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THE DEVELOPMENT OF BRYOPHYTA TEACHING BOOK FOR INCREASING THE STUDENTS' UNDERSTANDING OF THE CONCEPT

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Abstract:
One of the determinants of learning success is the achievement of cognitive abilities or, commonly called, concept understanding. In fact, mastery of concepts based on the results of prior research at various levels of education is still relatively low. The results of observations on the subject of Low Plant Botany at the Biology Education Department FKIP Universitas Sulawesi Barat also showed that students' conceptual understanding was still low. This problem certainly requires a solution such as the implementation of a Low Plant Botany textbook that has been developed by the research team. The purpose of this study was to find out the stages of developing teaching materials based on the results of research in the first year of research, knowing the results of validation test by design experts, material experts, results of individual trials, trial results of readability of teaching materials, and to determine the effectiveness of development results textbooks for understanding student concepts. The method of developing teaching books in this study using the ADDIE Model which according to Branch (2009) consists of 5 stages, namely analysis (analysis), design (design), development (development), implementation (product implementation/ testing), and evaluation (evaluation). The results of this development study revealed that: (1) developed textbooks fulfilled valid criteria by the validators so that it was feasible to be implemented into the learning process, and (2) textbooks that had been developed by the research team proved effective in improving understanding the concepts of students.

Keywords: ADDIE model, effectiveness of textbooks, understanding the concepts

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1. Introduction

One of the determinants of learning success is the achievement of cognitive abilities (Andrini, et al., 2017) or commonly called concept understanding. Understanding of concepts is a combination of dimensions of knowledge with dimensions of cognitive processes (Anderson & Krathwohl, 2010). Cognitive learning results are the results of teacher assessment, in the form of test results on student learning outcomes that show students' mastery of learning and behavior as learning outcomes in the classroom (Primary, et al., 2015). Leasa & Corebima (2017) explains that cognitive learning outcomes are representations of students' intelligence. Some education policies are carried out to improve student learning outcomes to obtain standard grades. Therefore, plans for learning, training, and evaluation must involve cognitive aspects holistically.

Anderson & Krathwohl (2010) explain that learning outcomes can be viewed from the dimensions of knowledge and cognitive processes. The dimension of knowledge consists of factual, conceptual, procedural, and metacognitive knowledge. The dimensions of the cognitive process consist of remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). Nursyamsi & Corebima (2016) added that students who have good learning outcomes will be able to solve problems and problems well too.

In fact, mastery of concepts based on the results of prior research at various levels of education is still relatively low (Hasan, et al., 2013; Pratama, et al., 2015; Bahri & Corebima, 2015; Bahri, 2016; Sangadji, 2016; Leasa, & Corebima , 2017; Suwono, et al., 2017; Andrini, et al., 2017; and Danial, 2018). Learning that has not yet empowered thinking potential causes a lack of development of mastery of student concepts. The impact of this learning pattern is seen after students take the semester exam by obtaining a score or low score (Danial, 2010). The results of observations on the subject of Low Plant Botany at the Biology Education department FKIP Universitas Sulawesi Barat also showed that students' conceptual understanding was still low.

This problem certainly requires a solution such as the implementation of a Low Plant Botany textbook that has been developed by the research team. The development of this textbook uses the ADDIE Model which according to Branch (2009) consists of 5 stages, namely analysis (analysis), design (design), development (development), implementation (product implementation/trial), and evaluation (evaluation). The reason for choosing this model is because the implementation is quite clear and easy to implement, so it does not create multiple interpretations. The implementation of the results of the development of research-based textbooks by the research team is expected to improve students' conceptual understanding.

The research on ADDIE Model development has been reported by Hidayatullah (2016) with the results of research showing that the learning media developed by flip bookmaker in Sampang Regency received an average rating of 82.63% with a valid category. The same study was published by Tegeh, et al. (2015) about developing teaching books through the ADDIE model. The results of the textbook validation from

the study by Tegeh, et al. (2015) revealed that both content experts, learning design experts, and instructional media experts rated textbooks as well qualified.

2. Research Method

This study uses a type of development research. The teaching material development model in this study adapted the ADDIE Model. The procedure chart of the ADDIE Model (Branch, 2009) can be seen in Figure 1.

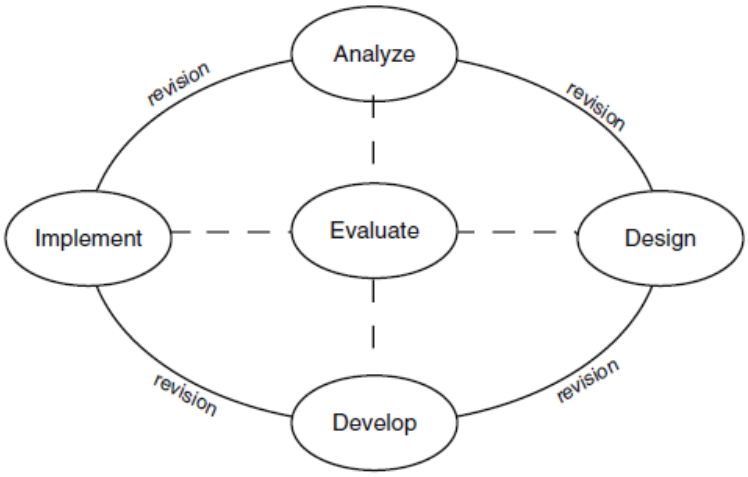

Figure 1: ADDIE Model Procedure Chart (Branch, 2009)

Explanation of Figure 1 in details are described as follows.

1) The Analyze aims to identify the needs of students regarding teaching materials.
2) The design aims to determine the purpose and framework of teaching materials.
3) The development aims to produce revised teaching materials based on input from experts/experts. This stage includes: validating teaching materials by the design expert validator (revision I) and teaching material experts (revision II)
4) Implementation, this phase is related to product testing. This stage includes small group trials. Trial subject: students who have taken the Low Plant Botany course, followed by the revision stage III.
5) The evaluation aims to determine the effectiveness of textbooks. This stage includes limited scale trials. Trial subject: Biology Education Department.

The location of the implementation in this study was in the classroom of the Biology Education Department FKIP Universitas Sulawesi Barat. The research subjects were second-semester Biology Education students at the Low Plant Botany course. The instrument used to collect data in the form of questions to test students' understanding of concepts.

Analysis of the data from the question development in the form of validity and reliability items. The technique used to test validity is the product moment proposed by Pearson (Arikunto, 2013). The formula used to test the reliability of the question is the Cronbach alpha formula.

The inferential statistics of the Independent Sample t-Test test are used to test the hypothesis. The data obtained were analyzed using the SPSS 21.0 for Windows program. Before the data are analyzed by the Independent Sample T-test, the prerequisite test is first, namely the normality test and homogeneity test. The normality test uses the Shapiro-Wilk test while the homogeneity test uses Levene's Test of Equality of Error Variances. The guideline for decision making in the prerequisite test is if the significance value is greater than the level of trust ($\acute{\alpha}$ = 0.05) then the data is normal and comes from a population that has the same variant. Decision making in hypothesis testing is if the sig value. <0.05, then the hypothesis H0 is rejected and H1 is accepted. If the value is the sig. >0.05, the hypothesis H0 is accepted and H1 is rejected.

3. Results and Discussion

3.1 Stages of Development of Teaching Materials

The development of teaching materials in this study is in the form of teaching books using the ADDIE Model which according to Branch (2009) consists of 5 stages, namely analysis (analysis), design (design), development (development), implementation (product implementation/trial), and evaluation.

Analyze aims to identify the needs of students regarding teaching materials. These activities are carried out by: (1) reviewing information on the results of development research conducted by previous researchers, and (2) conducting preliminary studies by giving questionnaires to lecturers in the Biology Education Department FKIP Universitas Sulawesi Barat (Unsulbar) about the types of the types of teaching materials used in the classroom. Some of the results of development research that produced valid/feasible teaching materials to be implemented have been carried out by researchers before: (1) development of phytoestrogen toxicity analysis materials in reproductive physiology subjects at the Biology Department, State University of Malang (Irmawati, 2014), (2) development of teaching materials educational research methods with the ADDIE Model (Tegeh and Kirna, 2013), (3) the development of teaching materials based on the research on characterization of sperm membrane proteins in biotechnology subjects (Oktaviana et al., 2015), and many other research results. In addition, the results of implementing the analyze phase also revealed that the Biology Education Department FKIP Unsulbar had never conducted development research based on the results of the research. The lecturers only use the types of teaching materials sold in the market so that they cannot measure the needs of students in attending lectures. Based on the identification of these problems, it is important to conduct research-based teaching material development research. The results of the research in this study were the results of the identification of the types of Bryopsida in the first year research. Teaching materials developed in this study are printed textbooks.

The design aims to produce a textbook draft. This activity is carried out by: (1) reviewing the format of teaching book development, (2) compiling a textbook framework, (3) analyzing various literary sources as compilation of material in

textbooks, (4) writing teaching materials based on the results of study literature and description of types of moss plants that have been identified, and (5) designing textbook covers. The topic of the material in the textbook that has been developed contains: (1) introduction, contains a general description of the habitat of Moss plants, geographic location and climate conditions of Majene Regency as the location of research samples, (2) characteristics of Bryophyta, containing characteristics of moss plants general which includes morphological and anatomical features, habitat, and metagenesis/rotation of moss plantations, (3) classification of Bryophyta, containing groupings of Bryophyta in general, namely Hepaticopsida (liverworts), Bryopsida (leaf moss), and Anthoceratopsida (hornworts). this grouping is also accompanied by an explanation of the material, such as characteristics, body composition, and method of reproduction, (4) types of Briopsida in Majene Regency, containing types of moss plants identified in Onang Waterfall and Sondong Hill in Majene Regency, (5) a list of terms, and (6) a list of references.

Development aims to produce a revised (valid) textbook based on input from experts / experts. This stage includes: validating textbooks by the learning design expert validator (revision I), material experts (revision II), individual trials (revision III), and testing the readability of teaching books (revision IV). The results in this study are in the form of validation data and also in the form of suggestions and responses from the validators. Validation data in the form of average scores and the percentage of textbook values that have been validated. Suggestions from the validators are used as a reference for improving the developed textbooks.

A. Results of Learning Design Expert Validation

The summary results of textbooks by the validators of learning design experts are presented in Table 1.

Table 1: Data Summary of Textbook Validation Results by Learning Design Expert Validators

No	Aspects	Average Score	Category
1	Conformity with the principles of assessment of learning outcomes	4	Very good
2	Format of textbooks	3.8	Good
3	Presentation of material in textbooks	3.4	Good
4	Exploration of textbook design	3.9	Good
5	Linguistics	3.1	Good
Average All Aspects		**3.64**	**Good**

The average score for teaching books by learning design experts based on Table 1 is 3.64 (good category). The percentage of teaching books based on the average score divided by the maximum score and multiplied by 100% is 91% (exceeding 70%) so that it falls into the very good category and is decided not to revise. Therefore, in terms of learning design, this textbook is appropriate for use in the learning process.

The data obtained at the validation stage of the learning design expert is also in the form of suggestions and responses from the validator as follows: a) The textbook cover should be green because it has the theme of mosses; b) The size of the picture in

the book should not be too small; c) Writing foreign terms should be italicized; and d) Please check again about the procedure for writing because there are still some inconsistent writings.

B. Material Expert Validation

The summary results of the textbook assessment by expert validators of learning materials are presented in Table 2.

Table 2: Summary of Data Results of Textbook Validation by Material Validator

No	Aspects	Average Score	Category
1	Conformity with the principles of assessment of learning outcomes	4	Very good
2	Format of textbooks	3.3	Good
3	Material coverage	3.5	Good
4	Material accuracy	3.6	Good
5	Up to date	3.4	Good
6	Presentation of material in textbooks	3.7	Good
7	Exploration of textbook display	3.6	Good
Average All Aspects		**3.59**	**Good**

The average score of teaching books by expert learning material based on Table 2 is 3.59 in the good category. The percentage of teaching books based on the average score divided by the maximum score and multiplied by 100% is 90% (exceeding 70%) so that it falls into the very good category and it is decided not to revise. Therefore, in terms of learning material, this textbook is appropriate for use in the learning process. The data obtained at the expert validation stage of the learning material are also in the form of suggestions and responses from the validator as follows: a) Give explanations for abbreviations that are not yet known by students; b) Need to make abbreviations that are not familiar with textbooks; c) We recommend that you add material about the role of moss plant species from different classes; d) Look again at the procedure for writing a referral list.

C. Individual Testing

The results of individual testing in this study were carried out by practitioners implementing learning in the field in the form of validation stages. The results of the summary of the textbook assessment by the validator of the expert practitioners in the field are presented in Table 3.

Table 3: Data Summary Results of Textbook Validation by Validators of Expert Practitioners in Learning in the Field

No	Aspects	Average Score	Category
1	Conformity with the principles of assessment of learning outcomes	3.4	Good
2	Format of textbooks	3.8	Good
3	Presentation of material in textbooks	3.3	Good
4	Exploration of textbook design	3.5	Good
5	Linguistics	3.6	Good
Average All Aspects		**3.52**	**Baik**

The average score for teaching books by expert practitioners in learning in the field based on Table 3 is 3.52 (good category). The percentage of teaching books based on the average score divided by the maximum score and multiplied by 100% is 88% (exceeding 70%) so that it falls into a very good category and is decided not to revise. Therefore, according to the expert practitioner of learning in the field, this textbook is appropriate for use in the learning process.

D. Test of Readability of Textbooks

The results of the readability of teaching books in this study were carried out by students who had taken the Low Plant Botanical course, namely fourth semester students (trial of the small group stage I) in the form of an evaluation of the validation stage. The results of the summary of textbook evaluations by students are presented in Table 4.

Table 4: Textbook Readability Test Results

No	Aspects	Average Score	Category
1	Format of learning textbooks	3.8	Good
2	Language used in textbooks	3.9	Good
3	Presentation of learning textbooks	3.8	Good
4	Display of learning textbooks	3.9	Good
5	Benefits of textbooks	3.8	Good
Average All Aspects		**3.8**	**Good**

The average score of the readability test for textbooks by students who have taken the Low Plant Botanical Course based on Table 4 is 3.8 in the good category. The percentage of teaching books based on the average score divided by the maximum score and multiplied by 100% is 95% (exceeding 70%) so that it falls into the very good category and is decided not to revise. Therefore, based on the results of the readability test, this textbook is appropriate for use in the learning process.

Implementation, this phase is related to product testing. This implementation phase includes a trial of a small group stage II that produces products from item analysis. The subject of the trial: the students who have taken the Low Plant Botanical course, then followed by the stage of revision V. Analysis of the items is done to find out the feasibility of the instrument for evaluating cognitive learning outcomes (multiple choice and description) that has been developed. Analysis of the items included the validity test and reliability test. Test the validity of the items used to determine the extent to which the instrument developed is able to measure what should be measured. Reliability testing is used to determine the extent to which an instrument is able to measure consistently when used at different times.

A summary of the results of the analysis of cognitive test items (multiple choice) is presented in Table 5. Based on Table 5 it is known that there is one item of invalid multiple choice questions so that this question must be revised. Cronbach Alpha coefficient value is 0.91 with very high criteria.

Table 5: Data Summary of the Results of Analysis the Questions for the Cognitive Assessment Instrument

No.	Questions validity		No.	Questions validity		Reliability			
	R_{xy}	Decision		R_{xy}	Decision	Coefficient		Decision	
						MC	Essay	MC	Essay
2	0.547		17	0.473		0.869	0.616	Reliabel	Reliabel
3	0.482		18	0.494					
4	0.553		19	0.638					
5	0.601		20	0.510					
6	0.476		21	0.473					
7	0.475		22	0.429					
8	0.491	Valid	24	0.491	Valid				
9	0.465		1(essay)	0.744					
10	0.528		2(essay)	0.642					
12	0.531		3(essay)	0.481					
13	0.491		4(essay)	0.682					
14	0.437		5(essay)	0.578					
16	0.429								

Note: MC is Multiple Choice

From Table 5, shows the number of valid questions as many as 25 items out of 30 items in the total number of questions. The question item is said to be valid if r table <r counts, r table (0.05; 22 students) is known as 0.423. The cognitive assessment instrument questions used in this study also show very high reliability, where the multiple choice question coefficient value is 0.869 and the essay question coefficient is 0.616.

The evaluation aims to determine the effectiveness of textbooks that are implemented in a limited manner. This stage includes testing the effectiveness of the results of the development of teaching books by the research team on improving student understanding of concepts. Data from the understanding of students' concepts in the experimental class were obtained from the post-test results after being treated by using research textbooks. As for the control class without using textbooks. Data from the frequency distribution of the post-test experimental class and control class are presented in Table 6.

Table 6: Distribution of Frequency of Understanding of Concepts

	Experiment Class		Control Class	
No	Interval Class	Frequency	Interval Class	Frequency
1	60-64	3	45-49	2
2	65-69	2	50-54	5
3	70-74	5	55-59	0
4	75-79	4	60-64	6
5	80-85	8	65-69	6
6	86-90	0	70-75	3

From Table 6, it can be seen that in the experimental class, the highest frequency is in the interval of 80 to 85. While in the control class, the highest frequency is in the range

of 60 to 69. The average post-test value of students in the experimental class is 73 while the post-test average value of students in the control class is 60.

A. Prerequisite Test (normality test and homogeneity test)

The data obtained were then tested for normality to determine whether the variables in the study had a distribution of normal or not. Normality test for cognitive learning outcomes of students using the Shapiro-Wilk test with the help of the SPSS for Windows version 21 program. The guideline for decision making in the normality test is if the significance value is greater than the confidence level ($\acute{\alpha}$ = 0.05) then the data is normally distributed. The results of the normality test for data resulting from understanding student concepts are presented in Table 7.

Table 7: Data Normality Test Results of Understanding Student Concepts

Class	Kolmogorov-Smirnov		
	Statistics	**Df**	**Sig.**
Eksperimen	0,921	22	0,081
Kontrol	0,918	22	0,069

From Table 7, it can be seen that the distribution of data resulting from the understanding of concepts in the experimental class is 0.081, while the distribution of data resulting from the understanding of the control class concept is 0.069. Seeing the significance value of the data resulting from the understanding of concepts in the experimental class and the control class which is greater than the level of trust ($\acute{\alpha}$ = 0.05), it can be said that all the data are normally distributed. Furthermore, the data obtained were also tested for homogeneity to find out whether the samples taken had the same variants or did not show significant differences with each other. The homogeneity test in this study used the Levene's Test of Equality of Error Variances test with the help of the SPSS for Windows version 21.0 program. The guidelines for decision making in the homogeneity test are, if the significance value is greater than the level of trust ($\acute{\alpha}$ = 0.05) then the data is said to be homogeneous, but vice versa if the significance value is smaller than the level of trust ($\acute{\alpha}$ = 0.05) then said to be not homogeneous. The results of the homogeneity test for data resulting from understanding the concepts are presented in Table 8.

Table 8: Homogeneity Test Results Data on Understanding Student Concepts

Data	Levene Statistic	df1	df2	Sig.
Results of Concept Understanding	0.105	1	42	0.748

From Table 8, it can be seen that the data resulting from understanding students' concepts have a significance value of 0.748. Seeing the significance of the results of understanding the concept that is greater than the level of trust ($\acute{\alpha}$ = 0.05), it can be said that classes taught using research-based textbooks and classes without using textbooks have the same (homogeneous) variance.

B. Hypothesis Testing

Hypothesis testing is done to test whether there is an influence on the use of research-based textbooks on the results of student conceptual understanding. The hypothesis testing in this study used the Independent Sample T-test with the help of the SPSS for Windows version 21.0 program. Decision making on hypothesis testing is if the value is the sig. <0.05, then the hypothesis H0 is rejected and H1 is accepted. If the value is the sig. > 0.05, the hypothesis H0 is accepted and H1 is rejected. The summary of the results of the Independent Sample t-Test on the understanding of students' concepts in the experimental class and control class is presented in Table 9.

Table 9: Summary of Independent Sample T-test on the Conceptual Outcomes

	T-test for Equality of Means				
	t	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Equal variances assumed	5.422	42	0.000	13.63636	2.51520

Table 9 shows that the data resulting from students' conceptual understanding have a value of t count of 5.422, a degree of freedom of 42, a significance of 0.000 and an average difference of 13.636. Seeing the significance value smaller than 0.05, it can be concluded that the alternative hypothesis (H1) is accepted and the null hypothesis (H0) is rejected, meaning that there is the influence of the use of research-based textbooks on student cognitive learning outcomes. Understanding of concepts is a combination of dimensions of knowledge with dimensions of cognitive processes (Anderson & Krathwohl, 2010). Cognitive learning results are the results of teacher assessment, in the form of test results on student learning outcomes that show students' mastery of learning and behavior as learning outcomes in the classroom (Primary, et al., 2015). The results of this study are in line with Suwono, et al. (2017) which states that the development of teaching materials is able to improve understanding of concepts.

4. Conclusion

The conclusions in this study are as follows: a) The stages of developing textbooks in the study used the ADDIE Model (analysis, design, development, implementation, and evaluation); b) The percentage value of the results of the validation of textbooks by learning design experts; material expert; and expert practitioners of learning in the field (results of individual trials) are 91% respectively; 90%; and 88% with a very good category so that it is valid/feasible; c) The percentage value of the readability test results of teaching books by students is 95% (very good) so that it has been valid/feasible; d) Textbooks that have been developed by the research team have proven effective in improving students' conceptual understanding.

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