
DEVELOPMENT OF ECOLOGY TEXTBOOK FOR SCIENCE EDUCATION STUDENTS**Indra Fardhani***, Yayuk Mulyati, Erti Hamimi, Dewi Khajar Fitriana, Dewi Fitria Cahyani

Faculty of Mathematics and Science, Universitas Negeri Malang

Email: indra.fardhani.fmipa@um.ac.id

Abstract

Ecology is one of the subjects that must be taken by undergraduate students. Lecture activities can certainly be hampered if there are no supporting textbooks. The purpose of this research is to provide textbooks that are in accordance with the demands of the curriculum by considering aspects of student needs, according to the characteristics and environment of students, helping students obtain alternative textbooks, and making it easier for educators in the learning process. This research method is Research & Development (R&D). In this study using the ADDIE's development research model, it's an approach that emphasizes an analysis of how each component interacts with each other by coordinating accordingly to the existing phases. Data collection techniques was using validation questionnaires for experts, individual test and small-scale trials. Data analysis results show that from material experts was 89.0% with the assessment criteria is very feasible, while the validation results by linguists was 71.4% with the assessment criteria is feasible. Readability tests shown percentage of 85.6% with the assessment criteria is very feasible. The product has an advantages and disadvantages which still needed to be revised.

Keywords: *Ecology, Learning process, Textbook*

Received: November 2021, Revised: July 2022, Published: July 2022

INTRODUCTION

Books are written materials that present knowledge and arranged systematically. Textbooks are printed learning media that contain a knowledge of the result of an analysis of the curriculum in written form (Depdiknas, 2008). Textbooks can also be used as student handbooks because they are written and compiled by experts in fields that are in appropriate with the material in the textbook (Dikti, 2009). According to Pasal 12 Ayat 1 s.d 3 UU Nomor 12 Tahun 2012, lecturers as members of the academic community have the task of transforming the knowledge and/or technology they master to students by creating an atmosphere of teaching and learning so that students actively develop their potential. Lecturers individually or in groups are required to write textbooks, which are published by universities and/or scientific publications as a source of learning and for the development of academic culture and the cultivation of reading and writing activities for the academic community (Khasanah, 2021). It means that for lecturer, writing is a must, whether writing journals, articles, research reports, or scientific books. The purpose of the preparation of this textbook is to provide textbooks that are in accordance with the demands of the curriculum by considering aspects of student needs, according to the characteristics and environment of students, helping students obtain alternative textbooks, and making it easier for educators in the learning process.

One of the learning resources needed in lecture activities is textbooks. According to (Suwarni, 2015), learning activities can run affectively if there are learning resources, and one example of learning resources is teaching materials in the form of textbooks. Textbooks is one that becomes a reference for learning activities. Depdiknas (2008) said that textbooks is useful for: (1) helping lecturers in the learning process, (2) facilitating the presentation of material in class, (3) guiding students to study, and (4) fostering student's motivation to develop themselves in understanding lessons. From the results of the needs assesment, it is necessary to have a variety of reading sources, especially ecology lessons to support lecture activities

Ecology is a compulsory subject that must be taken by science education students. There are several achievements that must be taken so that students can pass this lesson. Haeckel (1896) said that ecology is the knowledge of the overall relationship of various organisms to their environment with organic and inorganic factors. (Hunaepi et al., 2016) said that ecology for students is seen as a scourge because ecology has characteristics that are still connected with other sciences. This requires students to use the concepts of other branches of science in studying ecology. The existence of these characteristics is one of the reasons why not all students can understand the concept of ecology well.

Based on the results of the observations and explanations above, to solve these problems, lecturer must develop a textbook that can be used as a reference for students in learning. Textbooks will make students have a basic grip that can be used for independent learning. Textbooks will also make students gain in-depth material

knowledge. The provision of effective textbooks and teaching media can improve student understanding and achievement.

RESEARCH METHODS

Location and Research Subject

This research was conducted in the Science Education Study Program, Faculty of Mathematics and Natural Sciences, Malang State University. The research subjects are students of the Science Education Study Program who have taken ecology courses.

Methods and Research Models

This research method is Research & Development (R&D). According to Sugiyono (2013) research development methods are used to produce certain products, as well as to test the effectiveness of these products. This study was using the ADDIE's development research model, an approach that emphasizes an analysis of how each component interacts with each other by coordinating accordingly to the existing phases (Ryanto & Sugianti, 2020). ADDIE begun with Analyze stage, which was done by analyzed the needs of Science Education's textbook and textbook content. The second stage was Design, which was done by designed the learning objectives and learning materials and designed the textbook layouts. The third stage was Develop, it was done by developed and modified the content of the textbook, followed with conducted validation and readability tests of the textbook and evaluated or revised the textbook according to experts' suggestions. The Implementation stage will be conducted by implementing the textbook in real classroom with certain experimental design. While the evaluation stage was conducted on each stage of the texbook developments (Figure 1).

The validation phase of teaching materials is carried out to the validators consisting of material expert validators and linguist validators, and also readability tests. Validation and readability tests aimed to control the content of teaching materials so that they are in accordance with the needs and characteristics of students. Furthermore, a revision process is carried out to improve the textbook from various aspects. Revisions are based on suggestions and input from material expert validators as well as verbal suggestions during discussions with material experts (Zunaidah & Amin, 2016).

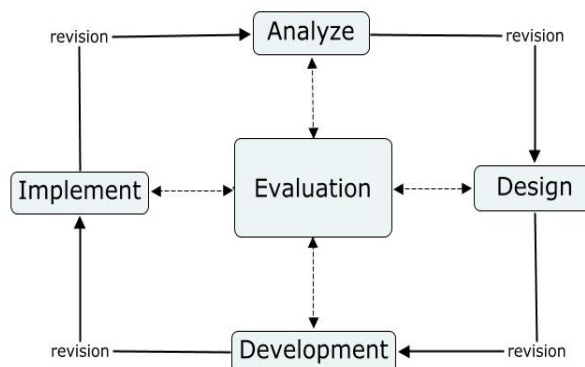


Figure 1. ADDIE's Development Research Model
(Sources: Wikipedia, 2021)

The types of data in this research are qualitative and quantitative. Qualitative data obtained from critics and suggestions from the validators and correspondents of the readability test. Quantitative data was obtained from the validation results of the validators and from the readability test data on students. The instruments in this research are expert validation's sheets and readability test questionnaire.

Quantitative data is the result of expert validation and readability. The questionnaire filling data refers to the Likert scale filling method with 5 choices from each component. This data is numeric with certain category, namely 5 (very good/VG), 4 (Good/G), 3 (Enough/E), 2 (Near Enough/NE), and 1 (Least/L). with certain criteria. The number is processed so can be concluded that the level of validity of the textbook.

The data collection's technique is first quantitative descriptive data analysis, used to process the data from the validation of material experts and language experts in the form of suggestions and critics contained in the validation instrument questionnaire. the second is descriptive qualitative statistical analysis which is used to analyze the data obtained in the form of percentage analysis. The data that has been collected first is converted into quantitative data according to the weight of the score. The conversion is carried out with the

following formula (Riduwan, 2003). The criteria of the validator assessment questionnaire data can be seen from the percentage results of the criteria in Table 1.

$$K = \frac{F}{N \times I \times R} \times 100\%$$

Description:

- K = eligibility percentage
- F = Number of respondents' answers
- N = Highest score in the questionnaire
- I = Number of questions in the questionnaire
- R = Number of respondents

Table 1. The Validity Criteria of The Validator Assessment

Score	Description	Test Decision
< 40%	Not feasible	Not feasible and needs major revision
41%-60%	Decent enough	Decent enough and needs major revision
61%-80%	Worthy	Decent but still make minor revisions
81%-100%	Very worth it	Very feasible and not revised if it reaches 100%

(Arikunto, 2013)

RESEARCH RESULTS AND DISCUSSION

The creation of an ecology textbook is intended to increase the knowledge of science education students in studying ecology. In addition, the manufacture of textbooks also has the aim of providing textbooks that are in accordance with the demands of the curriculum by considering aspects of student needs, according to the characteristics and environment of students, helping students obtain alternative textbooks, and making it easier for educators in the learning process (Depdiknas, 2008).

Table 2. Score of Each Indicator in Content Validation

Validated Components	Indicators	Score*				
		1 L	2 NE	3 E	4 G	5 VG
Suitability Material Descriptions With Basic Competencies	Completeness of Materials					√
	Breadth of Materials				√	
Material Accuracy and Material correctness	Depth of Materials				√	
	Introduction to Ecology				√	
	Ecosystem and Energy					√
	Evolution in Ecology				√	
	Population Structure					√
	Geographical Distribution and Limiting Factors					√
	Species Interaction					√
	Biodiversity					√
	Succession					√
	Productivity of Living Things					√
	Conservation Ecology					√
Learning Support Materials	Information Accuracy and Summary				√	
	Question Accuracy					√
	Compatibility with the Development of Science and Technology				√	
	Exercises of HOTS				√	
	Updates, Features, Examples and References				√	
Percentage	Relationships Between Concepts					√
	Enrichment		√			
Percentage	89.0 %					

Development research from textbooks produces textbook drafts that have been validated and tested for readability. The score of each indicator for content and linguistic validations were shown in Table 2 and Table 3. While for the score of each indicator for readability test was shown in Table 4. The read. Based on the results of validation by material experts, the average percentage of assessment results was 89.0% with the assessment criteria is very feasible, while the validation results by linguists was 71.4% with the assessment criteria is feasible. Readability tests shown percentage of 85.6% with the assessment criteria is very feasible.

Table 3. Score of Each Indicator in Linguistic Validation

Validated Components	Indicators	Score*				
		1 L	2 NE	3 E	4 G	5 VG
Conformity to the level of development of students	Compatibility with Intellectual Development Level					
	Compatibility with Social Emotional Development Level				√	
Communicative	Message Readability				√	
	Language Rule Accuracy			√		
	Correct sentence structure			√		
Coherence and Coherence of Thoughts	Coherence and Cohesion between Chapters				√	
	Coherence and Coherence between Paragraphs			√		
Percentage	71.4%					

Table 4. Score of Each Indicator in Readability Test

Number	Description	Score*				
		1 L	2 NE	3 E	4 G	5 VG
1.	Textbooks use language (vocabulary, sentences, paragraphs, and discourse) that are easy to understand					√
2.	The form of writing and the size of the letters are clear, making it easier to read textbooks				√	
3.	The width of the space makes it easier to read textbooks					√
4.	There are no writing errors in the textbook			√		
5.	The graphic aspects in the textbook are interesting			√		
6.	Presentation of teaching materials are interesting, according to the material and age of the reader (student)					√
7.	The textbook uses an attractive writing style				√	
8.	The density of ideas and information contained in the reading (short and long sentence) is easy to understand				√	
9.	Textbooks already use standard Indonesian grammar					√
10.	The systematic presentation of material in textbooks makes it easier for readers to understand					√
	Percentage					85.6%

The validator's comments and suggestions are used as improvements and revisions to the ecology textbook. The following are comments and suggestions by validators of material experts and linguists:

1. It is necessary to provide a glossary to make it easier for readers (students) to recognize “foreign” concepts.
2. There are still inconsistencies when writing a concept that have the potential to make it difficult for readers (students) to understand the meaning of the information presented.
3. This book presents questions in each discussion, this can be an advantage of this book because readers (students) can do self-assessment or even peer-assessment to assess how far they understand (catch) information from each discussion presented in the book.
4. Textbooks are very good at providing information and knowledge related to the discussion.

CONCLUSION

This book as a whole is arranged in a language and systematic which is easily understood by the readers. In difficult terms, bold or italics have been used, the spacing also makes it easier for the reader. This book uses easy-to-understand language with graphs and pictures that interpret concepts. However, improvements are needed before the next stage, that is implementation.

ACKNOWLEDGEMENT

We wish to thank to the Faculty of Mathematic and Science, Universitas Negeri Malang for funding this research through PNB faculty funding scheme.

REFERENCES

- Arikunto, S. 2013. *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Depdiknas. 2008. *Panduan Pengembangan Bahan Ajar*. Jakarta: Direktorat Pembinaan Sekolah Menengah Atas.
- Dikti. 2009. *Pedoman Operasional Penilaian Angka Kredit Kenaikan Jabatan Fungsional Dosen ke Lektor Kepala dan Guru Besar*. Jakarta: Kemendiknas.
- Haeckel, E. (1896). Systematische Phylogenie der Echinodermen. pp. 348–504. *In: Systematische Phylogenie der Wirbellosen Thiere (Invertebrata): Zweiter Teil des Entwurfs einer systematischen Stammengeschichte*. Reimer, Berlin. 720 pp.
- Hunaepi, H., Firdaus, L., & Kurnia, N. (2016). Validitas Buku Ajar Ekologi Berbasis Kearifan Lokal untuk Mengembangkan Sikap Ilmiah Mahasiswa. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 4(2), 94. <https://doi.org/10.33394/j-ps.v4i2.1152>
- Khasanah, Uswatun. 2021. *Kupas Tuntas Penulisan Buku Ajar*. Sukoharjo: Tahta Media Group.
- Rayanto, Y., H. & Sugianti. 2020. *Penelitian Pengembangan Model Addie Dan R2D2: Teori & Praktek*. Pasuruan: Lembaga Academic & Research Institute.
- Riduwan. 2003. *Dasar-Dasar Statistika*. Bandung: Alfabeta.
- Sugiyono. 2013. *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- Suwarni, E. (2015). Pengembangan Buku Ajar Berbasis Lokal Materi Keanekaragaman Laba-Laba Di Kota Metro Sebagai Sumber Belajar Alternatif Biologi Untuk Mahasiswa Sma Kelas X. *BIOEDUKASI (Jurnal Pendidikan Biologi)*, 6(2), 86–92. <https://doi.org/10.24127/bioedukasi.v6i2.336>
- Undang-Undang Republik Indonesia Nomor 12 Tahun 2012 Tentang Pendidikan Tinggi.
- Zunaidah, F. N., & Amin, M. (2016). Pengembangan Bahan Ajar Matakuliah Bioteknologi Berdasarkan Kebutuhan Dan Karakter Mahasiswa Universitas Nusantara PGRI Kediri. *Jurnal Pendidikan Biologi Indonesia*, 2(1), 19–30.