Research and Development in Education (RaDEn)

Research Article

Development of pteridophyte catarium (herbarium catalog) media in plantae materials for X graders of SMA Islam Batu

Faqih Asshiddiqie [a,1], Mohamad Amin [b,2], Elly Purwanti [c,3], Atok Miftachul Hudha [c,4*], Ahmad Fauzi [a,5]

[a] Department of Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Malang, Jl. Raya Tlogomas No. 246, Lowokwaru, Kota Malang, Indonesia
[b] Department of Biology Education, Faculty of Mathematics and Natural Science, State University of Malang, Jl. Semarang No. 5, Lowokwaru, Kota Malang, Indonesia
[c] Magister Program of Biology Education, Directorate of Postgraduate Program, Universitas Muhammadiyah Malang, Jl. Raya Tlogomas No. 246, Lowokwaru, Kota Malang, Indonesia
[1] faqihasshiddiqie@gmail.com; [2] mohamad.amin.fmipa@um.ac.id; [3] purwanti@ymail.com; [4] atok@umm.ac.id*; [5] ahmad_fauzi@umm.ac.id
* Corresponding author

Abstract: Plantae material is one of the materials that requires a direct observation process to determine the characteristics, morphology, metagenesis, and benefits for the environment, especially in Pteridophyte material. So far, students only use textbooks and students have not been invited to learn with contextual learning objects. Thus, media is needed to facilitate direct observation and identification of plants. The purpose of this research is to produce learning media Pteridophyte catarium (Catalog Herbarium). This type of research is research and development (R&D) with the ADDIE development model. The results showed that the quality of the product according to media experts was very feasible with an assessment percentage of 77.08%, as well as according to material experts who said it was very feasible with a 95% rating percentage. The results of the teacher's response were 79.16% and the results of readability by students on a small and large scale respectively were 76.5% and 81.16%, indicating very decent quality. It was concluded that the product in the form of Pteridophyte catarium learning media was very suitable to be used as a teacher's learning media in Plantae biology learning activities.

Keywords: Catarium; Learning media; Plantae material; Pteridophyte

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1. Introduction

Dynamic global challenges add to the challenges that educators must face (Li & Lalani, 2020; Nithyanantham et al., 2019). The development of human resources with high intellectual abilities is one of the fundamental challenges educators face (Lase, 2019; Suastra et al., 2017). In the 21st century, one of the intellectual abilities is interpreted as higher-order thinking skills (HOTs), which are essential skills needed as a reliable workforce (Sari et al., 2020; Yaniawati, 2013). It is characterized by having creativity (Anwar et al., 2012; Council, 2012), logical reasoning (Kiliç & Sağlam, 2014), being critical (Suarsana & Mahayukti, 2013), careful and having a good personality in solving problems (Halverson et al., 2011; Siew et al., 2016). One way to create human resources that have that things is through education (Lase, 2019; Sudarsana, 2015).

Educational institutions have an essential role in creating skilled and innovative students who also have character (Chu et al., 2016; Miharja et al., 2020; Suryawati & Osman, 2018). Students are expected to compete and become human resources that have high competitiveness after graduating or continuing to the next school level (Mustafa et al., 2016). Therefore, teachers as facilitators have challenges in the form of strategies that will be applied to improve student skills (Christ et al., 2017; Miharja et al., 2019). Sanderse (2013); Stern and Kampourakis (2017) stated that the teacher is one of the foundations for

determining the quality of students' final graduates. Teachers are expected to master the material and be able to manage the class well so that the learning process is active, innovative, creative, effective, and fun (Layyinah, 2017; Suryawati & Osman, 2018; Tompo et al., 2016).

An effective learning process is a process that uses a variety of learning resources (Hudha et al., 2017; Jailani & Hamid, 2017; Nurafifah et al., 2017). The success of the learning process is determined by two main components, namely the methods (Oğuz-Ünver & Arabacioğlu, 2011; Rajendra & Sudana, 2018) and learning media used (Anjarwati et al., 2016). The use of a learning method is related to the type of media used. The use of learning media can help teachers when delivering material and increase the stimulation of students in learning activities (Astuti et al., 2018; Bray & Tangney, 2016).

The selection of learning media needs to consider several criteria. In general, the criteria that must be considered in choosing learning media include learning objectives, target media users, time, characteristics, costs, and availability (Naz & Akbar, 2010). Each learning material has different characteristics. Science subject matter, especially Biology, is a subject that needs a variety of contextual-based media (Andarini et al., 2012; Anstey, 2017; Asrizal et al., 2017). Science learning, especially Biology, should describe the object being studied realistically or factually so that it requires media that can support these learning activities (Fisher, 2016; Nuraini et al., 2016; Peffer et al., 2015). One of the biology learning materials at the high school level is plants about applying the classification principle to classify plants into divisions based on observations and plant metagenesis and linking their role in the survival of life on earth (Permendikbud, 2016).

The observations at Batu Islamic Senior High School shows that teachers still dominate in lessons and still use traditional teaching methods, limited variety of learning media used by teachers. While the students still find it difficult to express their opinions and lazy to do the assignments given by the teacher. The observation results as the basis of needs analysis through student and teacher questionnaires. The observations showed that, on average, students and teachers answered that they had never used learning media in the form of a herbarium. So far, students only use textbooks to deliver material from the teacher in the form of lectures and group discussions. Students have not been invited to learn with contextual learning objects. Learning in applies the principle of classification to classify plants into divisions based on observations and plant meta-genesis and relates their role in the survival of life on earth. In this material, students should be invited to observe and classify plants directly. However, the observation activity was not carried out, so that it required the development of learning media that could support the learning.

Based on these problems, the media developed must facilitate direct plant observation and identification activities. Therefore, the development of media catarium (herbarium catalog) Pteridophyte material for class X Batu Islamic Senior High School was carried out. Catarium is a collection of the herbarium of various types of Pteridophyte, which are collected into one in a catalog. The herbarium is equipped with preserved plants, taxonomic, morphological, ecological, and geographical data. The development of catarium learning media is expected to overcome the problem of not carrying out direct plant observation and identification activities. Catarium was developed based on the 2013 curriculum syllabus.

2. Materials and Methods

The development of catarium media uses the ADDIE model (Figure 1). The final result of this research is the initial product for the phase, which is the initial product for the next phase. The product of research and development in the field of education is catarium learning media. This research was carried out in stages throughout January 24 - May 2018. The subjects of this study were subject teachers and also students of class X science at Islamic Senior High School Batu. The selection of schools was carried out based on the need to use learning media and the willingness of biology subject teachers to develop and implement these learning media.

Data collection techniques using tests and non-tests. The test uses cognitive evaluation questions, while the non-test uses observation and questionnaires. Observations were made by direct observation of the school environment and learning in the classroom, learning media, and a biology laboratory (science) to support learning activities. In addition, a questionnaire technique to collect information about the needs and responses of students and teachers to the learning media was developed. The questionnaire was given to media experts and material experts to test the validity of the learning media as an evaluation of the revision reference before the test.

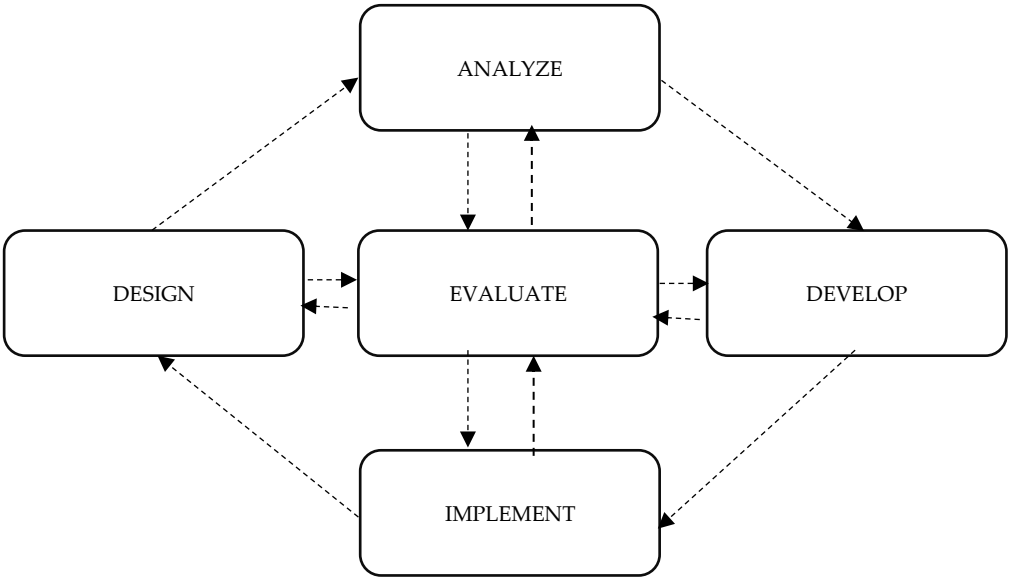

Figure 1. The steps for using the Research & Development Method

The media expert's assessment questionnaire consists of four aspects, including suitability (combination of colors, herbarium layout, and clarity of writing), balance (placement of herbarium plants, plant size, font size, and writing layout), color (background color, writing color, and image color), and linguistics (language accuracy and sentence accuracy). Meanwhile, aspects of material expert assessment include the quality of content, quality of learning, and quality of display. The student response assessment questionnaire is more about how students respond to learning from the perspective of the quality of content and appearance, as well as the quality of learning using catarium.

The design used in the trial was to compare the state of the pretest score and posttest score after learning using the Pteridophyte catarium concerning using pretest and posttest questions. Questions are used to determine the level of students' basic abilities before using the media. The test was carried out 22 times, namely, testing large groups and small groups. The experimental model uses one group pretest-posttest (Figure 2).

O_1	P	O_2
Pretest	Treatment	Posttest

Figure 2. Stages of the ADDIE development model

Quantitative data analysis was carried out on the data obtained from the student response questionnaire scores. The results of the analysis are used to describe the level of student response to learning media. At the same time, qualitative data techniques are used to determine students' responses after using learning media. Quantitative data obtained from the results of the media evaluation questionnaire were arranged based on a Likert interval scale (interval to 4) as in Table 1. Scores and Likert's were calculated for each question item and then converted the average score for each question item.

Table 1. Media scoring criteria

Categories	Score
very good/strongly agree	4
good/agree	3
less/disagree	2
very less/strongly disagree	1

Data validity of all aspects using the formula of descriptive analysis of the percentage. Based on the above calculations, the percentage results of all aspects of media experts, material experts, and teachers, the validity percentage can be converted as in Table 2.

$$P = \frac{f}{N} \times 100\ \% \quad (1)$$

Table 2. Validation criteria

Score Range (%)	Criteria	Information
1 - 25	Not feasible	Not worth it, needs to be revised
26 – 50	Quite decent	Quite decent, needs to be revised
51 – 75	Decent	Eligible, revised as necessary
76 – 100	Very decent	Very decent, no revision needed

Data on student learning outcomes were obtained from post-test scores with individual learning mastery > 76, while the effectiveness of catarium on student learning outcomes was analyzed using the N-gain formula. N-gain score assessment criteria refer to Table 3.

$$N - gain = \frac{Posttest\ score - Pretest\ score}{Max\ score - Pretest\ score} \times 100\ \% \quad (2)$$

Table 3. Data Analysis Techniques

Percentage (%)	Criteria
N-gain > 70	High
30 ≤ N-gain < 70	Medium
N-gain < 30	Low

3. Results

Batu Islamic Senior High School uses the 2013 curriculum in conducting learning. This curriculum requires students to be active in learning activities. Therefore, catarium was developed following the syllabus related to Basic Competencies 3.7, which focuses on developing material about Pteridophyte so that students are directed to a fun learning process. Therefore, the primary material used to develop the media is Plantae with subchapter Pteridophyte, as described in Table 4.

Table 4. Basic competency and indicators

Basic competency		Indicators	
3.7	Apply the principle of classification to classify plants into divisions based on observations and plant metagenesis and relate their role in the survival of life on earth	3.7.2	Distinguish between mosses, ferns, and seeds based on their characteristics.
		3.7.3	Classify mosses, ferns, and seed plants.
		3.7.4	Explain how mosses, ferns, and seeds reproduce.
		3.7.5	Make a chart of mosses' reproduction and life cycle, ferns, and seed plants.
		3.7.6	Finding the role of certain types of Plantae that exist in their environment on the economy and the environment.

The questionnaire questions presented the level of preference for the use of media types. Based on the needs analysis questionnaire, it was found that students have different preferences. The following diagram of the level of preference based on the type of use of learning media is presented in Figure 3.

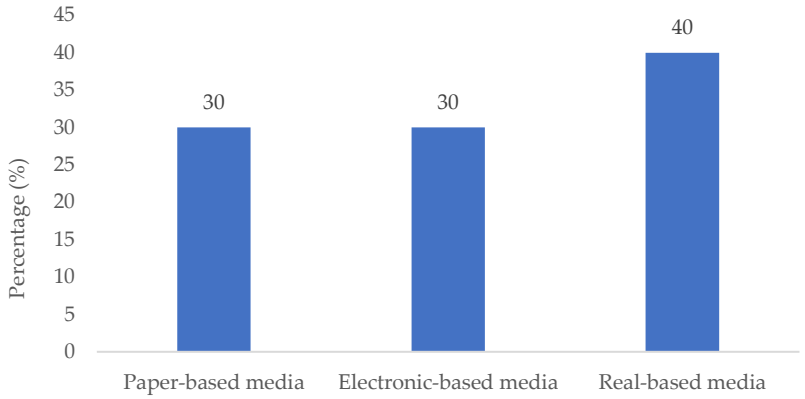

Figure 3. The level of student's preference for the type of learning media

The results of the catarium validation are included in the correct or appropriate category, but some sections need to be revised and completed from the developed media based on suggestions and comments from media experts (Table 5). Comments and suggestions from the expert validators of learning media are used as reference materials to support the improvement of the learning media, namely catarium (Table 6).

Table 5. Validation results by learning media experts

No	Aspect	Before			After		
		(%)	Category	Validation	(%)	Category	Validation
1	Suitability	58,33	Valid	Revision	75	Very decent	Not revision
2	Balance	56, 25	Valid	Revision	75	Very decent	Not revision
3	Color	50	Valid	Revision	83,33	Very decent	Not revision
4	Language	75	Valid	Revision	75	Very decent	Not revision

Table 6. Media expert comments and suggestions

No	Aspect	Comments and Suggestions
1	Suitability	1. Combine color selection to support product legibility. 2. Adjust the placement and attachment of plants to make it more attractive. 3. Adjust the font selection to make it more appropriate.
2	Balance	Add descriptions to each plant specimen and other interesting information
3	Color	Change the background color of the plant specimen holder

Small-scale implementation is done by taking a sample of five respondents. The assessment instrument refers to three aspects: aspects of content and objectives, aspects of display quality, and aspects of learning quality. The data on the results of the module quality assessment are presented in Table 7.

Table 7. The response to catarium as a learning media

No	Aspect	Percentage (%)		Category	Validation
		Before	After		
1	Content and purpose	75	100	Very decent	Not revision
2	Displaying quality	87.5	80	Very decent	Not revision
3	Learning quality	75	75	Very decent	Not revision

The results of the catarium effectiveness test in learning shows that the N-gain score obtained at the small-scale trial stage is 53.3 (medium). Thus catarium is quite feasible or used as a learning support medium. As for the responses from students regarding student learning media, it consists of two aspects, namely aspects of the quality of content and appearance and the quality of learning (Table 8).

Table 8. The quality of learning media based on student responses

No	Aspect	N-gain score		Category
		Small-scale test	Large-scale test	
1	Learning quality	76	80.03	Very decent
2	Content and purpose	77	82	Very decent
Average		76.5	81.16	Very decent

4. Discussion

Analysis of the school environment shows that the learning environment of Batu Islamic Senior High School is quite conducive to support learning. A conducive environment away from the noise is increasingly helpful in the learning process (Council, 2012; Stewart, 1995). In addition, the addition of learning activities outside the classroom adds to the interest in learning in the classroom. However, media analysis shows that the media used is limited to an LCD projector. Therefore, it causes students to feel bored and not interested in participating in ongoing lessons (Almroth, 2015; Criollo-C & Luján-Mora, 2019; Yücel & Usluel, 2016). Therefore, the researchers analyzed the results of the needs of students.

Based on the results of students' needs, it is known that in learning biology on Plantae material, students find it difficult to Pteridophyte sub-material. It is because students feel less satisfied with monotonous learning. The monotonous situation causes students to be unable to concentrate (Siagian et al., 2014), causing learning to decline. The results of the student need questionnaire showed that the most frequently used methods were lectures, discussion presentations, and practical's. As many as 55% of students answered the questionnaire that the teacher used the lecture method, 30% answered the practicum, and 10% answered the presentation discussion. The learning resources used are worksheets, textbooks, and modules. After analyzing the questionnaire, students were presented with questions about learning experiences, especially in Pteridophyte material. Students answered that 73.68% of students had difficulty learning Pteridophyte plants, and as many as 26.31% of students felt that they had no difficulty learning Pteridophyte plant material.

Development and design of Pteridophyte learning media equipped with herbarium from native plants. The first stage is to formulate indicators from the 2013 curriculum by adjusting the essential competencies students must master. Preparation is also based on the needs of the students themselves. The design of objectives and indicators were developed as a solution in solving student learning problems in studying Pteridophyte plants.

The design of catarium is made in several parts, including cover, introduction, the definition of Pteridophyte, breeding of Pteridophyte, division of Pteridophyte class, kinds of Pteridophyte according to class division along with explanations. Test design stage. The design of learning media testing with several stages, including the learning media expert test, the material expert test, and the teacher and student response and readability test.

At the design stage, an assessment instrument was also prepared, which became a reference for the assessment of learning media experts and material experts (Haviz, 2015; Krathwohl, 2002). Evaluation tests for students are also designed to determine the effectiveness of the use of learning media and students' responses to learning media (Kurniasih et al., 2016; Pluta et al., 2013).

The development of catarium uses Adobe Photoshop CC with variations of fonts, backgrounds, and color combinations that are adjusted to support the display aspect to

attract students' interest. This learning media is made to support and help students better understand the material about Pteridophyte plants. Presenting native plants is expected to help students directly observe each Pteridophyte plant's classification, characteristics, and benefits (Halim et al., 2021).

The results of material expert validation show that catarium is included in the excellent category, but some sections must be revised and completed based on input, suggestions, and comments from material experts. Comments and suggestions from expert validators are used as reference materials to support the improvement of the learning media. Improvements in learning media are carried out to get the best results in product development. After the repair phase is carried out, the repair results are validated again (Figure 4).

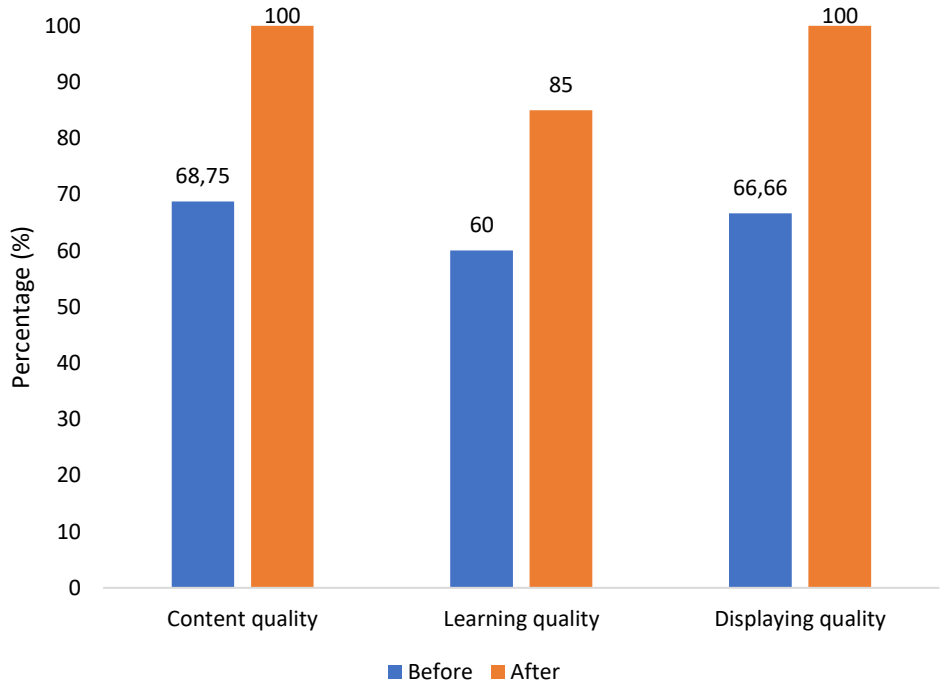

Figure 4. Comparison of material expert before and after revision

The increase in the N-gain score on the small-scale test and large-scale test (Table 8) shows that catarium can be used as a medium in teaching Pteridophyte. Furthermore, a score of 80.03% on the learning quality aspect shows that students feel learning satisfaction while learning to use the catarium. That is very relevant to the results of observations that show that students need more comprehensive learning facilitation. More than that, the depth of content and learning objectives in the catarium that align with the curriculum also play a role in improving the quality of learning because students can learn according to portions and provide space for improving thinking skills.

5. Conclusions

The development results show that the catarium is relevant to the 2013 Curriculum and is feasible or valid as one of the learning media. The results of expert assessments and student responses to readability also show relevant results. The results of the research on material experts are 95% (very decent), media experts are 77.08% (very decent), student readability responses and motivation are 76.5% (very decent), readability questionnaire responses 80.89% of students (very decent). Meanwhile, in terms of the effectiveness of small-scale media, the N-gain value obtained is 53.33% in the medium category, and for

the effectiveness of large-scale media, the N-gain value obtained is 58.9% in the medium category.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. (Methodology, Amin.M; validation, Amin.M., Assidiqie, F., Purwanti, E., Fauzi, A., and Hudha, A.M; analysis, Fauzi, A.; writing—original draft preparation, Assidiqie, F.; review and editing, Assidiqie, F.).

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Conflicts of Interest: Declare conflicts of interest.

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