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Development of Moss Plant Encyclopedia as a Biology Learning Media for Senior High School Students

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Abstract: This research aims to develop an encyclopedia containing the diversity of moss plant species in Selarong Cave as a learning medium and to determine the feasibility and practicality of an encyclopedia of moss plants (Bryophyta) as a biology learning medium. Product development research includes Research and Development (R&D) research using the four-D (4D) development model which is limited to the development stage. The encyclopedia that has been developed is then validated with assessment instruments including validation questionnaire sheets and student response questionnaires. Data analysis uses qualitative data analysis techniques which are then converted into quantitative data. The encyclopedia assessment was carried out by 1 material expert, 1 media expert, 1 biology teacher, and 15 class X students of SMA N 1 Pajangan. The results of validity tests by material experts and media experts show validity so that the product is declared feasible. The results of validity tests by teachers and students show validity so that the product is declared practical. The encyclopedia of moss plants (Bryophyta) in the Selarong Cave area was declared suitable and practical to use as a biology learning medium.

Keywords: Encyclopedia, learning media, four-D, feasibility and practicality.

Introduction

Bryophytes are included in the study of biology studied at the senior high school level or equivalent in the biodiversity material of the plant kingdom sub chapter. Based on interviews with biology teachers in high schools in the Bantul district, there are difficulties in learning material about moss plants. In the independent curriculum, the material about moss plants is not studied in detail so that students have difficulty knowing the differences between moss plants and other plants. Coupled with the small body size of moss plants, it is increasingly difficult to identify. Students have difficulty in understanding biology material due to the lack of visualization of the form and examples of the object of study studied. This is in accordance with what was conveyed by (Zarisma et al., 2016), that in the material of the plant world students have difficulty classifying and identifying the general characteristics of a plant.

In order to overcome students' learning difficulties in moss plant material, learning media is needed that contains images and detailed information that can make it easier for students to learn the material. One of the learning media that contains images and information that can be developed is an encyclopedia. Encyclopedia is a writing that contains complete information arranged alphabetically and then printed in book form (Fadhilah et al., 2022). Encyclopedia can be used as an alternative learning media in biology subjects, especially moss plant material.

In the encyclopedia of moss plants, original images of various types of moss plants will be displayed. Images of moss plants that are displayed can make it easier for students to identify and know the visualization of various types of moss plants. With well-presented images,

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it can attract students' attention and support the biology learning process (Cahyanti & Ibrahim, 2018). Based on these problems, it encourages researchers to conduct research on developing an encyclopedia of moss plants (Byophyta) as a biology learning media.

Material and Methods

The materials used in this research are photos of various types of moss plants found in the Selarong cave area. Photos were taken directly using a digital camera to get good results. After the pictures are taken, the moss plants are identified and classified then the photos and information are presented in the form of an encyclopedia. The encyclopedia was created using the canva application through a laptop.

The research method used is R&D (Research and Development) development research. In the field of education, Research and Development or development research is used to develop and validate products needed in education and learning (Hanafi, 2017). The research model used in this development research uses the 4D model (Four-D Models). The 4D model was chosen because the stages are not too complex so the time required is relatively short (Hasanah et al., 2017).

According to Thiagrajan, in (Maydiantoro, 2021) the 4D model consists of four stages of development. The first stage is define or needs analysis stage, the second stage is design or preparing the conceptual framework of learning devices, the third stage is develop or assessing the feasibility of media and the last stage is disseminate or implementation on research subjects.

Encyclopedia Development

The details of the stages of encyclopedia development with the 4D model are as follows:

1. Define Stage

Based on the results of interviews obtained that the availability of learning media in schools, especially for biology subjects is still limited. The availability of printed learning media is also still small and learning media is needed that displays visualizations or images of biological objects. So learning media is needed that can support the running of biology learning with the criteria of loading images of objects to be studied and containing information that is conveyed interestingly.

The concept used by teachers at SMA N 1 Pajangan uses an independent curriculum. In the independent curriculum there are learning outcomes that must be achieved in each phase or grade level. In class X or called phase E. In this section, researchers take learning outcomes regarding understanding the diversity of living things and their roles. This is in accordance with the problems regarding the lack of student interest and understanding of biodiversity material, especially the moss plant (Bryophyta). The product developed by researchers contains material about the diversity of moss plants and their benefits and roles. In addition, there is also a classification of moss plants.

2. Design Stage

At this stage, researchers chose learning media in the form of print media with an initial design including a cover, the initial part of the encyclopedia which contains an overview of the moss plant encyclopdia, the core part of the encyclopedia which contains material about moss plants and there are evaluation questions in the form of multiple choice and esay, and the closing part.

3. Develop Stage

The development stage is the stage taken to create a product. At this stage consists of the process of making a product then the product will be assessed and tested. The two steps of assessment and trial, namely expert appraisal accompanied by revision and delopmental testing (development trial). Before the assessment at this stage contains the steps of making an esniklopedia using Canva software.

Figure 1. Steps for designing an esniklopedia using canva software

Feasibility and Practicality Test of Encyclopedia

The encyclopedia feasibility test was carried out by material experts and media experts while the encyclopedia practicality test was carried out by biology teachers and 15 class X high school students as users of the moss plant encyclopedia (Bryophyta). The instrument used was a questionnaire. The data obtained are qualitative data and quantitative data. Qualitative data is obtained from the results of Likert scale assessment based on the assessment by material experts, media experts, biology teachers, and students. According to Sugiyono (2010) in (Fendya & Wibawa, 2018) the Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people regarding social phenomena. This social phenomenon has been determined by the researcher which is then referred to as the research variable.

In this study, statements by material experts, media experts and teachers are as follows; SB: Very Good, B: Good, C: Enough, K: Less, and SK: Very Lack. While qualitative data from the results of student responses as follows; SS: Strongly Agree, S: Agree, KS: Less Agree, TS: Disagree and STS: Strongly Disagree. Then for quantitative data can be seen in the following table:

Table 1. Quantitative data scoring guidelines from the assessment results of material experts, media experts, and teachers.

Criteria	Score
SB (Very Good)	5
B (Good)	4
C (Enough)	3
K (Less)	2
SK (Very Lack)	1

Table 2. Guidelines for scoring quantitative data from student assessments.

Criteria	Score
SS (Strongly Agree)	5
S (Agree)	4
KS (Less Agree)	3
TS (Disagree)	2
STS (Strongly Disagree)	1

From the data that has been obtained, data analysis is then carried out by conducting validity and reliability tests using the following formulas:

Test the validity of material experts, media experts, and biology teachers with Aiken's V formula:

$$\mathbf{V = \sum \frac{s}{(n(c-1)}, \text{ with } S = r - lo}$$

Description:

V: content validity index

r: rating given by the appraiser / score from the appraiser

lo: lowest assessment rating

n: number of raters / validators / assessors

c: number of rating categories

Item scores can be said to be valid if the analysis results show that each question given shows a V value ranging from 0 - 1 or adjusted for the number of validators (Abhi Purwoko et al., 2021). In this study using the validity criteria as follows:

Table 3. Criteria guidelines for validity score results.

Validity Score	Criteria
0,80 – 1	very high validity
0,60 – 0,79	high validity
0,40 – 0,59	medium validity
0,20 – 0,39	low validity
0,00 – 0,19	very low validity

Then to calculate the validity test of student responses, it was carried out using the Pearson product moment formula assisted by the Office Excel program with the benchmark for the instrument declared valid if r count> r table and a significant level of 0.05. In this study using the r table value of 0.514 because the respondents

amounted to 15 students (Astuti et al., 2023). The student validity test formula is as follows:

$$\text{r count} = \frac{n\sum xy-(\sum x)(\sum y)}{\sqrt{(n\sum x^2-(\sum x)^2(n\sum y^2-(\sum y)^2)}}$$

Description:

Rxy: correlation coefficient between item value and total value

n: number of respondents

∑xy: the number of multiplication results between the value of the question items and the respondents

∑x: the total number of scores per question item

∑y: the number of respondents' scores

∑x2: the sum of the squares of the values per question item

∑y2: the sum of the squares of the respondents' values

After the validity test is carried out, the reliability test is carried out with the Alpha formula from Cornbach. The Alpha formula is used to calculate the reliability of instruments whose scores are not only 0 and 1 but also a polytomous scale, for example a questionnaire with a Likert scale of 1 - 2 - 3 - 4 - 5 (Retnawati, 2016). Cornbach's Alpha formula is as follows:

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum \sigma i\, 2}{\sigma t\, 2}\right)$$

Description:

◎ : instrument reliability coefficient

k: number of questions in the instrument

∑ σi2 : total variance of instrument items

σt2 : total score variance

Decision making on the following basis:

Table 4. Guidelines for making decisions on the value of Cornbach's Alpha.

Cornbach's Alpha Score	Decision
> 0,70	Reliable
< 0,70	Not reliable

Data or instrument values that have been tested for validity and reliability can be calculated as a percentage of feasibility and practicality if they get valid and reliable results. The percentage of feasibility and practicality can be calculated using the following formula:

$$Idealized\ Percentage: \frac{Skor\ PerolehanAcquisition\ Score}{Ideal\ Highest\ Score}\ x\ 100\%$$

Table 5. Guidelines for the percentage scale of feasibility for material experts and media experts.

Assessment Percentage (%)	Interpretasi
81 - 100	Very Decent
61 – 80	Feasible
41 – 60	Fair
21 – 40	Less feasible
0 - 20	Not Feasible

Table 6. Practicality percentage scale guidelines for biology teachers and students.

Persentase Penilaian (%)	Interpretasi
81 - 100	Very Practical
61 – 80	Practical
41 – 60	Fair
21 – 40	Less Practical
0 - 20	Not Practical

Results and Discussion

Feasibility Assessment by Material Experts

Table 7. The results of the validity test by material experts.

No	Aspect	Question Item Number	V Skor	Description
1.	Feasibility of material / content	1 – 5	0,85	Very high validity
2.	Presentation of material	6 – 9	0,93	Very high validity
3.	Language	10 - 12	0,75	High validity
	V score all aspects		**0,85**	**Very high validity**

The results of the validity test from the material expert get a value of 0.85. This figure is in the range of 0.80 - 1 so that the instrument can be said to be valid. After that, calculate the reliability with the results that can be seen in the following table:

Table 8. Reliability test results by material experts.

Cornbach's Alpha Test Result	Decison
0,80	reliable

The value of the calculation results with Cornbach's Alpha shows a number of 0.80 where the number is greater than 0.70 so that it can be said to be reliable. After getting valid and reliable results, the product can be said to be feasible with a percentage as in the following table:

Table 9. Results of feasibility assessment by material experts.

No	Aspek	Skor Max	Perolehan Skor	Persentase (%)	Kelayakan
1.	Feasibility of material / content	25	22	88%	Very Feasible
2.	Presentation of Material	20	19	95%	Very Decent
3.	Language	15	12	80%	Very Feasible
Total		**53**	**60**	**88,33%**	**Sangat Layak**

Based on the table above, the percentage of feasibility is 88.33% or it can be said that the product is very feasible. According to the material experts, the overall content of the encyclopedia is good and the information presented is sufficient to increase students' knowledge. However, there are some errors in the writing of species names and the meaning of foreign terms that are not yet precise so that justification is needed so as not to cause misconceptions.

Feasibility Assessment by Media Experts

Table 10. Results of validity test by media experts.

No	Aspek	No butir soal	Nilai V	Keterangan
1.	Size of encyclopedia	1 – 2	1	Very high validity
2.	Cover design	3 - 6	0,93	Very high validity
3.	Content design	7 - 12	0,91	High validity
4.	Print quality	13 - 15	1	Very high validity
Nilai V keseluruhan aspek			**0,95**	**Validitas sangat tiggi**

The validity test results from media experts get a value of 0.95. This figure is in the range of 0.80 - 1 so that the instrument can be said to be valid. After that, calculate the reliability with the results that can be seen in the following table:

Table 11. Reliability test results by media experts.

Hasil Uji Cornbach's Alpha	Keputusan
1,00	reliable

The value of the calculation results with Cornbach's Alpha shows the number 1.00 where the number is greater than 0.70 so that it can be said to be reliable. After getting valid and reliable results, the product can be said to be feasible with a percentage as in the following table:

Table 12. Results of feasibility assessment by media experts.

No	Aspek	Skor Max	Perolehan Skor	Persentase (%)	Kelayakan
1.	Size of encyclopedia	10	10	100%	Very Feasible
2.	Cover design	20	19	95%	Very Decent
3.	Content design	30	28	93,33%	Very Decent
4.	Encyclopedia print quality	15	15	100%	Very Feasible
Total		**53**	**60**	**96%**	**Sangat Layak**

Based on the table above, the percentage of feasibility is 96% or it can be said that the product is very feasible. According to media experts, the overall appearance of the encyclopedia is good and interesting to use as learning media. However, there are some corrections to the layout and composition used. These inputs and suggestions are given so that the appearance of the encyclopedia has better proportions.

The validity and reliability tests carried out by material experts and media experts on the instrument were carried out to measure the data obtained were valid or not. After obtaining valid and reliable results, the instrument can be said to have measured the actual thing. In this case, what is measured by material experts includes aspects of material/content feasibility, material presentation, and language. For media experts, they measure the design aspects and print quality of the encyclopedia. If the results of the validity test show a high validity value and are reliable, the product developed can be said to be feasible (Turnip et al., 2021).

Results of the Authenticity Test by Biology Teacher

Table 13. Results of validity test by biology teacher.

No	Aspek	No butir soal	Nilai V	Keterangan
1.	Feasibility of material / content	1 – 3	0,91	Very high validity
2.	Presentation of material	4 – 7	0,75	High validity
3.	Language	8 – 10	0,75	High validity
4.	Size of encyclopedia	11	0,75	High validity
5.	Encyclopedia display	12 - 18	0,82	Very high validity
Nilai V keseluruhan aspek			**0,80**	**Validitas sangat tiggi**

The results of the validity test from the biology teacher get a value of 0.80. This figure is in the range of 0.80 - 1 so that the instrument can be said to be valid. After that, calculate the reliability with the results that can be seen in the following table:

Table 14. Reliability test results by biology teachers.

Hasil Uji Cornbach's Alpha	Keputusan
0,74	reliable

The value of the calculation results with Cornbach's Alpha shows a number of 0.74 where the number is greater than 0.70 so that it can be said to be reliable. After getting valid and reliable results, the product can be said to be practical with a percentage as in the following table:

Table 15. Results of practicality assessment by biology teachers.

No	Aspek	Skor Max	Perolehan Skor	Persentase (%)	Kepraktisan
1.	Feasibility of material / content	15	14	93,33%	Very Practical
2.	Presentation of material	20	16	80%	Practical
3.	Language	15	12	80%	Practical
4.	Size of encyclopedia	5	4	80%	Practical
5.	Encyclopedia display	35	30	85,7%	Very Practical
Total		**90**	**76**	**84,44%**	**Sangat Praktis**

Based on the table above, the percentage of practicality is 84.44% or it can be said that the product is very practical. According to the assessment of the biology teacher, the overall encyclopedia of moss plants (Bryophyta) in the Selarong Cave area is good and can be used as a biology learning media in schools, especially for class X. However, it needs to be checked again for the writing of foreign terms in both Latin and English adjusted to the writing rules. However, it needs to be checked again for the writing of foreign terms either in Latin or English adjusted to the writing rules.

Results of the Assessment of Archivalism by Students

Table 16. Validity test results based on student responses.

No Butir Soal	Nilai V	Keterangan
1	0,550	Valid
2	0,708	Valid
3	0,800	Valid
4	0,533	Valid
5	0,603	Valid
6	0,710	Valid
7	0,659	Valid
8	0,696	Valid
9	0,659	Valid
10	0,528	Valid
11	0,760	Valid
12	0,617	Valid
Total	**0,652**	**Valid**

The validity test results from students get a value of 0.652. This figure is the result of r count. The result of r count is greater than the table (0.514) so it can be said to be valid. After that, calculate the reliability with the results that can be seen in the following table:

Table 17. Reliability test results based on student responses.

Hasil Uji Cornbach's Alpha	Keputusan
0,87	reliabel

The value of the calculation results with Cornbach's Alpha shows a number of 0.87 where the number is greater than 0.70 so that it can be said to be reliable. After getting valid and reliable results, the product can be said to be practical with a percentage as in the following table:

Table 18. Percentage results of practicality assessment of moss encyclopedia based on student responses.

Responden	Skor Max	Perolehan Skor	Persentase (%)	Kepraktisan
1	60	56	93,33	Very Practical
2	60	53	88,33	Very Practical
3	60	50	83,33	Very Practical
4	60	52	86,67	Very Practical
5	60	55	91,67	Very Practical
6	60	56	93,33	Very Practical
7	60	53	88,33	Very Practical
8	60	54	90	Very Practical
9	60	52	86,67	Very Practical
10	60	53	88,33	Very Practical
11	60	50	83,33	Very Practical
12	60	50	83,33	Very Practical
13	60	52	86,67	Very Practical
14	60	52	86,67	Very Practical
15	60	50	83,33	Very Practical
Total	**900**	**788**	**87,56**	**Very Practical**

Based on the table above, it can be seen that the results of the practicality assessment reached 87.56% so that it can be said that the moss encyclopedia product is very practical to use. From the practicality test conducted by teachers and students, they have considered that the moss encyclopedia is easy to use so that the material can be understood properly. This is in line with what was conveyed by Irawan & Hakim (2021) that learning media must be used easily by students in order to achieve the expected learning objectives.

Conclusion

Bryophyta encyclopedia products can be said to have good quality based on the feasibility assessment of material experts obtaining a percentage of 88.33% and media experts obtaining a percentage of 96% so that the product is very feasible to use as a biology learning media. Then the practicality assessment by biology teachers obtained a percentage of 84.44% and from students obtained a percentage of 87.56% so that the encyclopedia was very practical to use as a biology learning media.

References

Abhi Purwoko, A., Andayani, Y., Hadisaputra, S., Yulianti, L., Nudia Fitri, Z., & Pariza, D. (2021). Prosiding Saintek Validitas Instrumen Dalam Rangka Pengembangan Metode Pembelajaran Inovatif Untuk Meningkatkan Minat Belajar Siswa. *LPPM Universitas Mataram*, *3*, 94–102.

Astuti, A., Tembang, Y., Waluya, S. B., & Asikin, M. (2023). Instrumen Gaya Belajar Siswa Pada Pembelajaran Matematika Di Sekolah Dasar. *Prima Magistra: Jurnal Ilmiah Kependidikan*, *4*(1), 1–6. https://doi.org/10.37478/jpm.v4i1.2307

Cahyanti, A. D., & Ibrahim, M. (2018). Pengembangan Ensiklopedia Serangga Sebagai Sumber Belajar Untuk Sma Kelas X. *Berkala Ilmiah Pendidikan Biologi*, *7*(2), 267–274. http://ejournal.unesa.ac.id/index.php/bioedu

Fadhilah, R., Auliaty, Y., & Wardhani, A. (2022). Pengembangan Ensiklopedia Digital Tanaman Hias Berbasis Kontekstual Sebagai Sumber Belajar Dalam Pembelajaran IPA Kelas IV SD. *ETJ: Educational Technology Journal*, *2*(2), 29–37. https://journal.unesa.ac.id/index.php/etj

Fendya, W. T., & Wibawa, S. C. (2018). Pengembangan Sistem Kuesioner Daring dengan Metode Weight Product untuk Mengetahui Kepuasan Pendidikan Komputer pada LPK Cyber Computer. *Jurnal IT-EDU*, *03*(01), 45–53.

Hanafi. (2017). Konsep Penelitian R&D Dalam Bidang Pendidikan. *Saintifika Islamica: Jurnal Kajian Keislaman*, *4*(2), 129–149. http://www.aftanalisis.com

Hasanah, T. A. N., Huda, C., & Kurniawati, M. (2017). Pengembangan Modul Pembelajaran Fisika Berbasis

Problem Based Learning (PBL) pada Materi Gelombang Bunyi untuk Siswa SMA Kelas XII. *Momentum: Physics Education Journal*, *1*(1), 56–65. https://doi.org/10.21067/mpej.v1i1.1631

Irawan, A., & Hakim, M. A. R. (2021). Kepraktisan Media Pembelajaran Komik Matematika pada Materi Himpunan Kelas VII SMP/MTs. *PYTHAGORAS: Jurnal Program Studi Pendidikan Matematika*.

Maydiantoro, A. (2021). Research Model Development: Brief Literature Review. *Jurnal Pengembangan Profesi Pendidik Indonesia (JPPPI)*, *1*(2), 29–35.

Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian (Panduan Peneliti, Mahasiswa, dan Psikometrian)*. www.nuhamedika.gu.ma

Turnip, R. F., Rufi'i, & Karyono, H. (2021). Pengembangan E-modul Matematika Dalam Meningkatkan Keterampilan Berpikir Kritis. *Jurnal Edukasi Matematika Dan Sains)*, *9*(2), 485–498. https://doi.org/10.25273/jems.v9i2.11057

Zarisma, U., Qurbaniah, M., & Muldayanti, N. D. (2016). Identifikasi Kesulitan Belajar Siswa Pada Materi Dunia Tumbuhan Kelas X SMA NEGERI 1 SAMBAS. *Jurnal Biologi Education*, *3*(2), 33–41.

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