



Development of an Encyclopedia Based on the Local Potential of Batang Gadis National Park (BGNP) as a Learning Resource on Biodiversity for Grade X Senior High School Students

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Abstract

This research aims to develop a biodiversity encyclopedia based on the local potential of Batang Gadis National Park (BGNP) as a learning resource for Grade X students of general Senior High Schools (SMA) and Islamic Senior High Schools (MA). This research is driven by the lack of biodiversity supporting learning resources other than textbooks and student worksheets, where, for every biodiversity material, teachers have to print original pictures of plants/animals along with their morphological characteristics. This research used the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The study was conducted from April to August 2025 at MAN 1 Mandailing Natal. Data collection was carried out through literature review, interviews, and validation questionnaires for material, media, and practicality from biology teachers and students. The data were analyzed quantitatively using a validity formula complemented with criteria, processed through Excel. The research results showed that the material expert validation was 97% (very valid), media expert validation was 100% (very valid), teacher practicality was 97% (very valid), and the small-scale trial of the encyclopedia product obtained a percentage of 94% (very good). Therefore, it can be concluded that the biodiversity encyclopedia of Batang Gadis National Park, Mandailing Natal, is feasible to be implemented as a supplementary learning resource.

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INTRODUCTION

In education, a teaching and learning process will always take place, which results in interaction between educators and students, to achieve the intended learning objectives (Angela & Aprianto, 2018). The achievement of learning objectives is produced by effective learning (Nafsiyah, 2020). According to Alvira et al., (2024), effective learning is influenced by learning models or strategies (Zendrato et al., 2024), learning environment, curriculum, technology, media, learning resources (Achmad et al., 2024), student motivation, and teaching materials (Rozalia et al., 2019). Learning resources are one of the important factors in the learning process (Dewi & Firanti, 2024), because they can facilitate the achievement of learning objectives (Mutuari, 2024). If based on their form or content, learning resources can be classified into places or the natural environment (Yasin, 2016), objects, people, books, events, and facts (Solin et al., 2023). To obtain optimal results, a learning resource must be developed systematically, properly, and functionally.

One of the variations in the development of learning resources that is highly interesting today is the encyclopedia. The encyclopedia is a learning resource that provides visualization, which can attract students' interest in the learning process, by presenting pictures or illustrations along with explanations that help in understanding the studied material, thereby improving learning outcomes (Solin et al., 2023). This is in line with the study of Az-Zahra et al. (2024) titled *Development of a Digital Mini Biology Encyclopedia on the Human Digestive System Based on QR Code to Improve Students' Cognitive Ability*, which showed that the cognitive ability of senior high school students could be improved, with an average pre-test score of 44.28 and a post-test score of 86.88.

In addition, according to Dewi & Firanti (2024), the advantage of using an encyclopedia as a resource is that students can obtain new and in-depth information related to the material or discussion, thereby increasing students' interest and motivation. Furthermore, the encyclopedia is also effective in improving literacy skills and environmental awareness (Tristiyono & Carolina, 2020). However, what needs to be considered is the adjustment of the material in the encyclopedia, where the material must be interesting (Nainggolan et al., 2025). One of the interesting materials in biology learning is biodiversity, because this material is related to Indonesia's vast and diverse natural environment.

One of the utilizations of the natural environment is local potential. According to Endah (2020) local potential refers to the capabilities possessed by a region that can be developed through certain efforts, thereby providing benefits for society, including in the field of education. The utilization of local potential is usually limited to the economic scope, particularly tourism, and is still rarely used in the field of education, especially in Biology subjects (Yasin, 2016). In the Merdeka Curriculum, the use of local potential is highly encouraged (Kemendikbudristek, 2022), because according to Carolina et al. (2022), integrating local potential and applying a contextual approach can enhance students' learning comprehension.

One of the local potentials in Mandailing Natal Regency, North Sumatra Province, is Batang Gadis National Park (BGNP), with an area of approximately 72,150 hectares (Bangun et al., 2009). This national park possesses natural wealth such as tropical rainforests, waterfalls, and wildlife that are still very rarely found and classified as protected species (Egenda, 2024), such as deer, tapirs (Kuswanda & Muhktar, 2010), tigers (Rambe et al., 2021), orangutans, muntjacs (Isa & Evanita, 2024), amphibians (Kaprawi et al., 2020), birds (Siregar & Mutiara, 2019), and others. In addition, there is also a wide variety of plants, such as Rafflesia (Rambe et al., 2019), medicinal and poisonous plants (Rambe et al., 2019), orchids (Hidayati et al., 2019), pitcher plants (Lestari & Lazuardi, 2025), fungi (Marpaung, 2017; Siagian et al., 2021), and many more.

Based on observations of students and interviews with Biology teachers at MAN 1 Mandailing Natal in the 2024/2025 academic year, information was obtained that MAN 1 Mandailing Natal has already implemented the Merdeka Curriculum. During the learning process, teachers more frequently used the lecture method because it was easier, and the learning resources used were student worksheets and textbooks. In certain situations, Biology teachers have to print colored pictures of plants or animals along with their characteristics to support biodiversity materials, because the student worksheets and textbooks used do not contain colored images, which can lead to boredom in students. Moreover, school-based environmental learning is also not supported, because the school environment has been concreted, making it challenging to

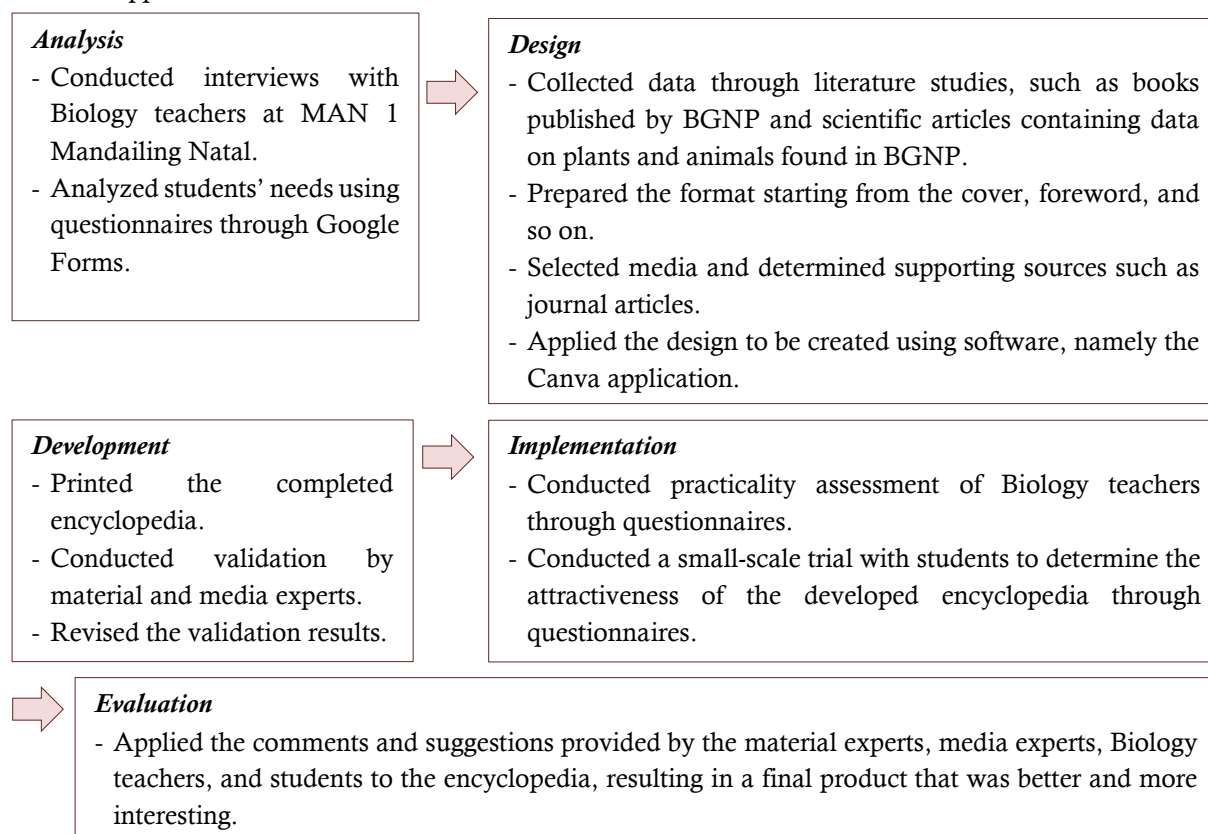
observe plant diversity within the school environment. At the same time, outdoor learning activities also cannot be carried out due to school regulations and policies.

For student learning outcomes, the results were neither high nor low, with an average of 75. Thus, in the aspect of theoretical concepts of biodiversity, students had sufficient understanding, but the essence was not attained, such as recognizing the characteristics of plants and animals. If students were shown the plants directly, such as the bird's nest fern brought directly from the BGNP forest, they would be more enthusiastic and able to recognize the plants around them.

Based on these observations, teachers and students need a learning resource containing the names of plants and animals, complemented with original pictures and their morphological characteristics, as well as general and environment-based conservation efforts. Therefore, this research aims to develop a biodiversity encyclopedia based on the local potential of Batang Gadis National Park (BGNP) as a learning resource for Grade X Senior and Islamic Senior High School students, in a conventional form as a printed book. The purpose of the encyclopedia being conventional is due to the consideration of the local community's economic conditions and the inadequate internet network in several areas, and this is in line with the opinion of Dewi and Firanti (2024), stating that to obtain optimal results, an encyclopedia as a learning resource needs to take into account technological developments, local cultural values, general economic conditions, and the condition of users.

RESEARCH METHOD

The type of research used in this study was Research and Development (R&D), which is a research method employed to validate and develop products (Sugiyono, 2020). The research model applied was ADDIE. The use of ADDIE was chosen because this research model is relatively simple, systematic, and procedural (Sofiyanti, 2023). The ADDIE model consists of the stages of Analysis, Design, Development, Implementation, and Evaluation (Sati et al., 2025). The following are the research stages of the ADDIE model that were applied.



Research Location and Time

This research was conducted at MAN 1 Mandailing Natal, from April to August 2025, with the research subjects being Biology teachers and Grade X Science students of MAN 1 Mandailing Natal (State Islamic Senior High School 1 Mandailing Natal).

Data Collection Technique

The data collection in this research used a descriptive qualitative approach. The techniques used were: 1) unstructured interviews, to identify the problems faced by teachers and students in the teaching and learning process; 2) questionnaires, in this research, including a student needs analysis questionnaire consisting of 15 questions, using the Guttman scale with yes and no answers via Google Form. The material expert validation questionnaire consisted of 11 statements, the media expert questionnaire consisted of 13 statements, the Biology teacher practicality assessment consisted of 11 statements, and the student response questionnaire consisted of 14 statements, all of which used a Likert scale with a range of 1–4; 3) literature study, in which the researcher conducted a literature review on several books published by BGNP, as well as journals and theses related to the research focus.

Research Instruments

The instruments used in this research were non-test instruments in the form of interview sheets and questionnaires, as well as software tools such as Canva, Excel, and Google Form. In addition, the instruments used in general included pens, paper, mobile phones, and laptops.

Data Analysis Technique

The data analysis technique used was validity analysis, which was carried out quantitatively. The validation data from material experts, media experts, and Biology teachers were analyzed by calculating the percentage of product validity as follows (Sofiyanti, 2023)

$$p = \frac{\sum x}{\sum xI} \times 100\%$$

Description

P : percentage

$\sum x$: total score obtained

$\sum xI$: maximum score

100% : constant

To determine the validity criteria of the developed learning resource product, the following product validity criteria were applied (Solin et al., 2023)

Table 1. Product Validity Criteria

No	Validity Criteria	Category	Description
1	85.01% – 100.00%	Very Valid	Can be used without revision
2	70.01% – 85.00%	Valid	Can be used with minor revisions
3	50.01% – 70.00%	Less Valid	Cannot be recommended for use, as major revisions are needed
4	01.00% – 50.00%	Invalid	Cannot be used

The analysis of student responses, with data obtained from the results of student responses, was carried out by calculating the percentage of student responses as follows (Sofiyanti, 2023)

$$p = \frac{\sum x}{\sum xI} \times 100\%$$

Description

P : percentage

$\sum x$: total score obtained

$\sum xI$: maximum score

100% : constant

To determine the criteria for student response scores toward the developed learning resource product, the following student response score criteria were applied (Sofiyanti, 2023)

Table 2. Student Response Criteria

Percentage (%)	Category
82% – 100%	Very Good
63% – 81%	Good
44% – 62%	Not Good
25% – 43%	Very Not Good

The qualitative descriptive data analysis was in the form of criticisms, suggestions, and improvement inputs from material experts, media experts, and Biology subject teachers, which were used for the improvement and refinement of the product.

RESULTS AND DISCUSSION

The development of the Biodiversity Encyclopedia of Batang Gadis National Park, Mandailing Natal, was carried out based on the ADDIE development procedure developed by Robert Maribe Branch, which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation.

Analysis



At the analysis stage, interviews were conducted with Grade X Biology teachers at MAN 1 Mandailing Natal, and student needs questionnaires were distributed through Google Form. Through unstructured interviews with the Biology teacher, a total of 15 questions and answers were obtained. Based on the results of the interviews, the learning resources used did not fully support biodiversity material; the student worksheets and textbooks used only contained black-and-white images with simple explanations; thus, teachers had to print pictures of plants/animals along with their more specific characteristics. In addition, based on school policy, students were also not allowed to conduct outdoor learning activities; thus, they were only introduced to the plants around the school. In the interview, the teacher stated the need for the development of a learning resource containing original pictures of plants and animals, complemented by their morphological characteristics.

Table 3. Results of Interviews with Biology Teachers

Aspect	Indicator	Question	Answer
Learning resources	Obstacles in using previous learning resources	What obstacles did you, sir/madam, face in using them?	If I use other resources, I have to print them, and that sometimes costs money and, in my opinion, is not effective. Moreover, the paper used is easily damaged. In addition, in the student worksheets or books, the pictures are not colored, and sometimes I notice that students become bored.
	Environmental-based learning	Have students ever conducted outdoor learning and direct observation?	In the school environment, mostly just in the classroom yard, but now grass is rarely found because the area has been concreted. As for outdoor learning activities (<i>lintas alam</i>), they have also never been conducted because the school does not permit them.
Learning resource development	Required learning resources	What kind of learning resources do you, sir/madam, need?	I need a learning resource that contains the names of plants and animals along with their morphological characteristics, so that students can easily understand the presented material. It also needs to include conservation efforts based on the surrounding natural environment. After I brought the fern from the forest earlier, students realized that in our forest, there are highly diverse plants and understood how to conserve them.

In the analysis of student needs, data were collected through a Google Form. A total of 17 respondents from Grade X at MAN 1 Mandailing Natal participated. The results of the needs analysis showed that 70.6% of respondents stated that frogs (*Rana*) and toads (*Bufo*) are the same animals, while 58.8% of respondents stated that spike moss (*Selaginella*), true ferns (*Dryopteris*), and bird's nest ferns (*Asplenium nidus*) are different plants. Thus, based on the needs analysis, students were not yet able to distinguish plants and animals based on their characteristics. In addition, 70.6% of respondents preferred learning resources with thematic explanations accompanied by interesting, relevant, and informative pictures.

Table 4. Results of Student Needs Analysis

Aspect	Indicator	Statement	Response Options	
			Yes	No
Material	Biodiversity material regarding the morphological characteristics of plants and animals	 <p>Observe this animal picture! Are the animals mentioned above the same species?</p>	70.6%	29.4%
		 <p>Observe this plant picture! Are the plants above from the same group?</p>	41.2%	58.8%
Learning resources	Students' learning resource needs	I like to use learning resources with thematic explanations accompanied by interesting, relevant, and informative pictures.	70.6%	29.4%

Design

At this stage, data collection was carried out through a literature study, namely by searching for books that had been written and published by BGNP, as well as journal articles containing research data on plants and animals whose existence was confirmed in BGNP, as follows.

Table 5. Literature Study Results from Books and Journal Articles on Plant and Animal Research in TNBG

Author(s)	Year	Title	Type	Findings
Wanda Kuswanda and Abdullah Syarif Muhkta	2010	Management of Terrestrial Large Mammal Populations in Batang Gadis National Park, North Sumatra	Journal Article	Animals found based on the research in TNBG include <i>Arctictis binturong</i> , <i>Catopuma temminckii</i> , <i>Rusa unicolor</i> , <i>Helarctos malayanus</i> , <i>Hystrix brachyura</i> , <i>Manis javanica</i> , <i>Martes flavigula</i> , <i>Muntiacus muntjak</i> , <i>Naemorhedus sumatraensis</i> , <i>Neofelis nebulosa</i> , <i>Panthera tigris sumatrae</i> , <i>Ratufa affinis</i> , <i>Sus scrofa</i> , <i>Tapirus indicus</i> , and <i>Tragulus napu</i> .
Dwi Ratna Anjaning Kusuma Marpaung	2017	Diversity of Basidiomycota Fungi in the Area of Batang Gadis National Park (TNBG), Sopotinjak, Batang Natal District, Mandailing Natal Regency	Journal Article	There are 11 families of Basidiomycota fungi, comprising 18 species, including <i>Polyporus arcularius</i> , <i>Ganoderma aplanatum</i> , and <i>Pleurotus pulmonarius</i> .
Ifham Rambe, Syahlan Siregar, Rommel Fitria Martini, Atos Febrisyahma, Rachmadani	2019	Rafflesia in Batang Gadis National Park	Book	The <i>Rafflesia</i> species found in TNBG are <i>Rafflesia arnoldii</i> , <i>Rafflesia meijerii</i> , and <i>Rafflesia gadutensis</i> .
Nisa Hidayati, Ifham Fuadi Rambe, Afdal Fuad Syam, Syahlan Siregar, Abda Irama Siregar, Hidayat, Ahmad Yani, Dedi Ariska, Riki Susandra	2019	Orchids of Batang Gadis National Park	Book	A total of 54 orchid species are found in TNBG, including <i>Aerides odorata</i> , <i>Appendicula anceps</i> , <i>Bulbophyllum laxiflorum</i> , <i>Bulbophyllum lobbii</i> , <i>Chelonistele sulphurea</i> , <i>Coelogyne xyrekes</i> , <i>Malaxis versicolor</i> , and <i>Oberonia padangensis</i> .
Fajar Kaprawi, Farits Alhadi, Amir Hamidy, Bobby Nopandry, Tom Kirschey, Jarian Permana	2019	Field Guide: Amphibians in Batang Gadis National Park, North Sumatra	Book	A total of 48 amphibian species were found in TNBG, including <i>Duttaphrynus melanostictus</i> , <i>Fejervarya limnocharis</i> , <i>Huia sumatrana</i> , <i>Leptobrachium hendricksoni</i> , <i>Limnonectes kuhlii</i> , <i>Megophrys nasuta</i> , <i>Microhyla heymonsi</i> , <i>Nyctixalus pictus</i> , <i>Odorrana hosii</i> , <i>Sigalegalephrynus mandailinguensis</i> , and <i>Ichthyophis</i> sp.
Ifham Fuadi Rambe, Rinto N.P Rajagukguk, Ihzan Zaki Siregar, Mulliyadi, Yendri Yanto, Liah Maliana,	2019	Biodiversity of Medicinal & Toxic Plants in Batang Gadis National Park	Book	A total of 100 medicinal plant species and 18 toxic plant species were found in TNBG, including <i>Ageratum conyzoides</i> , <i>Clidemia hirta</i> , <i>Donax caniniformis</i> , <i>Plantago mayor</i> , <i>Rubus moluccanus</i> , <i>Selaginella doederleinii</i> , <i>Sida rhombifolia</i> , and <i>Stachytarpheta urticifolia</i> .

Author(s)	Year	Title	Type	Findings
Putri Pulungan, Syalfiani Lubis, Ahmad Junaidi				
Nurul Husna Siregar, Mutiara Siagian	2019	Bird Diversity in Various Habitat Types in Batang Gadis National Park	Journ al Articl e	A total of 28 families, with 66 species, were recorded in TNBG, including <i>Buceros rhinoceros</i> , <i>Dicrurus sumatranus</i> , <i>Enicurus velatus</i> , <i>Pycnonotus aurigaster</i> , <i>Spilornis cheela</i> , and <i>Zosterops palpebrosus</i> .
Sri Mariani Siagian, Husnarika Febriani, Melfa Aisyah Hutasuhut	2021	Exploration of Macroscopic Fungi in Batang Gadis National Park, Resort 7 Area, Mandailing Natal Regency, North Sumatra	Journ al Articl e	A total of 11 families of macroscopic fungi, comprising 32 species, were found, including <i>Amanita muscaria</i> , <i>Marasmiellus candidus</i> , <i>Lignosus rhinoceros</i> , <i>Hygrophorus psittacinus</i> , and <i>Ganoderma applanatum</i> .
Ifham Fuadi Rambe, Ridahati Rambe, Sahlan Siregar	2021	Species Diversity, Abundance, and Wildlife Conservation Status in Batang Gadis National Park, North Sumatra, Indonesia	Journ al Articl e	Animals recorded in TNBG based on the research include <i>Panthera tigris sumatrae</i> , <i>Tapirus indicus</i> , <i>Muntiacus muntjak</i> , <i>Neofelis diardi</i> , <i>Paradoxurus hermaphroditus</i> , <i>Helarctos malayanus</i> , <i>Tragulus kanchil</i> , <i>Sus scrofa</i> , <i>Tupaia glis</i> , <i>Macaca nemestrina</i> , <i>Hystrix brachyura</i> , <i>Apodemus sylvaticus</i> , <i>Lophura ignita</i> , <i>Rollulus rouloul</i> , and <i>Myiomela diana</i> .
Rizki Lestari, Lazuardi	2025	Diversity of Pitcher Plant Species (<i>Nepenthes</i> spp.) in Batang Gadis National Park	Journ al Articl e	A total of 7 <i>Nepenthes</i> species were found in TNBG, namely <i>Nepenthes gymnamphora</i> Nees, <i>Nepenthes tobaica</i> × <i>spectabilis</i> , <i>Nepenthes rhombicaulis</i> Sh. Kurata, <i>Nepenthes rafflesiana</i> Jack, <i>Nepenthes tobaica</i> × <i>rhombicaulis</i> , <i>Nepenthes naga</i> , and <i>Nepenthes tobaica</i> Danser.

Then, several species were randomly selected as representatives, namely three species of *Rafflesia*, six species of *Nepenthes*, eight species of Orchidaceae, eight species of medicinal plants, seven species of macroscopic fungi, eleven species of amphibians, seven species of birds, and nine species of mammals. Subsequently, a description of each species was presented, including morphological description, classification, local name, habitat, distribution, benefits, and behavior. The components included in the Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal, consist of three main parts, namely.

Table 6. Components Included in the Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal

Section	Component	Content
Front Content	Cover	Logo of UIN Sumatera Utara, TNBG logo, images relevant to the research theme, title of the encyclopedia, author's name
	Main page	Words of dedication to the parents and the community of Mandailing Natal
	Preface	Title of the preface, expression of gratitude, a brief overview of the encyclopedia's content, and the main purpose of creating the encyclopedia
	Table of contents	Title of the table of contents and the materials of the encyclopedia to be discussed
Main Content	Introduction to Batang Gadis National Park	Title, general overview of TNBG, including area size, climate conditions, and some protected animals and plants in TNBG
	Rafflesia Plants	Title, general description of Rafflesia, Rafflesia in TNBG (taxonomy, morphology, distribution, and habitat)
	Nepenthes Plants	Title, general description of Nepenthes, Nepenthes in TNBG (taxonomy, morphology, distribution, and habitat)
	Orchidaceae Plants	Title, general description of Orchidaceae, Orchidaceae in TNBG (taxonomy, morphology, distribution, and habitat)
	Medicinal Plants	Title, general description of medicinal plants, medicinal plants in TNBG (taxonomy, morphology, distribution, habitat, and benefits as medicine)
	Macroscopic Fungi	Title, general description of macroscopic fungi, macroscopic fungi in TNBG (taxonomy, morphology, distribution, habitat, and chemical composition)
	Amphibian Class	Title, general description of amphibians, amphibians in TNBG (taxonomy, morphology, distribution, and habitat)
	Aves Class	Title, general description of aves, aves in TNBG (taxonomy, morphology, behavior, distribution, and habitat)
	Mammal Class	Title, general description of mammals, mammals in TNBG (taxonomy, morphology, behavior, distribution, and habitat)
	Conservation Efforts of Biodiversity as Local Potential in Batang Gadis National Park	Title, presentation of several efforts that can be undertaken to conserve biodiversity in TNBG
Closing Content	Glossary	Title, explanation of foreign terms frequently used in the encyclopedia
	References	Title, detailed list of references used in the encyclopedia
	Author Profile	Title, author's picture, and detailed author profile
	Back Cover	Illustration of Bagas Godang Mandailing and words of gratitude

Next, it was applied to the Canva software. In Canva, tools and media that support, such as arrows, colors, graphics, and others, were used.

Development

At this stage, the Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal, was printed, consisting of 130 pages along with the cover, with a size of 22.5 cm × 18 cm. The cover was printed on thick art paper, while the contents were printed on laser-printed construction paper.

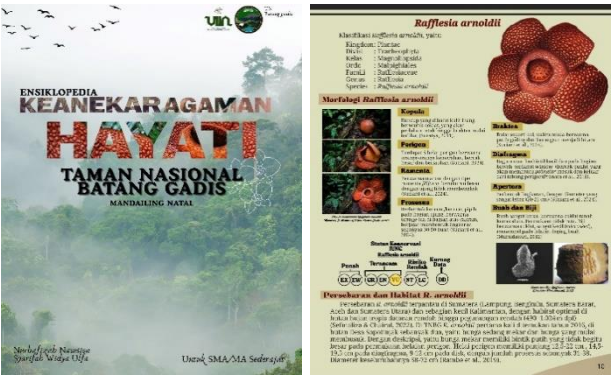


Figure 1. Appearance of the Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal

At this stage, an assessment was also carried out by validators, which aimed to determine the quality of the developed encyclopedia. The validation was conducted on the material and media contained in the encyclopedia. The following presents the data of the material expert validation results.

Table 7. Data Results of Material Expert Validation

Validation Stage	Assessed Aspects				Average	Criteria
	Material Relevance	Material Accuracy	Systematics of Presentation	Supporting Material Presentation		
Tahap I	75%	67%	50%	75%	67%	Less Valid
Tahap II	100%	100%	88%	100%	97%	Very Valid

In the first stage of validation, the aspect of material relevance obtained a result of 75%, the aspect of material accuracy obtained 67%, the aspect of systematic presentation obtained 50%, and the aspect of supporting material presentation obtained 75%. Based on these results, an average score of 67% was obtained, categorized as less valid; therefore, a major revision was recommended. The following are the comments and suggestions provided by the validator in the first stage of validation.

Table 8. Comments and Suggestions from the Material Expert

Validator	Comments and Suggestions
Material Expert Validator	In the anatomical observation of <i>Rafflesia</i> , please add the function of the characteristics of male and female flowers.
	In the morphological structure of <i>Nepenthes</i> , add parts such as the spur, wings, lid, peristome (rim of the pitcher), digestive zone, and tendril. In the general description of <i>Nepenthes</i> , include the concept of its distribution across Sumatra, Kalimantan, Java, and Sulawesi, noting the number of species found in each area.
	For source writing, please include the year of reference and ensure consistency in the citation style; if using <i>et al.</i> , all references must apply <i>et al.</i> , and if using <i>dkk.</i> (the Indonesian equivalent of <i>et al.</i>), all references must apply <i>dkk.</i> .
	All inputs have been included in the encyclopedia product.

Based on the comments and suggestions provided by the validator, the encyclopedia learning resource was revised/improved.

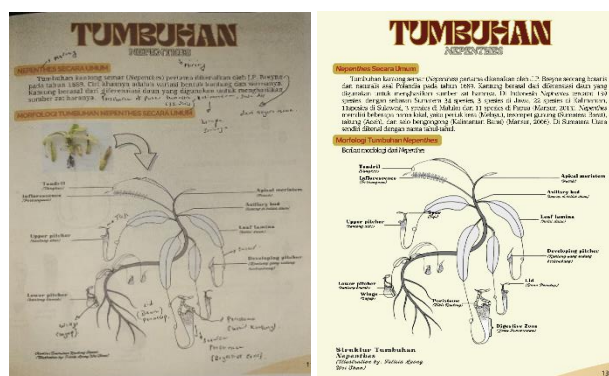


Figure 2. Revision/Improvement of the Encyclopedia Based on the Comments and Suggestions of the Material Expert Validator

After being revised/improved, the encyclopedia was re-validated (stage II) by the same material expert. In the aspect of material relevance, a result of 100% was obtained, indicating that the material had been presented completely, broadly, and in depth (Anggraini, 2022). In the aspect of material accuracy, a result of 100% was obtained, indicating that the concepts and definitions were presented correctly, and that foreign terms and scientific names were accurate (Novera et al., 2022). In the aspect of systematic presentation, a result of 88% was obtained, indicating that the material was organized systematically and sequentially (Anggraini, 2022). In the aspect of supporting material presentation, a result of 100% was obtained, indicating that the preface already contained information related to biodiversity; the glossary was appropriate and complete; and the references were highly adequate. Based on these results, an average score of 97% was obtained, categorized as very valid, allowing it to be used without revision and applied in the learning process (Anggraini, 2022). The material validation was carried out twice to produce a product that met the specified criteria (Mukhtar et al., 2022). After that, validation was conducted by the media expert, and the following presents the data of the media expert's validation results.

Table 9. Data Results of Media Expert Validation

Media Expert Validation	Assessed Aspects			Average	Criteria
	Simplicity	Integration and Balance	Graphics		
	100%	100%	100%	100%	Very Valid

Based on the results of media expert validation, in the aspect of simplicity, a percentage of 100% was obtained, indicating that the encyclopedia already contains sentences that are easy to understand and images that are easy to interpret (Laraswati, 2020). In the aspect of integration and balance, a percentage of 100% was obtained, indicating that the encyclopedia already has appropriate font sizes in each section, suitable image sizes, and a complete table of contents, material, glossary, and references (Laraswati, 2020). In the aspect of graphics, a percentage of 100% was obtained, indicating that the encyclopedia already has attractive images; appropriate selection of fonts, illustrations, and pictures; readable fonts; a balanced and appealing combination of text and background; clear colors; and a layout presentation of the front and back covers that is harmoniously arranged and consistent (Renita et al., 2020). Based on these values, an average of 100% was obtained, categorized as very valid, allowing it to be used without revision and applied in the learning process.

Implementation

At this stage, a practicality assessment was carried out with Grade X biology teachers. The following are the practicality assessment results of Grade X biology teachers.

Table 10. Data Results of the Biology Teacher Practicality Questionnaire

Biology Teacher Practicality	Assessed Criteria				Average	Criteria
	Material Coverage	Content Completeness	Presentation Components	Layout		
	100%	100%	88%	100%	97%	Very Valid

Based on the results of the practicality assessment by biology teachers, in the aspect of material coverage, a percentage of 100% was obtained, indicating that the encyclopedia already contains material that supports biodiversity content. In the aspect of content completeness, a percentage of 100% was obtained, indicating that the encyclopedia already contains content in accordance with the development of students; the content is relevant to references; the content presented can broaden knowledge; and it already presents material from the surrounding/local environment. In the aspect of presentation components, a percentage of 88% was obtained, indicating that the encyclopedia already contains a clear elaboration of content as well as clear material descriptions. In the aspect of layout, a percentage of 100% was obtained, indicating that the encyclopedia already has attractive colors, readable fonts, clear images, and a good and appealing front and back cover design. Based on these values, an average of 97% was obtained, categorized as very valid, allowing it to be used without revision and applied in the learning process (Sofiyanti, 2023).

Then, a small-scale trial was conducted with a total of 12 students from Grade X. At this stage, the students were given a questionnaire sheet and were asked to complete it. The purpose of this stage was to determine the attractiveness and quality of the developed learning resource, so that feedback could be obtained as input for product improvement.

Table 11. Data Results of the Encyclopedia Trial on Students

No	Assessed Aspect	Average Score Percentage	Criteria
1	Appearance	95%	Very Good
2	Supporting Presentation Features	98%	Very Good
3	Language	90%	Very Good
4	Use of Learning Resources	94%	Very Good
5	Content Material	92%	Very Good
6	Usefulness	94%	Very Good
Average		94%	Very Good

Based on the results of the student questionnaire, in the aspect of appearance, an average percentage of 95% was obtained, indicating that the developed encyclopedia already has text and font types that are easy to read, attractive color displays, engaging content, clearly presented material, and highly appealing images. In the aspect of supporting presentation features, an average percentage of 98% was obtained, indicating that the developed encyclopedia already contains illustrations and pictures that are easy to understand. In the aspect of language, an average percentage of 90% was obtained, indicating that the developed encyclopedia already uses language that is easy to understand. In the aspect of the use of learning resources, an average percentage of 94% was obtained, indicating that the developed encyclopedia can assist respondents in distinguishing the morphological characteristics of plants and animals, as well as in easily understanding the benefits of plants. In the aspect of content, an average percentage of 92% was obtained, indicating that the developed encyclopedia already contains material that is easy to understand. In the aspect of usefulness, an average percentage of 94% was obtained, indicating that the developed encyclopedia is already capable of increasing learning interest, fostering motivation, and preventing boredom during learning. Based on these values, an overall average of 94% was obtained, with the criterion categorized as very good. Therefore, it can be used as a learning resource in the student learning process (Musrifah, 2021).

Evaluation

At this stage, based on the comments and suggestions from the material expert, media expert, biology teachers, and students, these were applied to the Encyclopedia of Biodiversity of Batang Gadis National

Park, Mandailing Natal, so that it became a learning resource or final product that is feasible to be used in the learning process.

CONCLUSION

The Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal, which was compiled based on the results of a literature study using the ADDIE development method, obtained a material expert validation result of 97% (very valid), media expert validation of 100% (very valid), teacher practicality of 97% (very valid), and small-scale product trial results of 94% (very good). Based on the validation results and field trials, it can be concluded that the Encyclopedia of Biodiversity of Batang Gadis National Park, Mandailing Natal, is feasible to be implemented as a supplementary learning resource.

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