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COMPILATION OF HERPETOFAUNA CATALOGUE OF THE NGLAGGERAN ANCIENT VOLCANO AREA AS AN ALTERNATIVE LEARNING MEDIA FOR BIODIVERSITY MATERIALS FOR GRADE X SMA/MA

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Abstract. This research aims to (1) determine the feasibility of the herpetofauna catalogue media based on the assessment of material experts and media experts and (2) determine the feasibility of the herpetofauna catalogue media based on the assessment of learning practitioner experts and students. This research employs the Research and Development (R&D) method, utilising the ADDIE model, which is limited to the ADD (Analysis, Design, Development) stage. This research was conducted at the Faculty of Mathematics and Natural Sciences, UNY, with the subjects of this research comprising a material expert, a media expert, a biology teacher in grade X, and 26 students. Data collection was conducted using assessment instruments tailored for media experts, material experts, biology teachers of grade X high schools, and students. These instruments were compiled based on the assessment instruments outlined in high school textbooks, as per the BSNP (National Education Standards Agency) guidelines, and relevant research instruments. Data analysis was carried out descriptively and qualitatively. The results of this research are the Herpetofauna Catalogue of the Nglanggeran Ancient Volcano Area, serving as an alternative learning medium for Grade X high school students on biodiversity material. The developed catalogue has met the feasibility criteria assessed by material experts, media experts, learning practitioner experts, and students. This research is important in providing teachers with alternative learning media that capitalise on local potential. Further research is needed on the effectiveness of the media and the development of a catalogue for a wider range of materials.
Keywords: Biodiversity, Catalogue, Learning media

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INTRODUCTION

Education is a crucial field in ensuring the sustainability of human civilisation (Shafira & Suratsih, 2024). The field of education is at the forefront of developing the quality of human resources (Miranda & Wibowo, 2023). Learning within the educational process fundamentally addresses various aspects of life, including the surrounding environment (Mayasari & Paidi, 2022). The biology learning process embodies the interaction between subjects, namely students, and objects/problems that exist in life (Suratsih, 2010). Therefore, in biology learning, students should study and understand the natural environment to gain direct experience. Biology, as a science, can be identified through natural objects, phenomena, and the scientific process of discovering biological concepts (Nasution, 2010). Based on this essence, the Indonesian biology curriculum teaches biodiversity.

Indonesia is labelled a megabiodiversity country due to its high level of flora and fauna diversity, including herpetofauna diversity (Nurhati & Cordova, 2020). Herpetofauna is a group of animals whose body temperature is influenced by environmental temperature. Herpetofauna consists of reptiles and amphibians. Herpetofauna is one of the important components of the ecosystem (Kusrini, Mardiastuti, & Harvey, 2003). Another important role of herpetofauna is maintaining ecosystem balance, as most herpetofauna act as predators at the food chain level in an ecosystem (Iskandar, 1998), especially in controlling insect populations

(Kusrini et al., 2003). Indonesia has a diverse variety of amphibians and reptiles, estimated to be more than 2000 species, of which many are found in Indonesia. With this number, Indonesia ranks third in terms of reptile diversity wealth (Ministry of National Development Planning/Bappenas, 1993). Iskandar (1998) also mentioned that Indonesia has 450 species of the order Anura (frogs) spread from Sumatra to Papua.

With such a rich herpetofauna, it is imperative to recognise the potential of biodiversity and how to preserve it from an early age. This statement also aligns with the core competency objective of the 2013 Curriculum on biodiversity, which states, "Analyse various levels of biodiversity in Indonesia, including threats and conservation efforts." The implementation of the 2013 Curriculum, Core Competency 3.2, requires students to analyse observational data on various levels of biodiversity, including genes, species, and ecosystems, in Indonesia. Therefore, biodiversity learning in schools emphasises student engagement and direct field observation. However, fieldwork in schools sometimes faces time constraints (Ginting et al., 2024). Therefore, alternative learning resources are needed that incorporate biodiversity phenomena at the gene, species, and ecosystem levels.

One area with potential for herpetofauna diversity is the Nglanggeran area, as indicated by research conducted by Saputro, Boscha, Nainggolan, and Satria (2020) in the Banyu Nibo area. In the area, 15 species of herpetofauna were found. This result is also supported by research conducted by Sulistio, Sancoko, Hasnarani, Dafa, and Triatmanto (2023), who discovered the phenomenon of biodiversity at the gene, species, and ecosystem levels in the Nglanggeran area. Research by Sulistio et al. (2023) revealed the presence of at least 16 species of herpetofauna in the area. Of the 16 species recorded, five belonged to the amphibian group and 11 to the reptile group. This data collection has become a notable example of a biological phenomenon, specifically the phenomenon of biodiversity at the species level. Moreover, in the herpetofauna group, differences in colour and pattern variations are commonly found between individuals of the same species, indicating the presence of biodiversity at the gene level. In addition, the data collection locations identified by Sulistio et al. (2023) included the Nglanggeran Ancient Volcano, characterised by a mountainous ecosystem type, and the Kedung Kandang Waterfall, which features a semi-aquatic ecosystem type. This result further confirms that the Nglanggeran area also possesses ecosystem-level biodiversity.

Data in the form of facts regarding colour and pattern variations, herpetofauna species, and environmental conditions and ecosystem types in the Nglanggeran area from research conducted by Sulistio et al. (2023) are facts that can be processed to develop concepts for biodiversity at the gene, species, and ecosystem levels, as outlined in the 2013 curriculum. However, currently, no research has explored the potential of Nglanggeran's herpetofauna diversity as a learning resource or instructional media.

Putra and Suhartini (2025) explained that to support effectiveness, efficiency, and attractiveness in learning activities, the use of learning media is necessary. Learning media is expected to highlight and document facts and objects found in the field for display in class (Chen et al., 2020). Thus, learning media can overcome space and time constraints during learning. One graphic medium that can be used is a catalogue. The catalogue media were chosen because they contain visualisations of objects, animals, and phenomena, enhanced with information and descriptions tailored to conceptual understanding indicators (Aufa et al., 2021). This catalogue media design can be used to convey biodiversity concepts at the gene, species, and ecosystem levels (Landis & Cieslowski, 2022). This catalogue design features attractive graphics and layouts and can be reused repeatedly. This catalogue prototype was designed to accommodate the developmental characteristics of students.

By utilising biodiversity information in the Nglanggeran Ancient Volcano Area as a learning resource, the authors developed a research-based catalogue entitled "Compiling a Herpetofauna Catalogue in the Nglanggeran Ancient Volcano Area as an Alternative Learning

Media for Biodiversity Material for Grade X Senior High School/Islamic Senior High School." Based on this description, this study aims to determine the feasibility of the product based on assessments by material experts, media experts, learning practitioners, and students.

METHOD

This research employed the research and development (R&D) method. Research and development is a research method used to produce a specific product and test its effectiveness (Sugiyono, 2015). The catalogue development model used was based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model, developed by Robert M. Branch (2009). However, this research was limited to the development stage due to time constraints and the researcher's capabilities.

The research subjects included a material expert (a biology lecturer at a state university in Yogyakarta), a media expert (a biology education lecturer at a state university in Yogyakarta), a learning practitioner expert (a biology teacher at a Muhammadiyah high school in Yogyakarta), and 10th-grade students in the Mathematics and Natural Sciences program at a Muhammadiyah high school in Yogyakarta.

Data collection was conducted using a questionnaire. The questionnaire used an assessment sheet adapted from the National Education Standards Agency (BSNP, 2007; 2014). The instrument was validated by the supervising lecturer using expert judgment (logical and critical validation by the supervising lecturer). The type of data used in this study was qualitative data regarding product feasibility. This data was obtained from assessments, notes, and input from material and media experts during the editing/validation stage. At the same time, the readability test was conducted by the biology teacher and student respondent data was collected. Data on catalogue feasibility were then analysed descriptively and used in Revision I and II as an effort to improve the product being developed. Criteria items deemed satisfactory were retained and visualised, while those deemed unfavourable were followed up based on suggestions and input from material experts, media experts, teachers, and students. Therefore, this study focused on the development of catalogue feasibility. For ease of use, please refer to the diagram in Figure 1.

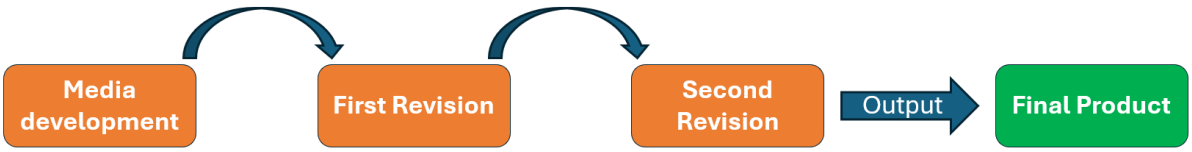


Figure 1. Catalogue development steps

RESULTS AND DISCUSSION

Results

After the learning media have been prepared and drafted, their suitability will be assessed through editing/validation and readability testing. The editing/validation stage involves subject matter experts and media experts, while the readability testing involves learning practitioners and students. This stage is conducted to gather qualitative data and determine the suitability of the learning media in relation to the research objectives. The following are the results obtained from the assessment of four research subjects.

Subject Matter Expert

The assessment by the material experts focused on reviewing the validity of the concepts presented in the catalogue. The material experts also reviewed the presentation and language aspects. The material expert lecturers assessed a total of 64 items. The material experts'

assessments identified several concepts that were not yet appropriate. Furthermore, there were aspects of the presentation that still lacked completeness. The results of the material experts' assessments are presented in Tables 1 and 2.

Meanwhile, in terms of presentation techniques and language, the material expert gave a satisfactory assessment (no improvement required). Furthermore, the material expert provided a suggestion, stating, "There are several points in the content suitability aspect that need to be addressed before the book can be printed and distributed." A visualisation of the material expert's assessment results is presented in Figure 2.

Table 1. Results of corrections to the concept section by material experts

No.	Catalog Section	Suggestion
1.	Understanding Amphibians	The use of the word "alam" needs to be corrected.
2.	Understanding Amphibians and Reptiles	Cold-blooded poikilothermic.
3.	Species Identification	Incorrect scientific names for the Moor Frog, Pearl-tailed Squirrel, and Snail Snake.
4.	Species Identification	Incorrect identification of the Deaf Frog and the Indo-Pacific Gecko.
5.	Species Identification	Incorrect author name rules in the identification book for the Javan Curved-Toed Gecko, Wood Gecko, Maned Chameleon, and Snail Snake.

Table 2. Presentation assessment table by material experts

No.	Suggestion
1.	There needs to be a caption for the image.
2.	There needs to be an arrow that explains the image.

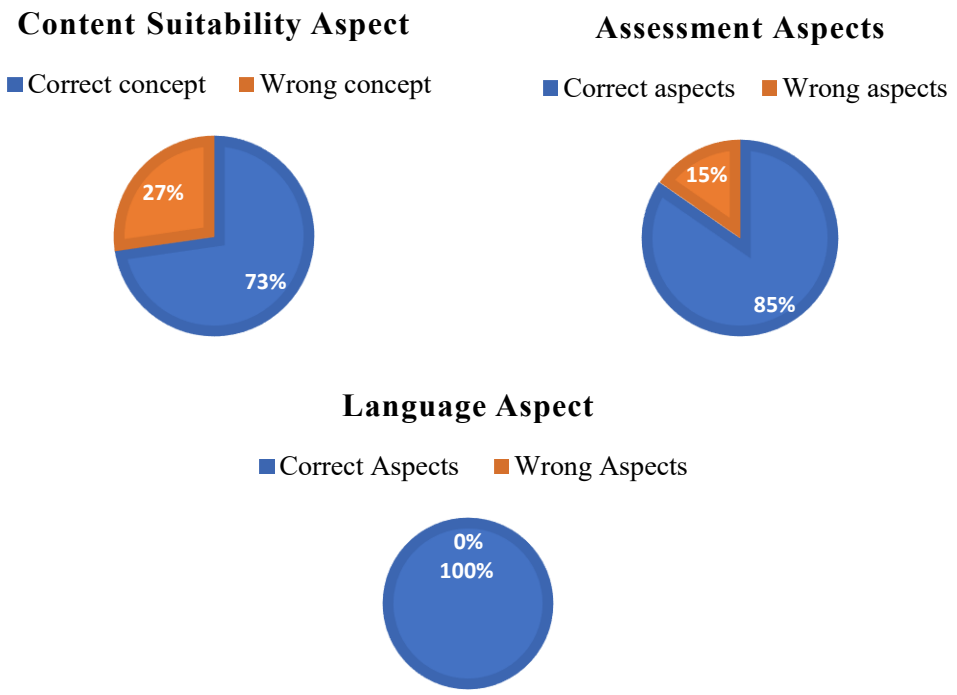


Figure 2. Visualisation of the results of the material expert assessment

Media Expert

The assessment by the media expert consisted of two aspects: presentation and graphics. A total of 22 items were assessed by the media expert lecturer. The media expert's assessment

aimed to review the catalogue design as a whole. The results of the media expert's assessment indicated that the presentation and graphics aspects had been met. However, the media expert still provided input to improve the catalogue's quality. The results of the media expert's assessment are presented in Table 3.

Table 3. Results of media expert assessment

No.	Suggestion
1.	Provide image credits and sources.
2.	Improve image captions.
3.	Some images are too small.
4.	Margins are too close to the page edges.
5.	Fonts should be consistent.
6.	Improve image layout.
7.	Add guidance on reading IUCN labels.
8.	Provide captions for key identification features in species images.
9.	The "User's Guide" section is on a separate page.
10.	There are line errors on the "Reading Guide" page.
11.	There is an inconsistent organisation of descriptions.
12.	Lack of explanation at the end of the book.

The media experts provided the same suggestions as the previous input (repetition). A visualisation of the media expert assessment results is presented in Figure 3.

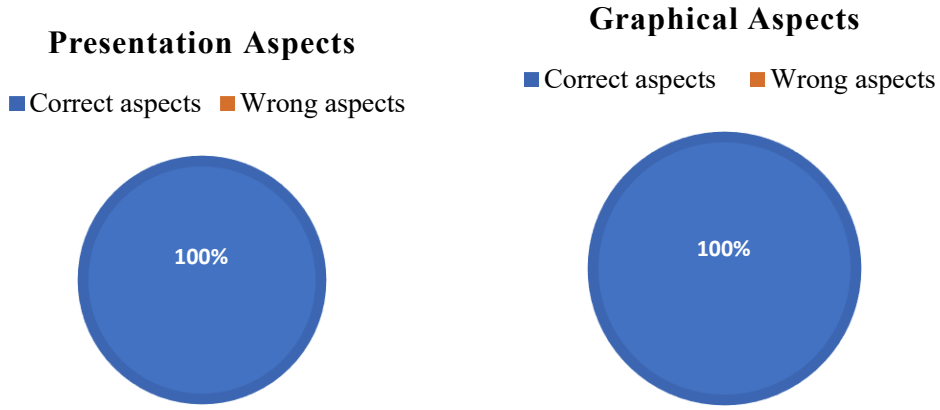


Figure 3. Visualisation diagram of media expert assessment

Practitioner validation

The practitioner expert conducted an assessment to determine the suitability of the catalogue material to the current curriculum. The biology teacher's assessment examined four aspects: content appropriateness, presentation, language, and graphics. The biology teacher assessed a total of 39 items. The assessment results from the learning practitioner expert indicated that the catalogue had been adequately met. However, the learning practitioner expert provided several suggestions for improving the catalogue's quality. The suggestions provided by the learning practitioner expert are presented in Table 4.

Table 4. Suggestion by practitioners

No.	Masukan
1.	There is a lack of pages devoted to biodiversity conservation efforts.
2.	Competency achievement indicator 3.2.7 is still not quite accurate in its verb construction.
3.	Need to add core competency 4.2 along with GPA.
4.	Add competency achievement indicator 4.2.

The advice given by the Learning Practitioner Expert was, “Overall, the catalogue is very good, it just needs a little improvement to be more perfect and more ready to be used as a learning medium.”

Student respons

Student assessments were used to assess the usability of the learning media from a user perspective. The catalogue feasibility assessment was conducted by students in grades 10 and 11 of a senior high school. The student assessment examined four aspects: presentation, language, usability, and graphics. Students assessed a total of 11 criteria. Of the 26 students who responded, 10 provided notes on the catalogue, while 16 others considered it appropriate. The results of the student assessments varied, as summarised in Table 5.

Table 5. Summary of student responses

No.	Suggestions
1.	Images need to be clarified for the species.
2.	Images need to be clarified in the “Guide to Reading IUCN Labels” section.
3.	Images require clarification in the animal morphology section.
4.	The back cover needs additional images.
5.	Some of the language is still simplistic and confusing.
6.	The font is too monotonous.
7.	The frog image on the “Guide to Reading the Book” page is not sharp enough.

Discussion

The editing or validation stage is the stage where competent experts assess the quality of the learning media to determine its suitability and shortcomings. Validation was conducted by two subject matter experts: a biology lecturer from Gajah Mada University and a media expert, a biology education lecturer from Universitas Negeri Yogyakarta. Validation took place from May 15, 2023, to May 23, 2023.

The subject matter experts assessed 64 criteria. The subject matter expert assessment identified 12 material concepts that needed improvement in the content suitability aspect, and two criteria that were not met in the presentation aspect. Discussions with the subject matter experts explained the proper procedure for writing author names: if there is a change in the genus name, the author’s name should be placed in parentheses. If the genus name has not changed from the initial description, the author’s name should be left in parentheses. The media expert's assessment found that 22 criteria were met; however, several notes and suggestions were made for developing the catalogue before its use in the readability test.

Based on the results of the editing process, the validator declared the media suitable for use, although there were several areas for improvement. Therefore, to meet the criteria for a good catalogue as a learning medium, follow-up improvements were made. Improvements to the feasibility aspect, based on the assessment results by subject matter experts, are presented in Table 6.

Improvements to the presentation aspects of the assessment results, as recommended by material experts, are presented in Table 7.

Follow-up actions taken in response to the assessment results by media experts are presented in Table 8.

First Revision

First revisions were conducted based on input and comments from material and media experts. This phase was conducted to refine the learning media before conducting readability tests. The results of the changes to the catalogue section, in accordance with the notes provided, are presented in Table 9.

Table 6. Improvements to aspects of content suitability according to subject matter experts

No.	Catalog Section	Corretion	Follow-up
1	Understanding Amphibians	Use of the word “alam”	Changed to habitat
2	Understanding Amphibians and Reptiles	Cold-blooded poikilotherm	Changed to ectotherm
3	Species Identification	Incorrect scientific names for the Moor Frog, Pearl-tailed Squirrel, and Snail Snake	Correct according to scientific principles (slash)
4	Species Identification	Incorrect identification of the Deaf Frog and the Indo-Pacific Gecko	Not used in catalogues
5.	Species Identification	Incorrect author name rules in identification books for the Javan Curved-Toed Gecko, Wood Gecko, Maned Chameleon, and Snail Snake	Correct according to the rules of researcher name spelling.

Table 7. Improvements to aspects of presentation according to subject matter experts

No.	Correction	Follow-up
1.	There needs to be a caption for the image.	Provide image captions
2.	There needs to be an arrow that explains the image.	Gives arrow directions

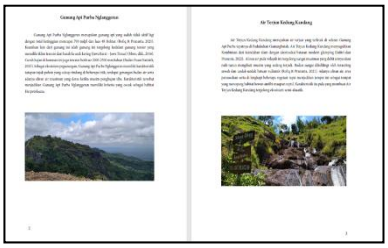
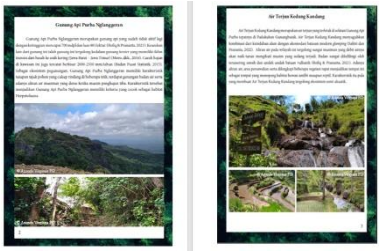
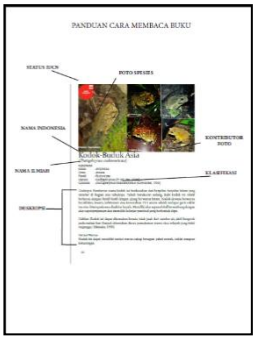
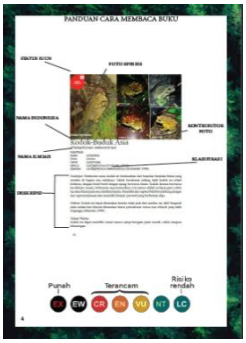
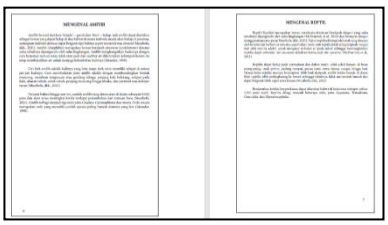
Table 8. Follow-up actions taken based on the results of the media expert assessment

No.	Correction	Follow-up
1.	Provide image credits and sources.	Include photo credits and provide image sources after the bibliography.
2.	Improve image captions.	Some photos are captioned to provide additional clarification.
3.	Some images are too small.	Enlarge and improve image quality.
4.	Margins are too close to the page edges.	Centre the book’s content to widen margins.
5.	Fonts should be consistent.	Standardise the font types and sizes for book content, namely: a. Minion Pro (14) in the introduction and conclusion. b. Minion Pro (18) in the scientific names of species. c. Constantia (15) in the species descriptions. d. Manrope (13) in the species classification. e. Constantia (34) in the local names of species.
6.	Improve image layout.	The image layout has been made more organised.
7.	Add guidance on reading IUCN labels.	The IUCN label reading page is placed after the “book reading guide” section.
8.	Provide captions for key identification features in species images.	Some species have been given arrows to indicate the identification key.
9.	The “User's Guide" section is on a separate page.	This was not possible because it would have left too much blank space.
10.	There are line errors on the "Reading Guide" page.	Editing has been carried out to ensure Accruracy.
11.	There is an inconsistent layout of the descriptions.	The descriptions have been ordered consistently (description → habitat → colour variation → notes).
12.	Lack of explanation at the end of the book.	This was not done at this time due to time constraints.

Readability Test

The revised catalogue was then subjected to a readability test. The readability test is a stage in implementing the catalogue as a learning medium during a limited learning process. This assessment phase utilises expert learning practitioners and students as users.

Table 9. Catalogue changes in the first revision

No.	Before revision	After revision
1.		
	The image is too small and messy.	The image is neater and has been supplemented with key identification instructions.
2.	There are no morphological images.	 Added a morphology image page to help students understand the concept of herpetofauna identification.
3.	 Lack of photos at the research location.	 Addition of photos of research locations.
4.	 There is no explanation on how to read the IUCN label.	 Addition of the IUCN label.
5.	 There are no images of examples of herpetofauna yet.	 Added sample images to clarify the concept of herpetofauna.

The readability test was conducted at a Muhammadiyah high school in Yogyakarta City on May 26, 2023. The readability test was administered to a 10th-grade high school biology teacher and 26 10th- and 11th-grade high school students majoring in mathematics and natural sciences.

Based on the readability test results and assessments by learning practitioners and students, the catalogue media was deemed suitable for use. The biology teacher's assessment indicated that 39 out of 39 important criteria for catalogue development had been met, but constructive feedback was still provided. The feedback focused on the Lesson Plan and Student Activity Sheets. The assessment of the learning tools included a discussion of the appropriate lesson plan writing format and the student worksheet, which was deemed too broad and focused on identifying rather than presenting biodiversity material. Regarding the catalogue assessment, the biology teacher suggested adding material on biodiversity efforts and threats, as well as completing the overall Core Competencies.

There were 11 items to be assessed by students. The results of the student assessment showed that 16 out of 26 students assessed that the important criteria in the catalogue had been met, with no notes or feedback needed. These 10 students consisted of 3 students from grade 11 and 7 students from grade 10.

To meet the criteria for a good catalogue as a learning medium, follow-up improvements were implemented. The following is a follow-up to the assessment results by the learning practitioners and students. The results of follow-up actions carried out based on the expert assessment of learning practitioners are presented in Table 10.

Table 10. Follow-up actions taken based on the results of the responses of practitioners

No.	Suggestion	Follow-up
1.	Lack of pages devoted to biodiversity conservation efforts.	Included a page on biodiversity threats and efforts in Indonesia.
2.	GPA 3.2.7 is still not quite accurate in creating verbs.	Replaced the verb "formulate conservation efforts" with "analyse biodiversity threats."
3.	Need to add core competency 4.2 along with GPA.	Added Core Competency 4.2: "present the results of observations of various levels of biodiversity in Indonesia and proposed conservation efforts."
4.	Add indicators for achieving competency 4.2	a. 4.2.1: Present (C6) a report on the results obtained from observations of genetic, species, and ecosystem diversity.

The results of follow-up actions carried out based on the results of student assessments are presented in Table 11.

Table 11. Follow-up actions taken based on student responses

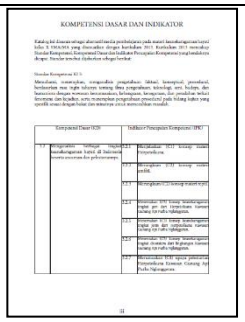
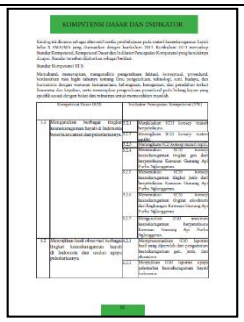
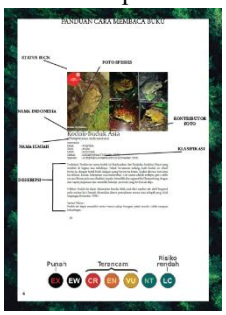
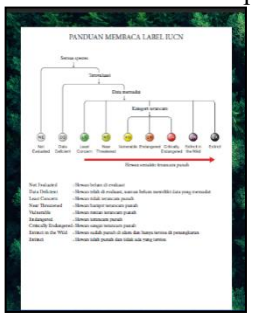
No.	Suggestons	Follow-up
1.	Images need clarification for the species.	Edited images in the descriptions of the Moor Frog and the Striped Climbing Frog to bring them into focus and reduce background noise.
2.	Images need clarification in the "Guide to Reading IUCN Labels" section.	Edited images on the IUCN page.
3.	The images require clarification in the animal morphology section.	Edited images on the morphology page.
4.	The back cover needs additional images.	Added a description of the book's contents and added two images representing amphibian and reptile groups.
5.	Some of the language is still simplistic and confusing.	Improved descriptions and assigned images for the Moor Frog, Pearly Wren, Sugar Gecko, Curved-Toed Gecko, and Wood Gecko.
6.	The font is too monotonous.	The font type and size have been adjusted for consistency, so no changes were made.

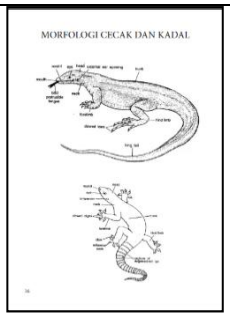
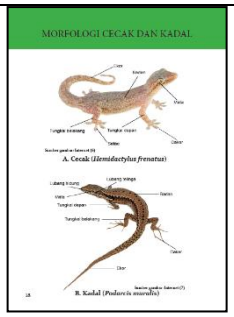
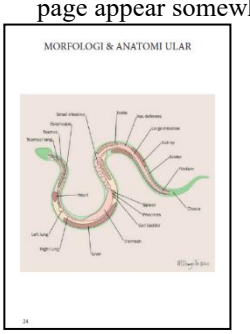
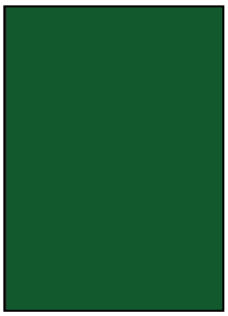
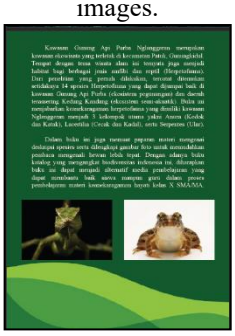
No.	Suggestons	Follow-up
7.	The frog image on the "Guide to Reading the Book" page is not sharp enough.	Tidak diberikan perubahan sebab katak pada gambar hanya berfungsi sebagai contoh.

Second Revision

The final revision was carried out based on suggestions and input provided by the 10th-grade Biology teacher and students during the readability test. These suggestions served as the basis for the catalogue improvements and were incorporated in Revision II. The following is the final revision of the catalogue section, based on the provided notes. Changes to the catalogue in the final revision are presented in Table 12.

Table 12. Catalogue changes in the final revision

No.	Before revision	After revision
1.	 Basic Competencies are not yet complete.	 Basic Competencies have been completed.
2.	 The IUCN explanatory label is too simplistic.	 IUCN label explanations have been made easier to digest
3.	There are no pages that discuss threats and efforts to preserve biodiversity.	 Added pages and biodiversity conservation efforts.

No.	Before revision	After revision
4.	 The photos on the Lacertilia morphology page appear somewhat disorganised.	 Improved image quality and morphological explanation of Lacertilia.
5.	 The explanations of snake morphology are too numerous and broad.	 Snake morphology is kept simple and uses clear images.
6.	 Plain back cover.	 Back cover, including a description of the book's contents and pictures.
7.	 Too many images, too small and unclear.	 The image is made simple and clearer.

After various review results were obtained from research subjects and improvements were made according to their portions in the Revision I and Revision II stages. Thus, the final product was obtained in the form of a Herpetofauna Catalogue for the Nglanggeran Ancient Volcano Area, which is suitable for use as an alternative learning medium for biodiversity materials in class X SMA/MA.

CONCLUSION

Based on the data analysis and discussion that has been described, it can be concluded that the learning media Herpetofauna Catalog of the Nglanggeran Ancient Volcano Area that was

created has met the eligibility criteria to be used as an alternative learning media on biodiversity material for grade X senior high school students based on the assessment of material experts, media experts, learning practitioner experts and 26 grade X students. With the limitation of catalogue development at the Development stage, the prospect of this research can be further developed to the evaluation stage to obtain results regarding the effectiveness of the catalogue learning media.

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