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Development biology reference book-based utilization telang flower (Clitoria ternatea L.) for food packaging natural indicators

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ABSTRACT

This study was based on the lack of knowledge and sources of information and the absence of media development regarding the potential utilization of telang flowers (*Clitoria ternatea* L.) as a natural indicator of food packaging among the general public. Therefore, the development of information media in the form of a biology reference book based on the utilization of the potential of telang flowers as a natural indicator of food packaging, assessing the feasibility of the developed reference book, and the community's response to the developed biology reference book. The research method used is R&D (Research and Development) with the 4-D development model modified into 3-D, which consists of 3 stages Define, Design, and Develop. The biology reference book developed is classified as feasible to use because it obtained an average score of 92.66% (very good) on the material expert validation and a percentage of 79.60% (enough) on the media expert validation. The results of the community's response are good categories with an average percentage of 80.99%. So, it is feasible to use a source of information for the general public. This research produced a source of information in the form of a biology reference book for the general public.

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INTRODUCTION

Indonesia is a country that has a fairly high level of biodiversity. Indonesian people utilize the existing plant biodiversity for clothing, shelter, and food needs. Several kinds of plants have been widely taken advantage of as traditional medicinal ingredients, main ingredients for crafts, industry, and natural coloring materials. Plants have natural dyes and distinctive colors, therefore their use has the potential to be used as natural dyes. According to research from Santa & Mukarlina (2015), dyes found in plants can also be formed such as chlorophyll, carotenoids,

flavonoids, quinones, and anthocyanins. Berlin, Linda, & Mukarlina (2017) conducted research that plants can produce natural dyes from each part of the plant such as the leaves of tom trees (*Indigofera tinctoria*), soga tree bark (*Ceriops tagal),* tegeran wood (*Cundrania javanensis*), mengkudu roots (*Morinda citrifolia*), and telang flowers (*Clitoria ternatea* L.).

One of the natural materials used as a natural colorant is telang flower (*Clitoria ternatea* L.). According to Kazuma, Noda, & Suzuki (2003), telang flowers contain flavonoids, anthocyanins, flavanol glycosides, kaempferol glycosides, quersetin glycosides and mirisetin glycosides found in the flower crown. In addition to having the potential to be used for natural dyes, bay flowers also have the potential for natural indicators on food packaging because they have a stable pH. Natural indicators are markers or signals made from natural components produced from colored plant parts, such as roots, leaves, stems, and flower petals that are used to test the state of the product during storage into acids or bases (Indira, 2015). Telang flower utilization has been widely used as a colorant in various local food products in Indonesia and Southeast Asian countries. This utilization is still limited to food products that do not last long (Angriani, 2019). However, from the results of the exploration, it turns out that in Indonesia there are still not many people who know and the limited knowledge of the local community regarding the benefits of telang flowers as potential natural indicators on food packaging. Therefore, it is necessary to develop reference book media as a source of information and knowledge among the public about the potential utilization of telang flowers as natural indicators of food packaging. Some information media that can be used by the community include television, magazines, posters, reference books and so on. The information media developed needs to pay attention to the needs of the community so that it is appropriate and by its use.

The solution that can be offered to overcome the problems described above is the development of biology reference book media. The reference book is a scientific writing presented in the form of a book and the discussion is only centered on certain fields of science (Sitepu, 2012). Biology reference books can help the general public as a source of information because of their attractive design, use of appropriate language, and simple sentences that are easy to understand. Piranti (2016) explained that reference books are effective learning resources used to understand general information or certain scientific fields. The completeness of the content presented in the reference book makes it easy for readers to capture and understand the development of the scientific theory that is the topic of discussion. The development of reference books is made according to the needs of the community so that the material can be understood properly and effectively to provide education related to the potential and utilization of bay flowers as a natural indicator of food packaging. In Zuhriyah's research (2020) with the title "Development of the Fabaceae Family Plant Morphology Reference Book as a Learning Resource". The results of the study found that the Fabaceae family plant morphology reference book is valid to be used as a learning resource. This is seen from the level of validity of the reference book, which is valid, which does not require revision from both supervisors, material experts, media experts and students. The novelty of this research is in the focus of the research developed. In this study, it focuses on the development of a reference book on the morphology of plants of the fabaceae family, while the author's research focuses on the development of a biology reference book on the use of telang flowers as natural indicators. The biology reference book on the potential utilization of telang flowers is expected to be able to attract the attention of the surrounding community to study plants that have benefits as natural indicators of food packaging and also the preservation of the telang flower plant so that it is maintained and cultivated by the community. This study aims to analyze the feasibility of biology reference book products based on the potential utilization of telang flowers as a natural indicator of food packaging based on expert validators and community responses

RESEARCH METHODS

Research Design

The development research entitled "Development of a Reference Book Based on Utilization of the Potential of Telang Flowers (*Clitoria ternatea* L.) for Natural Indicators of Food Packaging", development was carried out using the R&D (Research and Development) development method. This study uses the 4-D development model modified by Thiagarajan (1974) into a 3-stage (3-D) model consisting of the Define stage which contains the initial analysis and needs analysis stages, the Design stage contains the media selection stage, format selection, initial product design, and the Develop stage contains product preparation, validation testing, revision, and product feasibility testing. The development stages were modified because this study focused on the development of biology reference books and did not reach the disseminate stage. This research only reached the disseminate stage due to time and cost constraints.

Population and Samples

The population used in this development research is the general public as a response to the feasibility test of the book products that have been developed and 7 people were selected as samples with the same background, namely the Farmer Women's Group (FWG). The basis for selecting the farmer women's group as a sample is because it is one of the women's groups that cultivate Telang flower plants in Kebonrejo, Candimulyo Village, Magelang District.

Instruments

The research instrument used in the development research is a material validation sheet in the form of an assessment questionnaire regarding the material contained in the biology reference book media, media validation sheet in the form of an assessment questionnaire regarding the appearance, layout, and design of the biology reference book that has been developed, a community response sheet in the form of an assessment questionnaire with 11 (eleven) short questions to see the results of the community's response to the biology reference book media developed and to assess the feasibility as an information source media. The material and media validation questionnaire instruments were generated from the adoption of research (BSNP, 2006).

Figure 1. Research stages

Procedures

The stages in the research of R&D (Research and Development) development research are based on the explanation of the problems above, it is necessary to provide information about the utilization of the potential of Telang flowers as a natural indicator of food packaging to the community. (1) Development of research results into information media for the community is carried out. (2) Produced biology reference book media which is a source of knowledge and information to the general public. The research stages can be seen in Figure 1.

Data Analysis

Data analysis techniques used in R&D *(Research and Development)* development research are validation instruments used to validate products. Validation instruments include material expert validation, media expert validation, and community response. Validation from material experts, media experts, and community responses is needed to test the feasibility of the product in the form of a biology reference book. Validation was carried out by one expert lecturer as a validator and community response was carried out by the Women Farmers Group. Data from material and media expert validators as well as community responses will be analyzed on a scale of very good, good, sufficient, less, and very less. The value scale analysis uses a Likert scale with the following provisions, namely:

VP	(Very Poor)	: 1	L	(Less)	: 2
E	(Enough)	: 3	G	(Good)	: 4
VG	(Very Good)	: 5			

Then accumulated and calculated the average score with the formula:

$$\sum X = \frac{Total\ score}{Maximum\ score} \text{ X } 100\ \%$$

Description:
$\sum X$ = sum of scores

After being accumulated and calculated, it is then determined by the assessment criteria which can be seen in Table 1.

Table 1. Biology reference book assessment criteria

Score Range	Category
X > 90%	Very good
80% < X ≤ 90%	Good
70% < X ≤ 80%	Simply
50% < X ≤ 70%	Less
X ≤ 50%	Very Less

Source: Anikan & Danang, 2014

RESULTS

Based on the development research that has been carried out, the results are in the form of reference book development developed through 3 stages, consisting of the define stage, the design stage, and the developing stage. The define stage is the stage carried out to analyze the needs that

aim to define the requirements of development as well as the determination of products by the specifications. Then the second stage is the design stage which is the design stage, at this stage the design of biology reference book products is carried out and an assessment measure is made in the form of product validation by material experts and media experts as well as community response. The last stage is the development stage or the development stage where this biology reference book is validated by media experts and material experts as well as feasibility tests by the community to assess whether the reference book is feasible or not to use.

Define Stage

In this defining stage, what is done is to analyze the needs that aim to define the requirements of development and the determination of products that are in accordance with the specifications. The analysis of the results carried out is experimental research. The data from the experimental research was then analyzed using preliminary analysis and needs analysis by what was discussed that would become material or content in the reference book. The analysis can be seen in Table 2.

Table 2. Preliminary analysis and needs analysis of biology reference books

Analysis	Results
Initial Analysis	Reference books need to be developed to be used as a reference for processing, utilizing, and preserving telang flowers through their antioxidant content and their potential as natural dyes, so many people use telang flowers as natural dyes for natural indicators of food packaging.
Needs Analysis	Based on interviews with the community, namely one of the Telang flower cultivators in Kebonrejo Village, Candimulyo, Magelang Regency, there is no development of reference books among the community that discuss the antioxidant content in Telang flowers that have potential as natural dyes and used as natural indicators.
	Reference books are accessible to all members of society.
	Making a book is done with several processes consisting of (1) *Pre-writing is* done by analyzing the problem, namely the lack of biology reference books on the potential use of Telang flowers as a natural indicator, (2) *Writing* is writing the content or material that will be discussed and presented in the biology reference book, (3) Revision or improvement is carried out based on input from the supervisor and also material and media expert validators and community responses, (4) *Proofreading* is a review in writing grammar.
	Analyzing data on anthocyanin levels in Telang flowers that have potential as natural indicators. Furthermore, the validation results are used for book revision so that the biology reference book becomes better to use.
	Material analysis also needs to be done to select materials related to the subject that are by biology reference books. The material includes general characteristics of bay flower plants, antioxidant content in bay flowers, antioxidant potential in bay flowers, and the potential of bay flowers for natural indicators of food packaging.

Design Stage

In the design stage, several stages are carried out to design a biological reference book that discusses. This design stage is carried out by several systematics consisting of designing a biological reference book product framework. In addition, the determination of material or content and the creation of media display concepts are also carried out. The material or content is arranged in a systematic manner which can be seen in Table 3.

Table 3. Systematization of biology reference books

Systematics	Material
The Beginning of the Book	Written information on the book and the purpose of this reference book is made. The introduction consists of a title page, preface, table of contents, list of figures, and list of tables.
CHAPTER I	Discuss: - General characteristics of bay flower plants (definition, morphological classification, biochemical content and cultivation)
CHAPTER II	Discuss: - Antioxidant content in Telang flowers (antioxidants, polyphenols, flavonoids, anthocyanins that are utilized in the health sector and food industry)
CHAPTER III	Discuss: - Antioxidant potential of bay flowers (bay flower anthocyanins as food colorants and their potential as indicators)
CHAPTER IV	Discuss: - Potential of Telang flowers for natural indicators of food packaging (understanding of food packaging in general and food packaging that has the potential as smart packaging from Telang flowers)
CHAPTER V	The closing which consists of conclusions includes suggestions regarding the potential and prospects regarding the use of bay flowers as a natural indicator of food packaging.
End of the Book	The final part of the book consists of a bibliography, glossary, index, and author profile.

The cover of the biology reference book, both front and back, can be seen in Figure 2 and Figure 3. The front cover contains the title of the book, the author's name, the type of book, the logo of Tidar University, and several illustrations listed. Similarly, the back cover contains a synopsis or summary of the content or material of the book, the title of the book, some illustrations, and the logo of Tidar University.

Figure 2. Front cover of the book

Figure 3. Back cover of the book

Develop Stage

a. Material expert validation results

The biology reference book Utilizing the Potential of Telang Flowers as a Natural Indicator on Food Packaging has completed material validation by validators who are experts in the field of the material. The material expert validation questionnaire consists of 14 questions consisting of aspects of content feasibility, presentation feasibility, and language assessment. The data obtained based on the assessment of the material expert validator can be seen in Table 4.

Table 4. Analysis of material expert validation results

Aspects	Percentage (%)	Eligibility Criteria
Content eligibility	92%	Very good
Presentation feasibility	90%	Good
Language assessment	96%	Very good
Average	92,66%	Very good

Based on Table 4, the data analysis from the material expert validation results obtained a total average percentage of 92.66%. The percentage obtained is categorized in the score range > 90% which is included in the very good category. Based on the assessment by material experts, this biology reference book is very good and suitable for use as a source of information and knowledge with some notes and input.

b. Media expert validation results

The biology reference book Utilization of Telang Flower Potential as a Natural Indicator on Food Packaging has been validated by validators who are experts in the field of media. The questionnaire for the media expert validation test consists of 16 questions consisting of aspects of the size of the reference book, cover design and reference book content design, simple typography of reference book content, and illustrations of the contents. The data obtained based on the assessment of media expert validators can be seen in Table 5.

Table 5. Analysis of media expert validation results

Aspects	Percentage (%)	Eligibility Criteria
Reference book size	80%	Good
Reference book cover design	76%	Enough
Reference book content design	76%	Enough
Simple typography of reference book content	86%	Good
Illustration of contents	80%	Good
Average	79,60%	Enough

Based on Table 5, data analysis from the results of media expert validation obtained a total average percentage of 79.60%. The percentage obtained is categorized in the score range 70% < X ≤ 80% which is included in the sufficient category. Based on the assessment by media experts, this biology reference book shows that the reference book is suitable for use with improvements/revisions.

c. Community response results

The biology reference book Utilizing the Potential of Telang Flowers as a Natural Indicator on Food Packaging has been carried out as a feasibility test response by the community of the Women Farmers Group (KWT) in Kebonrejo, Candimulyo Village, Magelang Regency. The data obtained based on the assessment of the community can be seen in Table 6.

Table 6. Results of public response to the product

Aspects	Percentage (%)	Eligibility Criteria
Interest	88%	Good
Material	82,14%	Good
Language	72,85%	Enough
Average	80,99%	Good

The average results of 7 people's responses to the product can be seen in Table 6. Based on the results of the assessment by a group of 7 people, the average total percentage is 80.99% The percentage obtained is categorized in the score range 80% < X ≤ 90% which is included in the good category. Based on the assessment by the community, this biology reference book shows that the reference book is suitable for use by the wider community with some input and suggestions.

d. Average validation results of material experts and media experts

Based on the data obtained from both material experts and media experts, the average percentage is then calculated to determine the feasibility of the material and media. The validation results of the average material expert, media expert, and community response can be seen in Table 7.

Table 7. Average results of material and media validation

Assessment Aspect	Percentage	Eligibility Criteria
Material validation results	92,66%	Very good
Media validation results	79,60%	Enough
Average	86,13%	Good

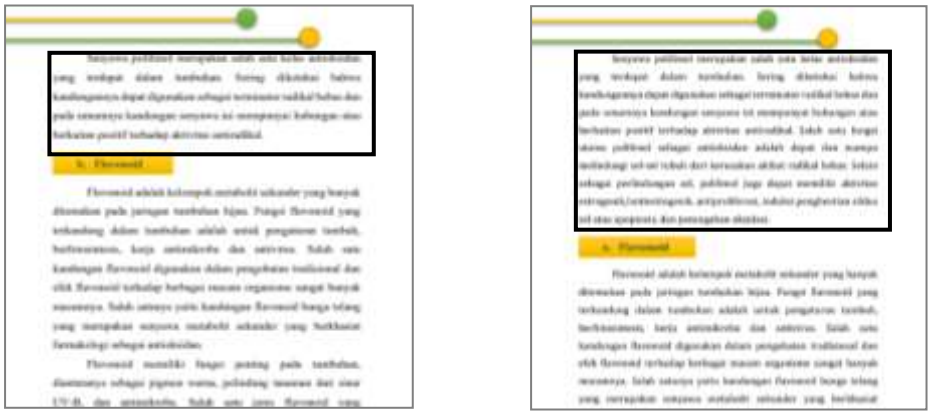
Based on the acquisition of data that can be seen in Table 7, which shows the average validation results of material experts and media experts, the average percentage is 86.13%. The average value is included in the category of the score range 80% < X ≤ 90%. These average results indicate that the reference book is suitable for use with improvements or revisions. The score range of scores is included in the good category.

e. Revision of validation results

In Table 8 and Table 9, comments, inputs, and suggestions are presented as well as a follow-up or revision of the draft reference book to be developed.

Table 8. Suggestions and follow-up comments on material aspects

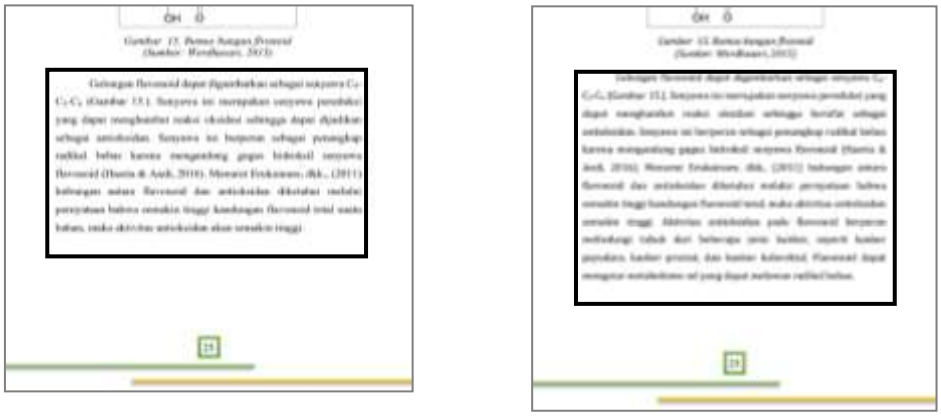
No.	Comments and Suggestions	Follow-up
1.	The polyphenol compound does not show the antioxidant function of polyphenols, it should be added and shown the antioxidant function of polyphenols.	Polyphenolic compounds have been added and the antioxidant function of polyphenols has been shown.



(a) (b)

Figure 4. (a) polyphenol compound section before revision, (b) revised polyphenol compound section

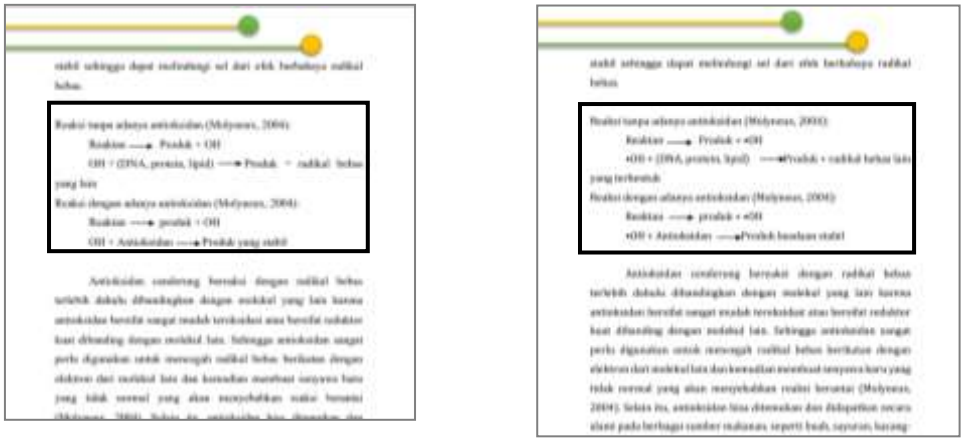
No.	Comments and Suggestions	Follow-up
2.	The flavonoids do not show how the antioxidant role is, it should be added to the antioxidant role of flavonoids.	In flavonoids, the antioxidant role of flavonoids has been added.



(a) (b)

Figure 5. (a) flavonoid section before revision, (b) revised flavonoid section

3.	In writing OH must be accompanied by a dot in front (· OH) which has the meaning of hydroxyl radical, you should add a dot in front.	The writing of OH already includes a period in front, namely (· OH).



(a) (b)

Figure 2. (a) OH writing section before revision, (b) revised OH writing section

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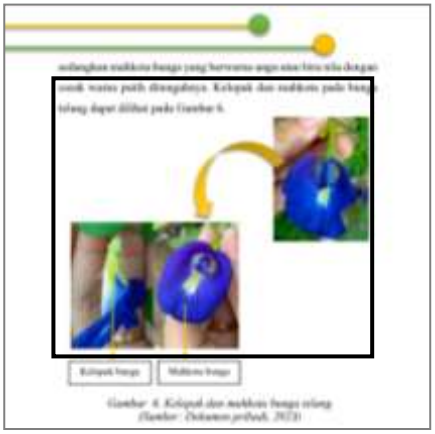
DISCUSSION

Based on the experimental research conducted, the results were developed into a biology reference book. The results of the research on the research were then used as material for the development of biology reference books using the 3D method. There are three stages of 3D research conducted, which can be seen in the following explanation.

Table 9. Suggestion and follow-up comments on media aspect

No.	Comments and Suggestions	Follow-up
1.	In the photo image, try to remove the hand background or re-take the image.	The photo image has been reshot.
	 (a)	 (b)
	The font of the book should not be Times New Roman, but a more attractive one.	The book font has been replaced with Cambria font size 11 to make it more attractive.
	 (a)	 (b)
3.	There are too many font variations on the cover and the writing is set left-aligned or straight.	The font variation on the cover has been replaced with 2 different fonts and the writing is left-aligned.
	 (a)	 (b)

A. Define Stage

At the define stage, researchers analyzed the results of the experimental research. Furthermore, it is analyzed regarding the initial analysis which serves to analyze the basis or find out the problems underlying the making of the biology reference book "Utilization of Telang Flower Potential as a Natural Indicator on Food Packaging" which can be seen in Table 2. In analyzing the needs of the defining stage, material analysis is also carried out. Material analysis is done by selecting or sorting the subject matter or material that is suitable to be used as content or content of biological reference books. The material included in the reference book includes an understanding of the general characteristics of bay flower plants, antioxidant content in bay flowers, antioxidant potential in bay flowers, and the potential of bay flowers for natural indicators of food packaging. Book development requires sorting of material that has the aim of making it easier for readers to better understand and understand what the contents of the book are (Yulia, 2014).

B. Design Stage

At the design stage, the author performs the stage of preparing the initial draft of the biology reference book to be developed. The purpose of this stage is to *design* a systematic and structured form of biology reference book to achieve the objectives that will be conveyed to the general public as readers (Kusrianto, 2013). The stage carried out is to make a systematic framework of the book based on the systematic guidelines of RISTEKDIKTI which can be seen in Table 3. The preparation of a biology reference book consists of two parts, namely the outside of the book in the form of a *cover* and the inside of the book in the form of content. The inside of the book contains content or material arranged as discussed in the previous paragraph. The *design* stage of this book relates to the initial physical appearance of the book to attract reading interest aimed at the general public.

C. Develop Stage

At the development stage, the process of improvement or revision is carried out based on input from material experts, media experts, and community responses. This stage consists of analyzing the results of the validation of material experts, media experts, and responses from the community which then shows how feasible biology reference books are to be used by the general public as a source of reading to gain knowledge and information. The complete analysis can be seen in Table 4 for the material expert analysis, Table 5 for the media expert analysis, and Table 6 for the community response analysis.

The validation was then assessed by expert validators and community responses using a Likert scale. The results of the material expert analysis by Mrs. Dea Santika Rahayu, M.Pd., obtained a percentage score of 92.66% with a very good category by the level of eligibility criteria put forward (BSNP 2006). This reference book category is included in the excellent category because several things underlie it. These results show how the feasibility of the content and material content in the reference book. The highest aspect is obtained in the aspect of language assessment. While the lowest aspect is in the presentation feasibility aspect, especially in supporting the presentation of material and the conciseness of concepts. In the assessment of the content feasibility aspect, it is assessed that the depth of the material still has several roles and benefits that should be added, therefore a follow-up is needed, namely by adding roles and benefits. In the assessment of the language aspect, it is assessed that the language used in the book is very communicative so that readers can more easily understand foreign terms that are less well-known and understood by the general public. In the language aspect, it is also assessed that the use of notations, symbols, or symbols is still inaccurate, especially in writing chemical formula symbols.

So that some symbol writing needs to be followed up, namely by correcting the writing so that it has the appropriate meaning. Through revisions given by material experts, there is material that must be reduced, changed, or added. This is related to the statement of Istifarida, Santoso, & Yusuf (2017) that reading media should not trigger and cause misinterpretation with concepts or frameworks and definitions that are easily understood by readers. The quality of a reference book is not determined by how the writing of the book is done, but rather by the amount of data and data references comprehensively.

The results of the media expert validation analysis by the media Mr. Setiyo Prajoko, M.Pd., obtained a score of 79.60%. This score falls into the sufficient category. Some of the things that underlie that the media in this book get a sufficient score are mainly the typography of the contents of the reference book which is simple and the design is quite interesting for a reference book and features several illustrations, although it still needs some input and improvement. In addition, in terms of the use of letter variations, it is not excessive. Overall, the media expert gave a scoring category of sufficient. Based on the average score obtained from material experts and media experts, the score is 86.13% which is included in the good category. The category is included in the good category so that the biology reference book developed is suitable for use. In line with research Anikan & Danang (2014) explained that if the average value obtained is in the range of scores 80 < X < 89, it is included in the good category and is suitable for use. Increasing public knowledge about the potential use of bay flowers as a natural indicator on food packaging in biological reference book media can support the achievement of community goals to better utilize and preserve bay flower plants to the fullest.

Several comments and suggestions are made as a reference for the revision of this biology reference book which has the aim that this book can be even better in terms of its presentation in the form of the outside of the book and the inside of the book to the readers, can be seen in Table 8 and Table 9. The material for improvement or revision provided by the media expert validator is related to some photo images that have hand backgrounds, book *fonts* that are made less attractive, *font* variations on the book cover are too many, and the consistency of writing titles in the book. Book revision is important because constructive comments, criticisms, and suggestions will be an important contribution to improving the quality or content of the book.

In the analysis of community responses, a score with a percentage of 80.99% was obtained in the good category. Some of the underlying feasibility of this reference book that this book gets a good score is mainly in the aspect of attractiveness, namely regarding the harmonization of colors, letters, sizes, images, and designs that are very attractive for reference books among the public. In addition, in terms of material, the discussion of this book is considered easy to understand based on the information presented. In line with the research of Sofiyana, Rohman, & Saptasari (2016) explained that graphics are a component of reference books related to the shape of the book, which consists of book size, *font* size, color, and illustrations that influence readers so that they are interested in reading books. In addition to graphics, the use of language and material is necessary, because it is the most important element in learning. Language is the means to acquire knowledge. The thing that is examined about the accuracy of the material is that the reader gains understanding and new information. Therefore, the biology reference book developed is suitable for use as a source of information and knowledge among the community with some improvements from media experts and material experts.

CONCLUSION

Based on the results of the development research conducted, namely the development of "Biology Reference Book Based on Utilization of Telang Flower Potential as a Natural Indicator on Food Packaging" is feasible to use. This is evidenced by the percentage of material expert

validation results of 92.66% which is included in the excellent category and the percentage of media expert validation results of 79.60% which is included in the sufficient category so that it is suitable for use by the community by obtaining a percentage of 80.99%. In general, the validation aspects of the material and media experts obtained an average of 86.13%. The results obtained in this development research provide implications for several parties in the world of education and the general public. The implications include producing a source of information and knowledge in the form of a biological reference book on the utilization of the potential of Telang flowers for the general public.

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