention is the increasingly massive digitization of learning resources as a result of the COVID-19 pandemic (Kang, 2021; Zancajo et al., 2022). In connection with these conditions, it is hoped that the current learning resources for enrichment activities can also be prepared in electronic form (Alyoussef, 2021; Maatuk et al., 2022). Through electronic-based learning resources, various benefits can also be obtained, such as more flexibility in time and place for students to utilize these learning resources (Abed, 2019; Sagita & Khairunnisa, 2020). In addition, the use of electronic learning resources can also optimize students' learning outcomes (Ritonga et al., 2020; Sidauruk et al., 2021) and other competencies (Haghparast et al., 2014; Zare et al., 2016). The form of learning resources also needs to be chosen appropriately in order to be able to facilitate students to become independent learners. One of the learning resources that can support student learning independently is a module (Nisa et al., 2020; Serrat et al., 2014). Therefore, the development of electronic-based modules or e-modules has great potential to optimize the creation of independent learning.

Based on the results of observations and analyzes that have been carried out, one of the topics in biology lessons that needs to provide enrichment learning resources is the topic of biodiversity. Considering that biology learning and learning resources must be designed contextually, enrichment on the topic of biodiversity also needs to utilize the surrounding environment or learning resources that are familiar to students' lives. In this regard, based on its location, the Gembira Loka Zoo is a familiar location for students in Yogyakarta. Therefore, it is hoped that the enrichment material on the topic of biodiversity can be related to the diversity of fauna at Gembira Loka Zoo. In line with that, the development of enrichment material has been carried out by several previous researchers (Marces, 2020; Susila et al., 2021), as well as the development of learning materials for the biodiversity topic (Pramita et al., 2019; Rohmah et al., 2022). The use of module as an enrichment learning resources has also been carried out in previous study (Khikmah & Suratsih, 2019). However, development research that transforms the results of research on the diversity of fauna at Gembira Loka Zoo into modules that are packaged electronically and is intended for enrichment material has yet to be found. Therefore, the purpose of this study was to examine the diversity of fauna in the zoo and develop an enrichment e-module based on the results of this research.

## 2. Materials and Methods

This development research consists of two stages of research, namely biology research and biology education research. The biological research conducted was a qualitative descriptive study using structured observation methods, structured interviews, and document studies at Gembira Loka Zoo. This research took place from March to early April 2022. The object of research in structured observation was the fauna in display cages and the object of research in structured interviews was the Assistant Manager of the Gembira Loka Zoo Conservation. The fauna obtained was then observed for its diversity

and morphological characteristics and their classification were identified. The instruments used in this biological research were observation sheets and interview guidelines.

The biology education research conducted was a Research and Development (R&D) research which aims to produce the final product in the form of enrichment e-module prototypes. The development model used in this research is the 4-D (Four D) development model. This model is a learning media development model developed by Thiagarajan et al (Thiagarajan et al., 1974). The stages of this model include (D) define or plan, (D) design or design, (D) develop or develop, and (D) disseminate or disseminate, but this research was only carried out until the develop or development. The first stage is Define, which includes an initial-end analysis, students, assignments, concepts, and specifications of learning objectives. Next is the Design stage, which includes media selection and media format selection. The last stage is Develop, including drafting, review by experts, stage I revision, review by practitioners, stage II revision, readability test, and stage III revision.

Expert reviews were carried out at the Yogyakarta State University Campus on 14 July-15 August 2022. Furthermore, practitioners' reviews and student readability were carried out at one of the Yogyakarta High Schools on 20-22 August 2022, as well as a readability test on students on 24-28 August 2022.

The object of this research was the Gembira Loka Zoo Biodiversity Enrichment E-module and the research subjects were 2 material experts, 2 media experts, 2 practitioners, and students of class XI MIPA in the 2022/2023 academic year at one Yogyakarta high school with 20 children, including class XI MIPA with 4 classes, namely MIPA 1, MIPA 2, MIPA 3, and MIPA 4, and class XI IPS with 2 classes, namely IPS 1 and IPS 2. The characteristics assigned to students are those who sit in class XI, has received Indonesian biodiversity material and has passed the KKM (Kriteria Ketuntasan Minimal = Minimum Competency Criteria) with a score of 75.

The data collection technique was carried out by observing the analysis of the needs of students and questionnaires, while the instruments used were questionnaires of students' needs, material expert questionnaires, media questionnaires, practitioner and student questionnaires.

The data analyzed was in the form of qualitative data which was then analyzed using qualitative descriptive data analysis techniques. The results of the data were obtained from a questionnaire, then the answers were analyzed based on the true/yes or false/no statements in the compiled e-module. Statements true/yes or false/no are answered by ticking in the column provided in the statement for each assessment item (Subali, 2016). This Guttman scale can also be said to be a single-dimensional scale, because the answers given are clear, namely yes or no, right or wrong, as well as other answer choices that have a single dimension. The statement that only provides two choices is an analysis using the Guttman scale. The Guttman scale will later be used to determine and provide an assessment according to their opinions and criteria. No/wrong/disagree answers are then revised to be yes/true/agree, so that the final product is said to be feasible and legible.

### 3. Results

#### 3.1. Fauna Diversity at Gembira Loka Zoo Yogyakarta

Based on structured observations, structured interviews, and document studies carried out at Gembira Loka Zoo from March to early April 2022, 88 species of fauna have been found, consisting of 4 species belonging to the Pisces Superclass and 84 species belonging to the Tetrapod Superclass, which includes 2 species Amphibia class, 35 species of Reptile Class, 22 species of Aves Class, and 25 species of Mammal Class. Data on faunal diversity at Gembira Loka Zoo collected in this study is attached at the following link: <shorturl.at/cpBCW>.

Furthermore, data on Gembira Loka Zoo conservation efforts obtained from structured interviews and document studies show that the zoo is guided by SEAZA (Southeast Asian Zoos and Aquariums Association) for the welfare and care of its fauna, then carries

out health and education activities, and there are several faunas that have been successfully breeding, namely Sumatran elephants using the Flehment Test breeding technique and orangutans using natural techniques.

### 3.2. Fauna Diversity at Gembira Loka Zoo Workshop and Conservation Efforts

Based on the research that has been done, not all of the fauna data obtained were taken to be included in the enrichment e-module, so only a few were taken with the criteria of representing each class at Gembira Loka Zoo as many as 23 species. Each class is then grouped into small groups, namely the family level. Several families consisting of several species, including the Boidae, Crocodylidae, Geomydidae, and Varanidae Families in the Reptile Class, the Psittacidae Family in the Aves Class, and the Bovidae, Felidae, and Hominidae Families in the Mammalia Class. All species included in the e-module also explain their morphological characteristics and classification, while the reason not all fauna is included in the e-module is because some species will be used for training in the e-module, so that students can further explore the fauna of Gembira Loka Zoo independently.

The conservation efforts carried out by Gembira Loka Zoo were obtained from structured interviews with the Assistant Conservation Manager of Gembira Loka Zoo. In general, the conservation efforts carried out by Gembira Loka Zoo are guided by SEAZA (Southeast Asian Zoos and Aquariums Association). SEAZA is an association that aims to implement welfare in animal care. The contents of the SEAZA guidelines implemented by Gembira Loka Zoo are regarding setting standards for display cages, cage size and space, presence of sleeping cages, presence of gates or doors for safety and security, nutrition and feeding, environmental enrichment, and provision of expertise to staff and facilities supportive visitors (SEAZA, 2020).

The Gembira Loka Zoo also implements activities, such as medical check-ups to check the health of the fauna, especially the large ones, BCS (Body Condition Scoring) to check the fauna's weight and then match it to the range of the fauna, there is also a distribution of keepers for each class, so that each fauna will be cared for by keepers on duty to the fullest, as well as education for animals to train animals to be able to demonstrate 32 special movements which can later be shown to visitors who come.

Another successful conservation effort carried out by Gembira Loka Zoo is breeding several fauna, namely Sumatran elephants and orangutans. Sumatran elephants are bred using the Flehment Test breeding technique and orangutans are bred using natural breeding techniques. The Flehment Test on Sumatran elephants is a technique that mixes male elephants with a group of female elephants, then the male elephants will sniff out the female elephants which emit chemical signals in the form of pheromones from inside their bodies and this event will last for 3-8 seconds, while special techniques are not applied to orangutans, but the thing that needs to be considered is regarding the lineage of the orangutans, so that inbreeding does not occur which later when the orangutans are mated, it will produce children with disabilities.

Gembira Loka Zoo also provides information boards on each fauna. This information board contains the name of the fauna, the physical condition of the fauna, the food given, their general habitat, reproduction, unique facts, and conservation status. This conservation status information is based on the IUCN Red List or the IUCN Red List in 2022. Based on the website [www.iucnredlist.org](http://www.iucnredlist.org), the IUCN Red List is an important indicator of the world's biological health which does not just provide a list of species and their status, but is used as a powerful tool. to inform and catalyze action for conservation and policy change. That is the outline of the conservation efforts carried out by Gembira Loka Zoo.

### 3.3. Development of Research Results as Learning Resources

#### 3.3.1. Define

The first stage begins with the definition and limitation of e-module development research. This stage discusses the initial-end analysis, students, assignments, concepts, and specifications of learning objectives. The following is an explanation of each stage.

##### 3.3.1.1. The beginning -end analysis

The initial-end analysis is the analysis that became the background for the development of research on the development of the e-module for enriching the biodiversity of the Gembira Loka Zoo's fauna. This analysis can be obtained by analyzing the needs of students obtained during Educational Practice by distributing questionnaires in the form of Google forms in class X MIPA and Social Sciences at SMA Negeri 1 Godean, as well as analyzing the potential requirements for Gembira Loka Zoo so that it can be used as a learning resource.

The initial analysis is an analysis of the needs of students. Analysis of student needs is a step to identify the learning experiences of students who have passed when studying Indonesian biodiversity in the first semester of class X. This analysis was obtained by distributing questionnaires in the form of google forms in class X MIPA and Social Sciences at SMA Negeri 1 Godean during Educational Practice in October 2021.

Based on the results of the analysis of the needs of students, it is known that students have never used flipbooks, because usually when learning the media used are textbooks, LKS, and PPT or LKPD. Furthermore, based on the results of the Daily Assessment of diversity it is known that more than 75% of students have completed it, but they still have difficulty with the material, then based on questions and answers with the biology teacher it turns out that there is no enrichment program for students who have completed it, due to lack of time to develop an enrichment program. Based on the analysis of the needs of students and biology teachers, a new learning media is needed that can summarize diversity material and can be aimed at students who have completed it, so that they can still get new insights in the middle of remedial for students who have not finished.

The next analysis is the final analysis regarding the potential of Gembira Loka Zoo which can be used as a learning resource for students. The zoo can fulfill Basic Competence 3.2 and 3.3. The zoo also fulfills the requirements as a learning resource, namely: (a) The clarity of the revealed potential is the clarity of the topic raised. The topic raised was the diversity of fauna in Gembira Loka Zoo and the conservation efforts being carried out by Gembira Loka Zoo as a conservation organization. The diversity disclosed is in the form of diversity of body coverings, locomotion, breathing apparatus, and other special morphological characteristics, while the conservation efforts disclosed are in the form of activities carried out by Gembira Loka Zoo in the welfare and care of the animals, as well as successful breeding carried out on Sumatran elephants and orangutans; (b) Compatibility with learning objectives is an adjustment to learning objectives that are expected to be achieved by students. The topic raised is regarding the biodiversity of the Gembira Loka Zoo fauna, so students are expected to be able to analyze this diversity and classify it based on similarities and differences. Another topic is regarding conservation efforts carried out by Gembira Loka Zoo as a conservation institution, so students are expected to be able to analyze threats and conservation efforts carried out by this conservation institution; (c) Clarity of objectives is the clarity of the material being disclosed and the designation of the material being prepared. The material disclosed is the diversity of fauna at the species level at Gembira Loka Zoo and the conservation efforts of conservation organizations, and later this material will be prepared for class X SMA/MA students who receive biology subjects; (d) The clarity of the information disclosed is the clarity of the information obtained from Gembira Loka Zoo. The results of the research conducted have obtained 88 species of fauna. The number of fauna revealed in the e-module is 23 species along with their morphological characteristics, namely body covering, locomotion, breathing apparatus, and other special morphological characteristics, as well as efforts to preserve Gembira Loka Zoo which is guided by SEAZA guidelines; (e) The clarity of the

exploration guidelines is the clarity related to the scientific process. The scientific process activities carried out are about collecting data or information from various sources, asking, processing, and then communicating it. This activity is revealed in exercises in each learning activity; and (f) The clarity of expected acquisition is the hope for students when students learn to use enrichment e-modules. Students are expected to be able to learn independently, confidently, and be able to solve the problems they face. This expectation is a characteristic of independent learning.

#### 3.3.1.2. Student Analysis

Student analysis is an analysis to determine the characteristics of students who are the target of using the Gembira Loka Zoo fauna biodiversity enrichment e-module. Students who are targeted in using the e-module are high school students in class XI who are over 12 years old. Students aged over 12 years have entered the formal operational stage. At this stage students have the characteristics of thinking abstractly and are able to do self-reflection or introspection and self-evaluation. These characteristics are related to the independent learning of students.

#### 3.3.1.3. Task Analysis

Task analysis is an analysis related to competencies in the curriculum taken. Determination of this competence is based on Permendikbud Number 37 of 2018 concerning Amendments to the Regulation of the Minister of Education and Culture Number 24 of 2016 concerning Core Competencies and Basic Competencies in the 2013 Curriculum in Basic Education and Secondary Education. Competency analysis of course also adjusts to the data obtained from Gembira Loka Zoo. The competencies taken are Basic Competence 3.2, namely analyzing various levels of biodiversity in Indonesia and its threats and conservation efforts, as well as Basic Competence 3.3, namely explaining the principles of classification of living things in the five kingdoms. Based on these competencies, the Competency Achievement Indicator that is expected to be achieved is 3.2.1 describing the concept of diversity of genes, species and ecosystems in Gembira Loka Zoo and the surrounding environment, 3.2.2 analyzing threats and efforts to preserve fauna conservation, and 3.3.1 classify the fauna in Gembira Loka Zoo based on their morphological characteristics.

#### 3.3.1.4. Concept Analysis

Concept analysis is the stage of selecting material concepts to be used in the e-module. The material concept that will be included is the biodiversity of the Gembira Loka Zoo Yogyakarta fauna which has been adapted to the needs of students. The data obtained from Gembira Loka Zoo cannot be used entirely to fulfill the concept of biodiversity, because fauna diversity in Gembira Loka Zoo only fulfills species-level diversity, while genetic and ecosystem-level biodiversity is supplemented outside of Gembira Loka Zoo to complete the biodiversity concept. The concept of biodiversity at the genetic level was obtained from examples of journals on diversity of milkfish in Indonesia and the ecosystem level was obtained from the surrounding environment in the form of river and pond ecosystems with video explanations.

Furthermore, structured interviews were conducted with the Assistant Manager of GL Zoo. The results of structured interviews are used to fulfill the concept of efforts to conserve biodiversity, while most of the threats to biodiversity conservation are obtained from other valid sources, because the results of the interviews only explain that threats to sustainability only occur mostly due to habitat destruction, while there are many other reasons that cause threat to sustainability.

#### 3.3.1.5. Analysis of the specification of learning objectives

Analysis of the specifications of learning objectives is an analysis to formulate learning objectives to be achieved by adjusting the GPA or Competency Achievement Indicators. The learning objectives to be achieved are that students are expected to be able to describe the concept of diversity of genes, species, and ecosystems that are in the Gembira Loka Zoo and the surrounding environment, students are expected to be able to analyze the similarities and differences in fauna that are in the Gembira Loka Zoo based on their



morphological characteristics, as well as participants students are able to analyze threats and efforts to preserve conservation institutions to protect Indonesia's biodiversity.

### 3.3.2.Design

The planning stage is the stage for preparing learning media prototypes. This stage discusses the selection of media and the selection of media formats. The following is an explanation of these stages.

#### 3.3.2.1. Media Selection

Selection of media is a step to determine the appropriate media with learning materials. The selection of media was also adjusted to the era of the industrial revolution 4.0 which has used digital media more than manual, namely by making flipbook-based books in the form of web links and can be opened via mobile phones or laptops by first connecting to the internet (Figure 1). The selection of this media is also a fulfillment of the needs of students regarding their experiences that have never used flipbooks. This media will later include videos of river and pond ecosystems taken from the surrounding environment, besides that there are also various links that can direct students to pages on related material.

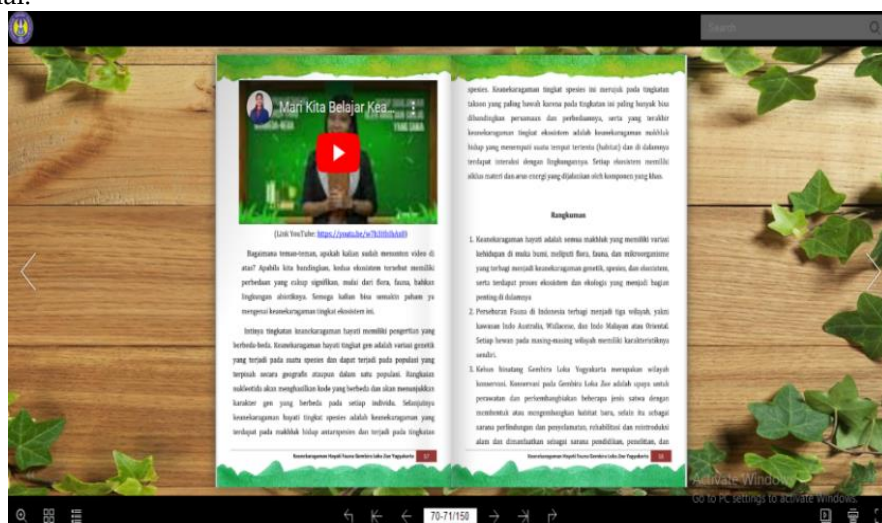


Figure 1. Video views and flipbook links

#### 3.3.2.2. Media Format Selection

The selection of media formats is a step to determine the arrangement and design of e-modules based on a study of existing or developed formats in developed countries. The format of the e-module framework, including the front page, preface, table of contents, list of figures and tables, instructions for using the module, competencies, concept maps, introductory material, learning activities, exercises, summaries, formative tests, answer keys and feedback, glossary, bibliography, as well as author and supervisor biodata (Figure 2). The framework above is then compiled in the form of modules using Ms. Word 2010 A4 size with 2 cm top and bottom margins, and 1.5 cm left and right margins. The font size used is 16 pt. The compiled modules are then formed into flipbooks using the Flipbook PDF Corporate Edition, Publuu, and HTML5 applications. Navigation buttons to complete the flipbook, including a table of contents or table of contents, buttons to view all pages, page turn buttons, buttons to zoom in and out of the screen, search or search buttons, print to print pages, social share to share flipbooks, and autoflip.

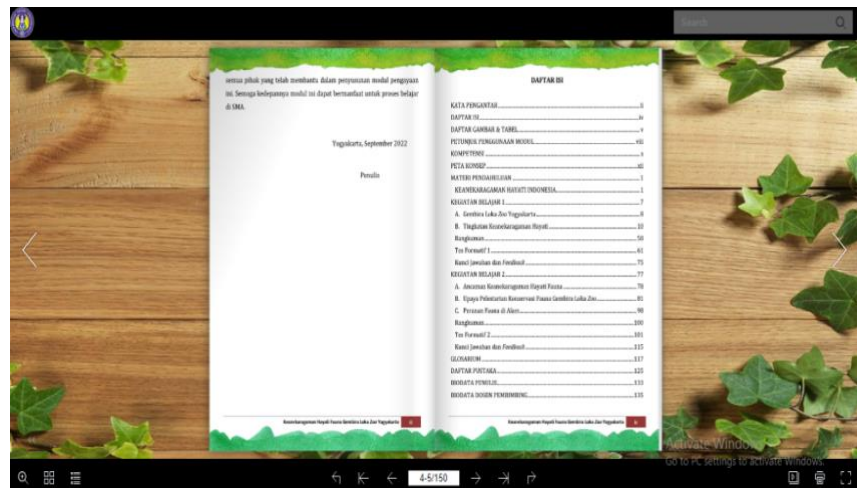


Figure 2. Display of flipbook framework and navigation

### 3.3.3. Develop

The development stage is the stage of producing learning media that has been previously revised by experts, teachers, and students. This stage includes drafting, expert review, stage I revision, review by practitioners, stage II revision, readability test, and final revision. The following is an explanation of these stages.

#### 3.3.3.1. Drafting

Drafting is writing that is adjusted to the framework and systematic media guidelines that have been prepared at the design stage. At this stage, the preparation of sections is carried out according to the planning stage and supports it with other biological concepts to support the discussion of the material in the e-module, thus the e-modules that have been compiled are expected to provide knowledge that is useful, feasible, and of good quality. Figure 3 present the cover of the flipbook draft. The result of making this draft is the initial draft before being reviewed by experts.

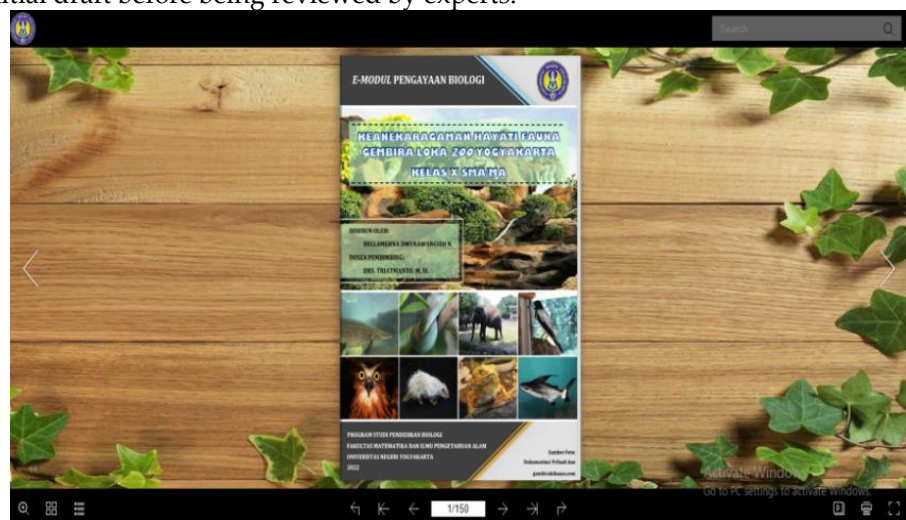


Figure 3. View of the flipbook draft cover

#### 3.3.3.2. Review by Experts

Expert review is editing by experts/experts and followed by revisions. The experts who will review the media are material and media experts with a total of two people each.

#### 3.3.3.3. Phase I Revision

Revisions are made after the assessment instrument sheet is returned. Revisions are corrected based on comments and notes from experts to improve the product. The first is the result of the material expert's assessment. Material experts provide an assessment of the correctness of the concept of material presented in the e-module.



**Table 1.** Material expert assessment results

Reviewer	$\Sigma$ Statement	Options	
		True	False
Material Expert 1	283	253	30
Material Expert 2	283	277	6

**Table 2.** Media expert assessment results

Reviewer	Aspect	$\Sigma$ Statement	Options	
			Yes	No
Media Expert 1	Appearance	9	9	0
	Graphic	10	9	1
	Programming	6	6	0
	Language	10	10	0
Media Expert 2	Appearance	9	9	0
	Graphic	10	10	0
	Programming	6	6	0
	Language	10	10	0

Based on the number of assessment results from [Table 1](#), it is known that according to material expert 1 as many as 30 out of 283 material concepts are declared wrong and from material expert 2 it is known that 6 out of 283 material concepts are wrong. It is known that most of the errors occur in the language structure used. Broadly speaking, the correctness of the concept in the e-module is appropriate, it's just that in some of the sentences used it is incomplete and less communicative, so follow-up or improvement needs to be done to perfect the lacking sentences.

Next is the assessment of media experts. Different from material experts, based on the [Table 2](#) it is known that there is only one answer "no" to the statement items and the rest have fulfilled the statement items but with notes/suggestions for improvement. The statement item answered "no" is a graphical aspect regarding font size. According to the media expert, namely media expert 1, the font used was too small for the specification of the laptop he was using, so as a follow-up, the font size was increased to 16 pt. Overall, both the material and media experts gave a good assessment of the e-module that was made and deserved to be continued at a later stage with revisions according to the suggestions and input given.

#### 3.3.3.4. Review by Practitioners

The next review is a review by practitioners who in this case are educators who teach biology subjects. Educators who will review the product are two Biology teachers from SMA Negeri 1 Godean. The purpose of this review is to avoid errors in the aspects of content, appearance, programming, language, and learning independence.

#### 3.3.3.5. Phase II Revision

Revisions are made after the assessment instrument sheet is returned. Revisions are corrected based on comments and notes from practitioners to improve the product. The results of the questionnaire assessment given by the biology teacher can be seen in the [Table 3](#).

**Table 3.** Biology teacher assessment results

Reviewer	Aspect	Σ Statement	Options	
			Yes	No
Practitioner 1	Content	14	14	0
	Appearance	9	9	0
	Graphic	6	6	0
	Programming	10	10	0
	Learning Independence	7	7	0
Practitioner 2	Content	14	14	0
	Appearance	9	9	0
	Graphic	6	6	0
	Programming	10	10	0
	Learning Independence	7	7	0

Based on the [Table 3](#), overall, the assessment given by the biology teacher to the e-module compiled is feasible for use with all statement items answered "yes", however there are several things that the biology teacher emphasizes regarding the material. The biology teacher asked about the depth of the material given, especially on genetic level diversity material which discussed DNA, as well as ecosystem level diversity material which discussed energy flows and material cycles.

The biology teacher thought that the material was a little broad because it involved genetic material for class XII and ecosystem material for class X, then the biology teacher was given an explanation that the material was a recommendation from an expert which was then reviewed by the expert, the expert even suggested adding material regarding RNA. The biology teacher was also given an explanation that the e-module compiled was an e-module for an enrichment program, so it would not be a problem if the discussion provided was extensive. Indirectly the material in the e-module can become a provision for ecosystem and genetic material. After being given this explanation, the Biology Teacher did not give suggestions/input, because the reasons given were acceptable. Overall, the compiled e-module is feasible to continue the readability test.

#### 3.3.3.6. Product readability test

The product readability test is a readability test for students. This readability test was carried out on 20 students of SMA Negeri 1 Godean Class XI MIPA and Social Sciences, then continued with the last stage of revision. The reason for taking this class is because class XI is a class that has received material on biodiversity in class X.

**Table 4.** Student Table

Aspect	Σ Statement	Statement Number	Options	
			Yes	No
Content	6	4	18	2
Appearance	9	12	19	1
Graphic		14	18	2
Programming	6	21	19	1
Learning Independence	8	-	-	-
Content	7	30	19	1
		31	19	1
		32	18	2
		33	18	2

Aspect	$\Sigma$ Statement	Statement	Options	
		Number	Yes	No
		34	17	3
		35	17	3
		36	18	2

Based on the [Table 4](#), it can be seen that there are several statements that have a "no" answer, so these answers need to be corrected so that they become "yes" later. Aspects that have the answer "no" are aspects of content, display, programming, and independent learning, while there are no aspects of language. Overall, students responded that the Gembira Loka Zoo biodiversity enrichment e-module was good and interesting, it just needed improvement in several related aspects.

#### 4. Discussion

Based on the results of research on the diversity of fauna at Gembira Loka Zoo Yogyakarta, 88 species of fauna were found, consisting of 4 species belonging to the Pisces Superclass and 84 species belonging to the Tetrapoda Superclass, which includes 2 species of Amphibia class, 35 species of Reptile Class, 22 species of Aves Class, and 25 species of Class Aves. species of class Mammalia. The conservation efforts implemented are guided by the SEAZA guidelines, carrying out various health and educational activities, as well as animal breeding.

Furthermore, the results of research at Gembira Loka Zoo are used as the basis for developing e-modules to enrich the topic of biodiversity. According to material experts, media, and practitioners, the feasibility of e-modules is good. Furthermore, according to students, the e-modules are good, readable, and interesting. The feasibility of the e-module is in accordance with the aspects of the book used in the education unit according to the Regulation of the Minister of Education and Culture of the Republic of Indonesia ([Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia, 2016](#)) as well as [Ulumudin et al. \(2017\)](#).

The development of enrichment learning resources has been appointed as the focus of this development research. The development of this learning resources is urgent because of the limited number of enrichments learning resources in schools. In fact, enrichment activities are important activities that need to be carried out after the assessment is carried out. Through enrichment activities, students will be able to learn more broadly and more deeply about the material they have mastered before ([Renzulli et al., 2021](#)). Through enrichment activities, differentiated learning can also be optimally realized ([Kashdan et al., 2018](#)).

The module was chosen as a form of learning resource developed in this study. The selection of modules is based on the usefulness of these learning resources for optimizing learning. With modules, students will be trained to become independent learners ([Nisa et al., 2020](#); [Serrat et al., 2014](#)). Through this kind of independent learning, teachers are able to focus their time on providing treatment to students who need remedy. In addition, by being trained to become independent learners, they have the potential to become lifelong learners ([Oates, 2019](#)).

The modules developed in this study are packaged in electronic form. Modules are packaged in electronic form because currently learning is expected to be based on digital technology developments ([Alyoussef, 2021](#); [Maatuk et al., 2022](#)). Apart from being an implication of the pandemic, technological developments have required teachers to utilize various digital technologies in the learning process ([Kang, 2021](#); [Zancajo et al., 2022](#)). In addition, by utilizing electronic modules, students have more opportunities to become independent learners because they can access learning resources anytime and from anywhere ([Abed, 2019](#); [Sagita & Khairunnisa, 2020](#)). The use of e-module is also reported to be able to improve student learning outcomes, both students in biology ([Kismiati & Nurcahyo, 2018](#)) and other subjects ([Jaenudin et al., 2017](#); [Zakiah & Dwiningsih, 2022](#)).

## 5. Conclusions

This paper has reported the results of research on the diversity of fauna at Gembira Loka Zoo. There are 88 species of fauna consisting of fish, amphibians, reptiles, birds, and mammals. The research results were then developed into an e-module for enrichment activities on the topic of biodiversity. Material experts, media, and practitioners state that the e-module has good feasibility. According to students, the e-modules are good, readable and interesting.

Based on the results of this study, it is hoped that the modules that have been developed can be continued to be used. Product dissemination needs to be carried out and various schools in the Yogyakarta area are also expected to be able to take advantage of this module. Further research which aims to analyze the effect of using this e-module on students' 21st Century competencies is also expected to be carried out.

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