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Fern Diversity in Taman Nasional Gunung Merapi and Its Potency as a Biology Learning Resource

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Abstract. In the kingdom of Plantae, fern (Pteridophyte) is one of the largest and diverse plant group. They are dominant on the forest floor in warm temperatures and high humidity. This research aims: (1) to present the diversity of fern in Taman Nasional Gunung Merapi (TNGM), (2) to analyze the potency of fern diversity in TNGM as biological learning resources and (3) the feasibility of Pteridophyte Photo Sequence as learning media. The research was carried out through observation for identifying anykinds of fern and analyzing the potency of fern diversity as a learning resource, especially to study the Pteridophyte. In order to develop media photo sequence, this research used the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), but it was limited to the step of Development. The result showed that seventy five species of fern have been found in TNGM which is included in the 3 of 4 classes i.e. Lycopsida (8 species), Equisetopsida (1 species), and Pteropsida (66 species). It could be used as learning resource on subtopic of Pteridophyte for high school students in 10th grade based on Biology Curriculum 2013. The feasibility value for media photo sequence of pteridophyte in TNGM showed "very good" category.

1. Introduction

Among the group of plant in the forest that has a fairly high diversity are ferns (Pteridophyta). Indonesia is estimated to have more than 1,300 species of ferns that scattered very broadly [8]. Mountainous areas in general have ferns more diverse than in lowlands, due to the higher humidity and a lot of water flow.

Taman Nasional Gunung Merapi (Mount Merapi National Park) is one of the representative forest ecosystems mountains in Java island that still left. Based on survey of National Park post eruption in 2010, it found approximately 154 type of plants. The highest type of the plant composition was found in low vegetation, such as ferns, orchids, herbs, shrubs, and lianas.

Biology learning resources are every objects or symptoms that can be used to gain experience in solving specific biology problems. Currently, development of biological learning resource is a must in the system of learning that is increase rapidly, along with the development of science [11]. The development of learning resources ranging from environment and nature can still be used as a reliable learning resource to achieve specific learning objectives. Students get to know and observe these kinds of plants, the process of its growth, and benefits for its surrounding. Knowledge gained by observation is easier and faster to understand than the explanations by the teacher [9].

Curriculum 2013 demanding students form the scheme of knowledge to understand, apply and analyze factual, conceptual, and procedural knowledge [6]. Curriculum 2013 through basic competency 3.7 demanding students apply principles of classification to classify plants into division based on observations of plant morphology, metagenesis and relating his role in survival life on earth. The environment is felt more appropriate to use as a learning resource for that topic, because the environment is the main resource of biology learning systems.

Biology learning is essentially an interaction between students with learning objects of living organisms and all aspects of his life. The main constraint in the teaching-learning process is the limitation of biological objects. The distance learning resource and time limitation, it is not possible to do direct observation in the field. This result made the students did not get some of information that can be retrieved based on direct observation. Most of the information has not been obtained with the presence of book packages or student worksheet packets. On the other hand, the theories in the book are sometimes not same with the results of direct observation, as science continues to evolve over time.

Learning media is one of materials that can overcome the limitations of senses, space, and time by showing objects such as those in the field [2]. Learning media can facilitate students to reveal the knowledge or information more easily in learning. Students have an interesting in using the media and easily receive information, it is necessary to use an interesting learning media, simple, compact, and give the description might look like in real with the conditions in the field. Visual-based media is one of the media which filled these criteria [3].

Photo sequence is one of visual-based media form a collection of photos or images that are arranged systematically according to the order of a particular issue. The image was compiled with information and a few interactive questions to invite students thinking. It will help the students get the concept conveyed. The media photo sequence is easier to illustrate the concepts presented and enhancing students interest [1]. Therefore, the ferns of Taman Nasional Gunung Merapi further examined its potential as an alternative learning resource which are then packaged in the form of learning media photo sequence.

2. Research Method

This type of research was Research and Development (R&D). R&D is used to produce a particular product and test the effectiveness of the product [11]. This research was conducted in two stages. The first stage was biology research about identified anykind of ferns in TNGM area. Primary data obtained from sampling method using exploration which was tracing the route of the trail on Bukit Plawangan. While secondary data obtained through documents from previous research about diversity ferns in TNGM area. The second stage was educational research. The results of first stage data were selected in accordance with the competencies in Curriculum 2013, then to develop a media photo sequence. The media development followed ADDIE model. ADDIE model is one of the models used in the instructional design field a guide to producing an effective design. This model is an approach that helps to create an efficient, effective teaching design by applying the processes of the ADDIE model on any instructional product [5]. ADDIE model has five phases, i.e. Analysis, Design, Development, Implementation and Evaluation phase, but in this study used only up to Development phase. The media development procedure could be explained briefly as followed:
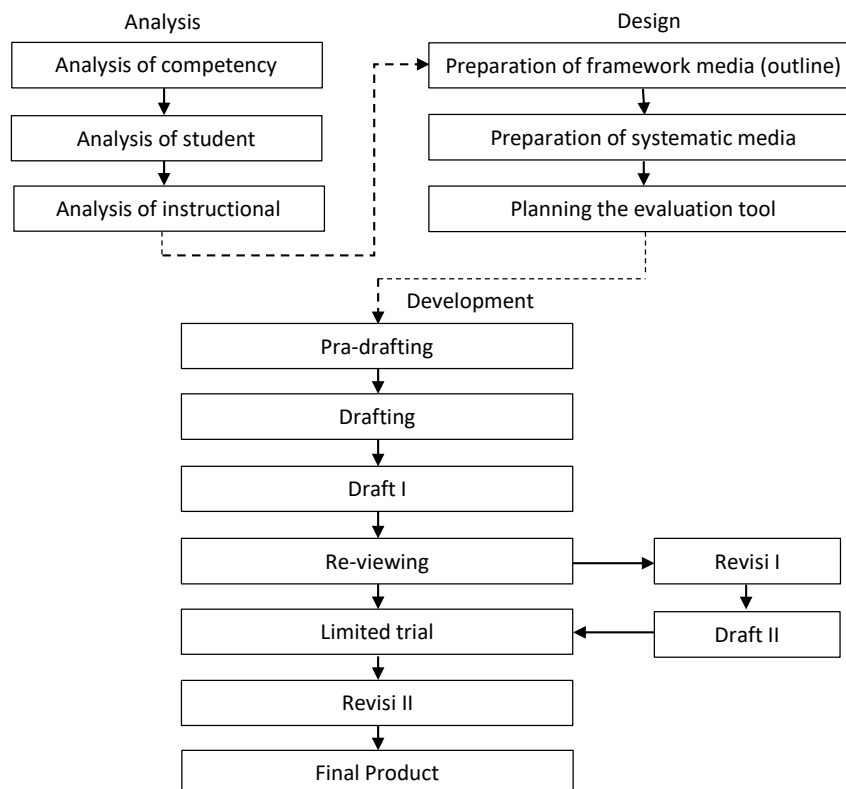
Figure 3. Schematic of media development procedure

2.1. Research instrument

Instrument was review forms about evaluating of learning media. This instruments were used to obtain data on experts opinions and suggestions on the media that have been arranged as the reference/guidance in revising media. The revew results were used as input to revise media enhance learning media developed. The review forms were completed by content experts, media experts, and biology teacher and students

2.2. Analysis data

Qualitative data were obtained from the review results by content experts, media expert, biology teacher, and students' responses. Then, it converted into quantitative data by calculating the average score of each aspect was assessed with the formula:

$$X = \frac{Total\ score\ of\ item\ to-i}{Total\ maximum\ score}\ x\ 100\%$$

The criteria are according to Riduwan [18] :

81 – 100	: very good
61 – 80	: good
41 – 60	: good enough
21 – 40	: not so good
≤ 20	: very poor

The media declared worthy of use if the conversion result are on the category at least enough [5]

3. Results and Discussion

3.1. Diversity of fern species in TNGM

The research identified as many as 21 types of ferns at Bukit Plawangan, in TNGM area. The twenty one species belonging to 2 class were arranged alphabetically in table below. The majority of fern species recorded as Class Pteropsida (16) followed by Class Lycopsida (5).

Table 1. Fern species at Bukit Plawangan, TNGM

No.	Name of the spesies	Family	Class
1.	*Adiantum concinnum*	Pteridaceae	Pteropsida
2.	*Adiantum raddianum*	Pteridaceae	Pteropsida
3.	*Arachniodes aristata*	Dryopteridaceae	Pteropsida
4.	*Athyrium appendiculiferum*	Athyriaceae	Pteropsida
5.	*Christella parasitica*	*Thelypteridaceae*	Pteropsida
6.	*Cyathea contaminans*	Cyatheaceae	Pteropsida
7.	*Davallia canariensis*	Davalliaceae	Pteropsida
8.	*Dipteris* sp.	Dipteridaceae	Pteropsida
9.	*Dryopteris sparsa*	Dryopteridaceae	Pteropsida
10.	*Nephrolepis hirsutula*	Davalliaceae	Pteropsida
11.	*Phymatodes longissima*	Polypodiaceae	Pteropsida
12.	*Phymatodes nigrescens*	Polypodiaceae	Pteropsida
13.	*Pteris biaurita*	Polypodiaceae	Pteropsida
14.	*Pteris ensiformis*	Polypodiaceae	Pteropsida
15.	*Pteris grevilleana*	Polypodiaceae	Pteropsida
16.	*Pteris vittata*	Polypodiaceae	Pteropsida
17.	*Selaginella* sp.	Selaginellaceae	Lycopsida
18.	*Selaginella ornata*	Selaginellaceae	Lycopsida
19.	Var. *Selaginella ornata*	Selaginellaceae	Lycopsida
20.	*Selaginella plana*	Selaginellaceae	Lycopsida
21.	*Selaginella singalanensis*	Selaginellaceae	Lycopsida

In addition, it also performed secondary data collection from the results of other studies regarding identification of the gullies in TNGM area. The secondary data was recorded as many as 63 types of ferns in TNGM area. The twenty one of ferns that were identified from observation at Bukit Plawangan, quite a lot compared to the accumulated results of the research of the identification of ferns in the TNGM area. Overall, types of ferns that were identified were included in the 3 classes of 4 classes. The three classes were Lycopsida, Sphenopsida/Equisetopsida, and Pteropsida. Pteropsida class was the highest species population, followed by Lycopsida class, and Sphenopsida/Equisetopsida class that only consists one species, *Equisetum debile*. The comparison of percentage of each class is presented on Figure 1.
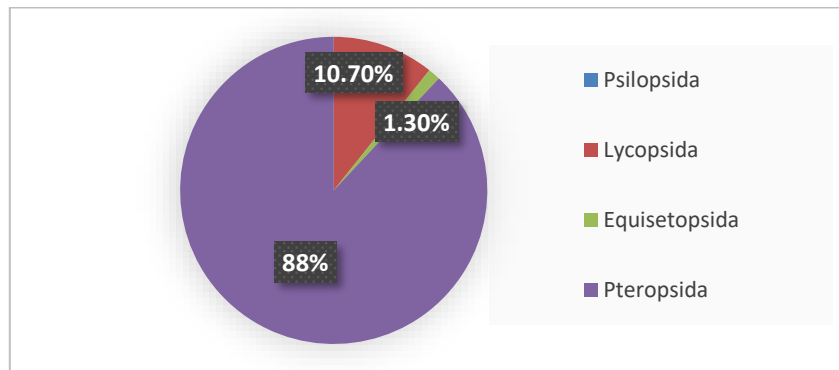
Figure 1. The comparison of Class Psilopsida, Class Lycopsida, Class Equisetopsida, and Class Pteropsida in TNGM

3.2. Potency of fern diversity in TNGM as learning resource

The research result of fern diversity in TNGM has been analyzed its potential as learning resource. The utilization of research results as learning resource was done through some of stages. Stage of identification process and product was done by examining curriculum and the process/research results that are relevant to the problems of biology in high school. Next stage were selection and modification of the research results by presenting primary and secondary data. The secondary data was done to overcome various learning limitations such as ability students, time allocation and school infrastructure for observation. The last stage, application of research results as learning resource was manifested in form of learning media photo sequence for high school students in 10th grade on sub-topic of Pteridophyta.

3.3. Characteristic of photo sequence of pteridophyte in TNGM

Photo sequence was designed and adapted to the basic competencies, indicators of achievement, and the fern material learning characteristics. It contained general morphology of ferns, metagenesis (life cycle) of ferns, classification of ferns, various forms and location of sorus. The photo sequence were display photo of each type of fern (pterydophyte) supported by scientific names, common names, and description. These figures below shows the display of media photo sequence that has been developed.
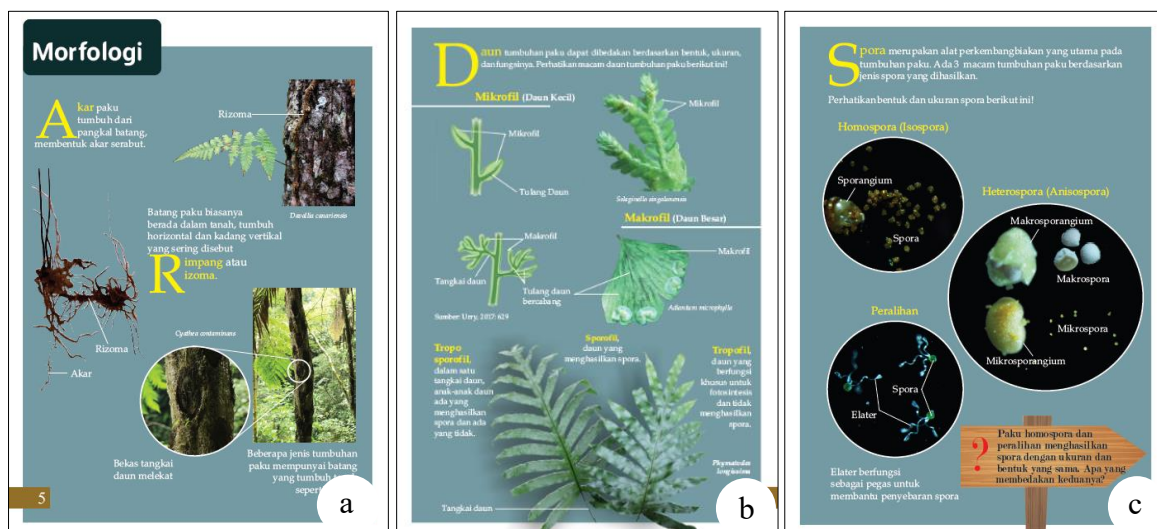

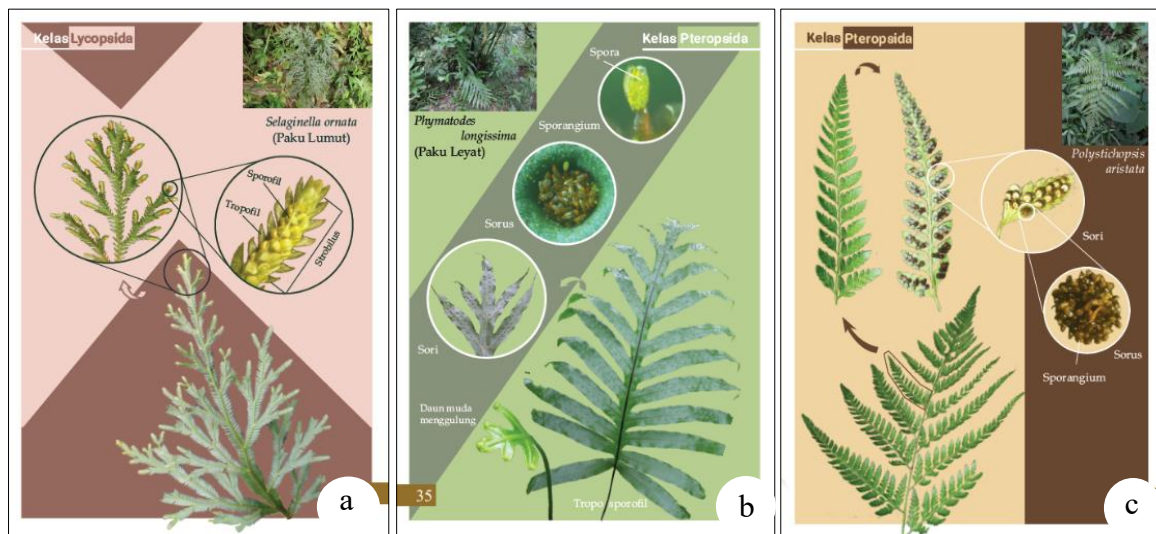**Figure 2.** Display of morphology: (a) *stem and root*; (b) *leaf*; (c) *spora*

Figure 3. Display of fern species in TNGM: (a) *Selaginella ornata*; (b) *Phymatodes longissima*; (c) *Polystichopsis aristata*

3.4. Feasibility of photo sequence of pteridophyte in TNGM

Content experts reviewed from the aspect of truth concept such as concept of metagenesis, morphology, and classification of ferns. Media experts and biology teacher reviewed from aspect of media and aspect of language. Media aspect included cover of media content, appearance, and usability, whereas language aspect included the use of Indonesian language and biology term. These figures below shows the review result of media photo sequence.
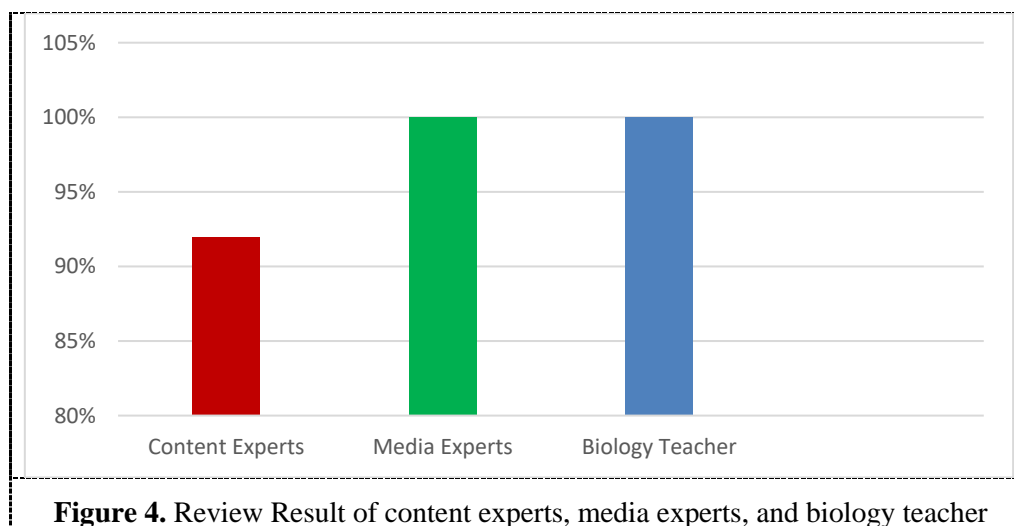

Figure 4. Review Result of content experts, media experts, and biology teacher

From the review result by experts shown in Figure 4 can be taken an average value of review 97,33%. Based on the assessment criteria table, the media photo sequence can be used in the learning process. Several suggestions for media photo sequences is given by the experts such as revision in materials, display (organization pictures and illustrations), and more descriptions. After that, media photo sequence is revised based on their suggestions.

The result of students' responses to the photo sequence of pteridophyta in TNGM can be seen in table 2.

Table 2. Students' Responses to Photo Sequence of Pteridophyta in TNGM

No.	Aspect	Statement	Score (1 – 4)	Percentage (%)
1.		Interesting design cover	3,47	86,75
2.		The font and letter size in the photo sequence are easy to read	3,4	85
3.	Display	Interesting layout	3.67	91,75
4.		The photos and pictures are clear and easy to observation	3,87	96,75
5.		The photos and pictures are interesting to learn	3,87	96,75
6.		The combination of photo/picture and explanatory sentence make easy to understand the concepts presented	3,6	90
7.	Language	The words are simple, straightforward, and easy to understand	3,47	86,75
8.		The words are not ambiguous	3,53	88,25
9.		The terms used are clearly defined and easy to understand	3,27	81,75
10.		Study instructions are clear to understand how to use the media	3,67	91,75
11.		The media gives the direct impression of learning objects in classroom	3,4	85
12.	Usability	Questions and orders train to find the concepts by myself	2,87	71,75
13.		Questions and orders make easier to understand the concepts presented	3	75
14.		The media make the acquaintance of ferns in TNGM area	3,53	88,25
15.		The media is easier to understand about the principles of fern classification based on morphology and metagenesis	3,47	86,75
		Average	3,47	86,62

Students' responses to the photo sequence of Pteridophyte in TNGM has obtained average score 3,47 with maximum score is 4. It is obtained average percentage as 86,62%. The average score of students' responses can be categorized as "very good" to be used in classroom activities for biology learning.

4. Conclusion

There are seventy five species of ferns have been found in TNGM area. They are included in the 3 of 4 classes i.e. Lycopsida (8 species), Equisetopsida (1 species), and Pteropsida (66 species). The fern diversity in TNGM have the potential to serve as learning resources of topic Plantae, especially fern at taxonomic rank of Division and classification of Pteridophyte. The media photo sequence of pteridophyte in TNGM has been drafted fulfilling aspect of content, display, usability and obtain the category "very good". The media photo sequence was declared worthy to help high school students in 10th grade learning biology on sub-topic Pteridophyta.

5. References

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