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Developing Supplementary Books on Mangroves in Aceh Tamiang for Biology Students

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Abstract.
This study aimed to produce supplementary books on mangroves in Aceh Tamiang for undergraduate students in the Ecology course. Research and Development (R&D) adapted from the Thiagarajan (4D) model consisting of defining, designing, developing and disseminating stages were used. Field research was employed to develop the product. Material expert lecturers, learning design experts, and layout design experts validated the supplement book developed. Ecology lecturers and students of the Biology department at the State University of Medan assessed it. The results of the assessment by the material experts had a mean score of 86.6% in the very good/feasible category. Meanwhile, learning design experts had a mean score of 93.2% in the very good/feasible category. Likewise, the layout design experts had a mean score of 91.3% in the very good/feasible category. Responses towards the books by lecturers had a high very good/feasible category with an overall percentage of 90.26%. The students' results based on individual, small group and limited field tests obtained the mean scores of 97.9%, 89% and 90.95%, respectively, in the very good/feasible category. These results indicated that the supplementary books that have been developed were very good/feasible. This product's effectiveness could be seen from the gain score of 0.52 in the moderate category and the results of the Wilcoxon test t-count 0.000 < t-table 0.05. It can be concluded that using the supplement books effectively increases students' knowledge of mangrove ecosystems with significant differences in pretest and posttest scores so that supplement books can be used as additional teaching materials for lecturers, students and readers.

Keywords: supplementary books, mangroves, ecology course

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1. INTRODUCTION

Higher education is a component of the national education system that has an important role in educating the nation and advancing science and technology [1]. The use of science and technology in all aspects of life is part of the development of this century. The development process in the 21st century learning as learning is more student-centered by involving students in planning, learning activities, assessment, and

reporting based on student needs, interests and abilities [2]. Student learning resources are not only obtained from lecturers but from all the information around them [3].

The learning process requires the professionalism of a teacher or lecturer, so that learning becomes quality and meaningful. In the learning process, learning resources are needed to support teaching and learning activities. Suitable learning resources can support the achievement of learning objectives, so it is necessary to develop materials that can increase interest in learning and motivate students [4]. One of the components that can support the learning process is a book. Books are learning resources that play an important and strategic role in improving the quality of education. The extraordinary technological developments in this era require lecturers/teachers/students to use more than one handbook as a source of information for teaching and learning. Basically, books have an important role because they allow students to learn something in an organized manner to achieve certain competencies independently [5]. One of the challenges faced in learning biology is the lack of adequate teaching materials, especially teaching materials that help improve the realm of student skills by presenting research results in the student environment.

In formal education, good books enrich and broaden the knowledge and experiences of students. The importance of books really helps students in the teaching and learning process, without teaching materials it will be difficult for students to adjust to learning, especially if the lecturer teaches the material quickly and unclearly. Therefore books are considered as material that can be used by both lecturers and students as an effort to improve the quality of lessons.

Ecology is a science that studies the interactions between organisms and their environment so that in studying them, it requires direct proximity to the organisms being studied as well as the natural surroundings. Ecology is a compulsory subject that students at Medan State University must take. Some material in ecology, especially plant ecology, in its achievement is not only done in the classroom but also outside the classroom environment. Based on the results of observations on teaching materials for ecology courses, there is no specific material on mangroves in ecology textbooks at the State University of Medan, while the use of mangrove forests can be used as a learning resource that will provide direct learning experiences for students

Mangroves are one of the natural resources on the coast that have ecological and economic functions and are important for students to learn, this is because mangroves as one of the local potentials can be empowered as a source of information in the science learning process both in the classroom and outside the classroom and make use of the environment in nature. Learning resources that take advantage of the natural

environment directly will make students more active and make it easier for them to form their understanding of concepts and foster an attitude of caring for the environment. The environment has the potential to be used as a source of ideas that can be developed to support the learning process. Environmentally oriented learning resources make learning more contextual and are expected to increase student knowledge not only theoretically, but also practically to recognize the phenomena around them [6, 7]. In addition, mangroves are widely used as knowledge tourism studies, so that when students are taught about it, they will be able to get to know the conditions of the surrounding environment and become people who care for their environment.

Based on this, research was carried out on the development of field research-based mangroves supplementary books as a source of student learning. Thus, through the use of results from the field as a learning resource compiled in the supplementary books developed, it is hoped that it can improve cognitive mastery and foster positive attitudes of students towards mangrove forests and the environment and provide information to consider linking biological material, especially in ecology courses with the real situation of student life.

2. RESEARCH METHOD

This study applied a Research and Development (R&D) approach adapted from the Thiagarajan (4D) model consisting of defining, designing, developing and disseminating stages. The research design was a one group pretest-posttest design for data collection on cognitive learning outcomes. The instruments were expert validation questionnaires, subject questionnaire responses from lecturers and students, and pretest and posttest questions in the form of multiple choices.

Product development was started on September 2020 and preliminary field testing was carried out on January 2021 to know the determine the effectiveness of using the supplement book being developed. The results of the feasibility calculation are accumulated in the percentage formula for each aspect of the assessment below. The calculation results were accumulated in the percentage eligibility formula for each aspect of the assessment below:

$$The\ percentage\ of\ the\ suitability\ score\ = \frac{Obtaining\ total\ score}{Ideal\ total\ score} x100$$

The testing on the effectiveness of supplementary books in improving students' cognitive was carried out with the Normalized Gain formula as follows:

TABLE 1: Criteria for books feasibility in each aspect [8].

No.	Score Range	Predicate	Category
1.	85 ≤ % score ≤ 100	Very Good	Feasible
2.	69 ≤ % score ≤ 84	Good	Quite Feasible
3.	53 ≤ % score ≤ 68	Satisfactory	Unfeasible
4.	37 ≤ % score ≤ 52	Poor	Unfeasible
5.	20 ≤ % score ≤ 36	Very Poor	Unfeasible

$$N - Gain = \frac{Posttest\ Score - Pretest\ Score}{Ideal\ Score - Pretest\ Score}$$

3. RESULTS AND DISCUSSION

The supplementary books that have been developed were also validated by 5 experts including 3 material experts, 1 learning expert, and 1 layout design expert. In finding out the responses towards the product, 5 lecturers responded to the supplementary books and its feasibility was tested to Biology students. Furthermore, knowing the effectiveness of the supplementary books was also carried out by the N-Gain test. The results of the data analysis and research results were described as follows:

3.1. Results of Validation and Material Expert Assessment

Material validation was carried out by 3 material experts. The evaluation by the three experts was carried out to improve the quality of the book materials. The quality of the materials in mangrove studies, calculations on vegetation analysis, and the role of mangroves in the species of marine. The suitability of the material discussed with the competency standards and basic competencies in the ecology courses. The feasibility of presentation was in the form of a technique in describing the subject or supporting books and the language feasibility in accordance with a good and correct writing order. The results of the mean percentage of the material experts as presented in Table 4.

The validation carried out from material experts included content feasibility (material completeness, material accuracy, material sophistication, material presentation, and language/readability). Each component consisted of several aspects so that the percentage level of the supplementary book validation was obtained by 86.60% in a very good category so that it has met the feasibility requirements in terms of the material that can be used as a source of reading material for students. The materials should be related to the achievement of competencies that must be mastered by students

Table 2: Percentage of assessment from the material experts on the content feasibility.

No.	Component of Assessment	Average (%)	Category
1.	Material Completeness	88.89	Very Good
2.	Material Accuracy	87.62	Very Good
3.	Material Sophistication	84.00	Very Good
4.	Material Presentation	85.83	Very Good
5.	Language/Readability	86.67	Very Good
Average		86.60	Very Good

because it helps students in mastering various predetermined competencies [1]. The understanding of the materials is presented in a coherent and clear manner, starting from easy to complex discussions, and in standard, non-rigid language, so that it is easy to understand because the use of these books is designed for students with the hope of helping students in the learning process by understanding theoretical concepts and stimulating students to do research [9].

3.2. Results of Validation and Instructional Design Expert Assessment

The components assessed from instructional design experts were the content suitability according to competency standards and basic competence, the learning suitability could encourage student curiosity, teaching students independently, the language in the supplementary books had a relationship between good sentences, and product ratings. The results of the mean percentage of validation from instructional design experts on supplementary books for each component as presented in Table 3.

Table 3: Percentage of assessment from the instructional design experts on the content suitability in ecology learning.

No.	Component of Assessment	Average (%)	Category
1	Material Coverage	100	Very Good
2	Material Presentation	96.67	Very Good
3	Language/Readability	84	Good
4	Effects for Readers	92	Very Good
5	Product Appraisal	93.33	Very Good
Average		93.20	Very Good

The assessment of mangroves supplementary books based on the components of assessment was 93.20% in a very good category. Supplementary books are considered to contain book elements that can be used in learning such as having clear learning

outcomes, motivating students to discuss, fostering curiosity and motivating students to ask questions, having clear evaluations, providing feedback for students and having good and clear assessments. According to Robert (2012), several learning activities include: (1) determining learning objectives; (2) learning questions and answers; (3) adjusting the discussion before the assessment is held; (4) reviewing, filtering and improving; and (5) offering feedback and ratings.

3.3. Results of Validation and Layout Design Expert Assessment

The validation assessed from the layout design experts consisted of graphic feasibility (book size, book cover design and book content design). The assessment was carried out to improve the feasibility and quality of the book size and design. The results of the mean percentage of layout design experts as presented in Table 4.

TABLE 4: Percentage of assessment from the layout design experts on the book size and design suitability.

No.	Component of Assessment	Average (%)	Category
1	Book Size	86.67	Very Good
2	Book Cover Design	100	Very Good
3	Book Content Design	87.22	Very Good
	Average	91.30	Very Good

Based on the results from the validation of layout design experts; the feasibility of the graphics (book size, book cover design and book content design) obtained a mean score of 91.30% indicating that this book was suitable for use in a very good category.

3.4. Results of Ecology Lecturers' Responses

The response from the lecturer who conducts the course was carried out by 5 lecturers. The assessment was carried out to improve the suitability of book size and design towards students' development. The quality of book display and presentation was feasible in supporting the learning process in ecology courses. The results of the mean percentage of responses from lecturers on mangroves supplementary books in each assessment indicator as presented in Table 5.

Based on the results of the lecturer responses on the product, it obtained a mean score of 90.26% in a very good category. The results showed that in terms of material content and presentation, these supplementary books could be used in the field as additional books in learning activities.

Table 5: Percentage of assessment from ecology lecturers on the learning material and book design suitability.

No.	Component of Assessment	Average (%)	Category
1	Material Content	90.4	Very Good
2	Material Presentation	90.67	Very Good
3	Language/Readability	92	Very Good
4	Graphics	88	Very Good
Average		90.26	Very Good

3.5. Results of Students' Responses on the Book Feasibility Tests

The assessment of responses and book feasibility tests were conducted on biology students. This was carried out by 3 students in individual tests, 10 students in small group tests and 28 students in limited field tests. Based on the results of individual, small group and limited field tests scored 97.90%, 89% and 90.95% respectively in a very good category, indicating that students were interested in reading study/research-based supplementary books. Students were interested in these books, especially based on the content and images presented were considered attractive and able to increase curiosity and motivate them to read. Textbooks with images really did well in teaching, when text and images were combined, reading performance and retention were improved compared to text-only books. The supplementary books that have been developed from the study results was set forth in a teaching material for students so that students could understand the basic principles of ecology, development and the role of mangroves in people's lives and the ecosystem in them. In addition, these books also described the design of a mangrove study, especially in analyzing vegetation and how to calculate mangrove diversity as a material or guide for students in carrying out the same field research. The comparison of the mean percentage of students' responses to the individual, small group, and limited field tests as presented in Figure 1.

3.6. Dissemination and Effectiveness Test of Supplementary Books

The book dissemination was carried out to 48 students consisting of 22 students in PSB 2019 and 26 students in PSB 2018 at Universitas Negeri Medan by giving them pretests and posttests. The pretests were done before reading the books. Both pretests and posttests used 30 multiple choice tests that have been validated by the validators and declared feasible. The pretest score for the students in PSB 2019 was 60.15 and the pretest score for the students in PSB 2018 was 62.95. Meanwhile, the posttest score

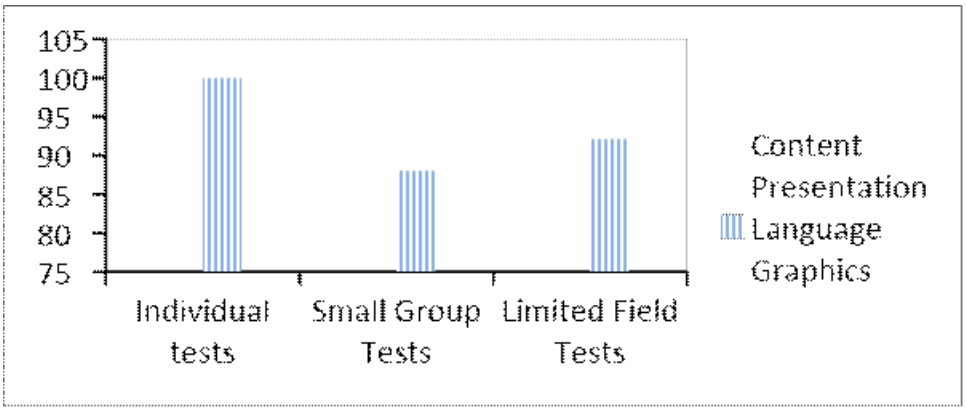

Figure 1: Percentage of students' responses on supplementary books.

for the students in PSB 2019 was 80.25 and the posttest score for the students in PSB 2018 was 83.01. The results of the students' pretest and posttest analysis at Universitas Negeri Medan showed an increase in scores. The score increase was followed by differences in the entire score of students at Universitas Negeri Medan. Furthermore, the difference in the mean pretest and posttest scores was significantly carried out by the Wilcoxon test as presented in Table 6.

TABLE 6: Wilcoxon test on students' pretest and posttest scores.

		N	Mean Rank	Sum of Ranks	Asym Sig. (2-tailed)	Level of Significance
Posttest - Pretest	Negative Ranks	0[a]	0.00	0.00	0.000	0.05
	Positive Ranks	48[b]	24.50	1176.00		
	Ties	0[c]				
	Total (N)	48				

Based on the data of statistical tests through the Wilcoxon test, it was known that Asymp.Sig. (2-tailed) was 0.000. Because the value of 0.000 was less than the level of significance 0.05, it seems that the hypothesis was accepted, meaning that there was a significant difference in learning outcomes during the pretest (before reading the supplementary books) and posttest (after reading the supplementary books) by students. In the end, it could be concluded that there was an increase in students' cognitive results from pretests to posttests.

3.7. N-Gain Score

The N-gain test was carried out at the distribution stage to determine the effectiveness of the supplementary books that have been developed in improving students' cognitive

about mangroves. The N-gain test involves the students' pretest and posttest scores. It was known that the posttest mean score was 81.83 and the pretest mean score was 61.75. As the analysis was carried out, it obtained the total gain score of 24.84 with the mean score of 0.52 in a moderate category. Based on these results, a field research-based-mangroves supplementary books had a good effect on the success of the students' learning processes to improve their understanding and cognitive abilities. This was because the achievement of student learning success was supported by the feasibility of supplementary books that has been made and used by students.

Books are a medium in education that contains information about learning materials formulated from the basic competencies contained in the curriculum, used in learning facilities and used for lecture materials, because it is indispensable for teachers or lecturers to be able to produce a book that is not only educating, but also enlighten and upload students' spiritual reasoning to be creative and innovative [10]. Books play a very important role in the learning and learning process [11].

According to [12], quality teaching materials are teaching materials that have a content component that helps students answer problems to achieve a learning goal. The books used can be in the form of textbooks or non-textbooks. Non-text books are books that can be used in educational institutions, but are not mandatory reference books for students in participating in learning activities. Therefore, the material from the books is not developed based on competency standards and basic competencies in content standards, but must be related to material in accordance with content standards and the achievement of learning objectives. Non-text books do not have questions or exercises that are used to determine the extent of students' understanding of the topic being studied [13]. The books developed for the ecology subject are the supplementary books that are included in the type of non-text books. The supplementary books that have been developed are the supplementary books from the results of field research.

In the field research-based supplementary book that was developed, it contains material descriptions from basic concepts to findings (research). These supplementary books present learning material on the topic of mangroves. The content of the material in this book does not only describe theory but also contains facts obtained through research carried out accompanied by illustrations in the form of pictures, work steps and diagrams. So that the developed books can improve abilities and skills in analyzing and solving problems [14].

The book development process is adjusted to the instructional objectives of the course, by collecting various information from various library sources, such as text books, scientific articles, journals, and mass media, then packaged according to student needs

and written as teaching material using a systematic framework [15]. The supplementary books can enrich and improve mastery of science and technology, skills, and shape the personalities of students, educators, education managers, and other communities. The learning material in the supplementary books that is made must be more applicable, so that it can further increase reading interest for students, because it is not only a concept that they get but can also be useful in their lives [16].

4. CONCLUSION

The field research-based mangroves supplementary books were developed in 4 stages based on the Thiagarajan (4-D) model. In preparing the book products, the first step in this study was to conduct the field research. The supplementary books that have been developed for students were very good and suitable for use in learning in ecology courses based on the assessment criteria from the eligible experts. Students and lecturers also gave excellent responses to the field research-based mangroves supplementary books. From the N-Gain score test, these products were very effective for improving students' cognitive skills based on the pretest and posttest results.

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