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Development Of Lichens Nontext Book As A Research-Based Bioindicator Of Air Pollution In Medan City

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ABSTRACT

There are very few books of Lichens as a bioindicator of air pollution in the city of Medan, so the purpose of this study is to develop a non-textbook about Lichens as a research-based bioindicator of air pollution in the city of Medan. This type of research used Research and Development 4D Thiagarajan. The method used in this research is the book feasibility test, N-Gain, and t_{test}. The validated book results are 88% (material aspect is very feasible), 82% (language aspect is very feasible category) and 83% (graphic aspect is very feasible category). The results of the product trial showed that the test results obtained were 87% (the individual aspect was in the very feasible category), 82% (the small group was in the very feasible category) and 85% (the limited group was very feasible category). The non-text book was then tested for the effectiveness of its use on 28 students, it was obtained 0.84 with a percentage of 80% (effective) and the general public as many as 25 high school teachers, it obtained 0.93 with a percentage of 93% (effective). The t-test results obtained $t_{count} > t_{table}$, namely, 9.096> 1.703 for the cognitive abilities of students majoring in Biology at the State University of Medan, and the t_{test} results obtained $t_{count} > t_{table}$ namely, 8.345> 1.729 for general public cognitive, it can be concluded that the results of the t-test are obtained significantly, and non-text books have an effect on improving cognitive abilities of students and the general public, with $\alpha = 0.05$.

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INTRODUCTION

Books are one of the most used and easiest learning sources. Books have an especially important function in the process of acquiring knowledge. Mastery of science may only be achieved by reading books because

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almost all knowledge is documented in written form (Basuki, 2009).

Textbooks are books that are often used to gain knowledge. However, not all knowledge is contained in textbooks. This is because the textbooks are arranged based on a curriculum so that the information or knowledge in the textbook is limited to the Low Level Organism Taxonomy course. So that additional books are needed to add information and knowledge in the form of non-text books about Moss as an Air Pollution Bioindicator.

General public knowledge about moss as a bioindicator of air pollution is very minimal. This is evident from the results of an analysis of the needs of the general public which was conducted on 25 alumni in February 2020. The result was that 64% of alumni did not know detailed information about moss as a bioindicator of air pollution and said that the information contained in the dictates was not specific to moss as a bioindicator of pollution. air. While 36% of alumni already know information about moss as a bioindicator of air pollution and said that this information is contained in a special order for moss as a bioindicator of air pollution. The results of this analysis were obtained from questionnaire data to analyze the needs of the general public. From the results of this analysis, it is necessary to develop a Non-Text Lichens Book as a Research-Based Air Pollution Bioindicator in Medan City.

Books, book development research on Lichens as a bioindicator of air pollution are very few. This is evidenced by observations in the libraries of USU, Unimed, UMA, and UISU in October 2019. Therefore, it is necessary to develop the book Lumut as a research-based bioindicator of air pollution in Medan City so that people and students know the benefits of Moss and can recognize the characteristics of Moss. absorbs a lot of air pollution.

METHOD

Study area-1

Research on *Lichens* as a bio indicator has been carried out in 3 places with different indicators. A fairly high indicator of polluted environment is found in the Medan Industrial Estate in Mabar (Jalan Pulau Batam No.1, Sampali, Percut Sei Tuan district, Deli Serdang regency, North Sumatra 20371), Low polluted indicators are found in the Banyan Park (Jalan Jenderal Sudirman, Anggrung, Medan Polonia district, Medan city, North Sumatra 20151) and very low polluted indicators are found in T-garden (Jalan Jati Kesuma, Namorambe District, Deliserdang Regency, North Sumatra 20353).

Procedure-2

The type of research used in this research is research and development. Development research is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2019). This type of research has 4 stages, namely: Design, Develop and Disseminate. This method and model were chosen because it aims to produce a product in the form of book media. The product developed is then tested for its feasibility with validity and product testing. The subjects of this development research are Undergraduate Biology Education Students who participate in the Low Level Organism Taxonomy Course, and the general public (Minimum S1 graduate).

Data Analysis-3

The field research conducted was analyzed using analytical techniques, namely:

1. Calculates the diversity of *Lichens*

$$H' = -\sum PiLnPi$$

2. Calculate the area of the tree

$$Tree\ trunk\ area:$$
$$tree\ circumference\ x\ tree\ weight$$
$$Tree\ circumference = 2\pi r$$

(Nurjanah, 2016).

Book products are tested for their feasibility, the data obtained in this study can be calculated using the formula (Sugiyono, 2015):

$$P = \frac{\Sigma}{N} X\ 100$$

Furthermore, the data obtained will be analyzed descriptively by calculating the presentation score for each criterion in the research-based book developed, in order to obtain a percentage of the feasibility of the aspects assessed by the following formula:

Percentage score =

$$\frac{Total\ Indicators\ per\ Category}{Indicators\ in\ all\ Categories} x\ 100\%$$

After the development stage is complete, the dissemination stage is carried out, the purpose of this stage is to disseminate books and test the effectiveness of books. After validation by experts, a limited field trial was conducted to determine the results of the application of research-based non-textbooks in learning activities. This book-based trial was carried out in 1 class of Biology Education Undergraduate Students at Medan State University who took the 2nd semester of the Low Level Organism Taxonomy Course, and the general public, namely Grade X High School biology teachers. The N-gain test was conducted to determine the effectiveness of using non-textbooks developed in improving the general public's cognitive about *Lichens* as bio indicators of air pollution. The category of cognitive enhancement of the general public can also be known by calculating the pretest and posttest scores using the Normalized gain formula by Meltzer (2002) as follows:

$$<> = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

RESULT AND DISCUSSION

Result

Based on the results of the assessment of the material and the presentation of the material by the validator, an average percentage score of 88% was obtained with a very decent predicate and the feasibility data for the material aspect and its presentation can be seen in Table 1. The results of the language assessment from the language validator for non-teaching books developed obtained an average score percentage an average of 82% with a very decent predicate and can be seen in Table 2. Meanwhile, the results of the language assessment from the developed non-teaching book layout design validator obtained an average score percentage of 83% with a very decent predicate and shown in Table 3.

Based on the results of Lichens' nontext book assessment as a bio-indicator based on air pollution research in Medan City, it was found that 6 people representing each field research area rated 87% in the very feasible category. Meanwhile, a small group of 10 SMA class X teachers rated 82% as very feasible. Assessment by a limited group, namely non-educational C students in 2018, 85% were in the very decent category. Due diligence data can be seen in Table 4.

Based on the results of the N-Gain test which was carried out from the results of the pretest and posttest of students and the general public, it was obtained 0.84 (84%) for the N-Gain test of students with the high N-Gain category (Effective) and the result was 0.93 for the N-test. Gain of the general public (class X high school teacher) with the high N-Gain category (Effective). Data on the results of the pretest and posttest assessments with N-Gain can be seen in Table 5. Meanwhile, in a t_{test} using IBM SPSS Statistic 21, the t_{test} value in the general public (class X high school teacher) is 9.09, with the t_{table} (α = 0.05, df = 27) namely, 1.703. Based on the results obtained, it is certain that in general the *Lichens* non text

book as a bioindicator of air pollution in Medan City can improve the cognitive abilities of the Students with the ratio: $t_{count} > t_{table}$ = 9.096> 1.703. Data on the results of the t_{test} for students can be seen in Table 6.

For the t_{test} using IBM SPSS Statistic 21, the t_{test} value in the general public (class X high school teacher) is 8.345, with the t_{table} (α = 0.05, df = 27) namely, 1.729. Based on the results obtained, it is certain that in general the *Lichens* non-textbook as a bio indicator of air pollution in Medan City can improve the cognitive abilities of the general public with the ratio: $t_{count} > t_{table}$ = 8.345> 1.729. Data on the results of the t_{test} for the general public can be seen in Table 7.

Table 1. Data on the Feasibility Value of Material Aspects and Their Presentation

No.	Sub-aspect of Assessment	Score	Category
1.	The suitability of the material description with the readers	65%	Feasible
2.	Legal certainty in terms of material	100%	Very Feasible
3.	The authenticity and correctness of the material	80%	Feasible
4.	Material proficiency	100%	Very Feasible
5.	Material sources	80%	Feasible
6.	Presentation technique	93%	Very Feasible
7.	Utilization of the material	90%	Very Feasible
8.	Presentation feasibility	100%	Very Feasible
	Average score percentage	**88%**	**Very Feasible**

Table 2. Data on Feasibility of Language Aspect

No.	**Sub-aspect**	**Percentage score**	**Category**
1.	Language use	86%	Very Feasible
2.	Writing and terms	80%	Feasible
3.	Cohesiveness and Integrity	80%	Feasible
	Average score percentage	**82%**	**Very Feasible**

Table 3. Data on the feasibility of layout design aspects of the book

No.	**Sub-aspect**	**Score Percentage**	**Category**
1.	Book cover design	80%	Feasible
2.	Book layout	73%	Feasible
3.	Book Content	90%	Very Feasible
4.	Typography	75%	Feasible
5.	Illustration (Tables and charts)	100%	Very Feasible
	Average score percentage	**83%**	**Very Feasible**

Table 4. Feasibility Trial Data

No.	Research subject	Evaluation Aspect	Value	Category
1.	Individual	Material	94%	Very Feasible
	(6 representatives from each field	Language	84%	Very Feasible
	research area)	Presentation	87%	Very Feasible
		Graphics	83%	Very Feasible
		Average	**87%**	**Very Feasible**
2.	Small Group	Material	91%	Very Feasible
	(10 Grade X High school teachers)	Language	80%	Feasible
		Presentation	80%	Feasible
		Graphics	80%	Feasible
		Average	**82%**	**Very Feasible**
3.	Students (32 people from Non-Education	Material	91%	Very Feasible
	C class 2018)	Language	85%	Very Feasible
		Presentation	80%	Feasible
		Graphics	85%	Very Feasible
		Average	**85%**	**Very Feasible**

Table 5. Results of Pretest and Posttest Assessments with N-Gain

No.	Research Subject	*Pretest* Score	*Posttest* Score	Maximum Score	*N-Gain* Value	*N-Gain* Percentage
1.	2nd semester Biology students (Total of 28 people)	616	806	840	0.84 (Height)	84% (Effective)
2.	Public (Grade X high school teachers, with a total of 25 people)	441	589	600	0.93 (Height	93% (Effective

Table 6. Student t_{test} result data

Research subject	Average Pretest Results	Average Posttest Results	t_{count}	t_{table}
Students	73.25	96	9.096	1.703

Table 7. Student t_{test} result data

Research subject	Average Pretest Results	Average Posttest Results	t_{count}	t_{table}
General Public	73.45	98.25	8.345	1.729

Discussion

Lichens can be used as bio indicators that will show changes in circumstances, body resistance, and will react as a result of changing environmental conditions which will provide information about changes and levels of environmental pollution. *Lichens* acts as a decomposer and as a bioindicator of environmental pollution (Campbell, 2010).

Lichens are extraordinary plants. Unlike ordinary moss that grows in humid places, *Lichens* can grow in difficult places, those that are very cold and dry. *Lichens* live as epiphytic plants on trees, but can also live on the ground, especially in the area around the north pole, on rocky rocks, on the coast and also in high mountains (Tjitrosoepomo, 2011).

Environmental factors are very influential with the diversity of a species, one of which is the growth of *Lichens*. Environmental factors that affect the environment include temperature, humidity, light intensity and topography. *Lichens* generally stick to tree bark, so the bark will become a substrate for *Lichens*. The nature and condition of the bark of the plant will directly affect the shape and condition of the development of thallus in *Lichens* (Susilawati, 2013).

Lichens are known to be plants that are sensitive to air pollution, if the air quality in an environment has decreased, their growth will be stunted. Color differences do not only occur in differences between types of *Lichens*, but can also occur in the same species that develop in different places. The different substrates and conditions where *Lichens* grew resulted in different responses for each plant. In locations where the air quality is better for growth, *Lichens* have thallus with bright colors. Conversely, in locations with low air quality *Lichens* have a dull colored talus (Sofyan, 2017).

According to Puskurbuk (2008), non-textbooks have the following characteristics: (1) Non-textbooks can be used in schools or educational institutions, but they are not mandatory reference books for students in participating in learning activities; (2) Non-textbooks provide material to enrich conventional textbooks, or as information about science and technology in a deep and broad manner, or as a guidebook for readers;

(3) In the case of publishing, non-textbooks are not published in series based on educational levels; (4) The material or content of non-textbooks can be used by readers from all levels of education and school grades or across readers; and (5) In terms of presentation, non-textbooks are loose, creative, and innovative so that they are not bound by the provisions of the learning process and systematics which are determined based on the science of education and teaching.

Development of *Lichens* non-textbook as a research-based bio indicator of air pollution in Medan made use of the Thiagarajan (4-D) development model, which includes the Define, Design, Develop, and Disseminate stages. The first stage in the Thiagarajan development model is the Define stage, where analysis and determination of problems, weaknesses and needs for a condition are the driving forces behind the development of a product (Prasetyo, 2015).

The second stage is Design. At this stage, the main aspects that need to be considered are the selection of formats and media for materials and the production of the initial version (Prasetyo, 2015). This stage involves designing a product and designing an assessment validation sheet. Selection of presentation forms or formats that already exist and are adapted from close reference sources (Widyaningrum et al, 2015).

After reviewing it, a simple, unique, colorful layout, presentation and format was chosen, the material discussed started from simple to complex, the understanding of the material was presented coherently and clearly, and the language used was standard but not standard so it could be easily understood because this book is for all people at all levels of education.

The design of the validation sheet was developed based on Puskurbuk (2008), presented in the form of a questionnaire containing every item of the assessment aspect, consisting of material, presentation, language and graphic aspects. The validation sheet or questionnaire assessment of the book is intended for expert validators, the general public with undergraduate degrees and students to assess the feasibility of this non-textbook.

The normalized gain test (N-Gain) was carried out to determine the increase in student cognitive learning outcomes after being treated. This increase was taken from the pretest and posttest scores obtained by students. Normalized gain, or abbreviated as N-Gain, is a comparison of the actual gain score with the maximum gain score, the effectiveness of using non-textbooks developed in improving good cognitive if the normalized score gain is greater than 0.4 (Hake, 2002).

Lichens non-textbook as a bio indicator of air pollution in Medan City was produced based on validation/feasibility tests by 3 expert validators, namely lecturers in the field of *Lichens*, language and graphics. Expert validators must have at least a master's degree and have served for 5 years. The non-textbook products developed are intended for students, teachers, students and the general public to enrich their knowledge and understanding of *Lichens* as bio-indicators of air pollution in Medan City.

Based on the Ministry of Research and Technology and Higher Education (2012), relating to Government Regulation Number 19 year 2005 regarding National Education Standards and the duties of the National Book Center of the Ministry of National Education in controlling the quality of books, then those who have the authority to standardize textbooks are National Education Standardization Agency (BSNP).

The pattern of presenting a material will be considered good if the material is presented consistently, systematically and coherently so that it can help in understanding the content of the material. The placement of images in the book must be in accordance with the material discussed. Images must also have a caption so that readers can observe the image without turning the pages of the book (Martin, 2012).

CONCLUSION

If the polluted environment is high, the Lichens diversity index is low, and if the polluted environment is low, the Lichens diversity index is high. The results of the N-Gain test which was carried out from the results of the students' pretest and posttest scored 84% for the N-Gain test of students in the effective category. The results of the N-Gain test which was carried out based on the general public pretest and posttest results (Grade X high school teacher) scored 93% in the effective category. If the results of the N-Gain test are effective, then the book is effective to use because it improves the cognitive abilities of students and the general public. The N-Gain test is also supported by the t-test with the results of $t_{count} > t_{table}$ for students and the general public, namely: 9.096 > 1.703 and 8.345 > 1.729. If $t_{count} > t_{table}$, the book that is distributed will improve the cognitive of students and the general public.

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