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Development of Popular Scientific Book on the Type of Shrimp in Coastal Waters of Tabanio for Enhancing Critical Thinking Skills of Senior High School Students

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Abstract

This development research is intended to describe the results of the development of a popular scientific book on shrimp species in the coastal waters of Tabanio, including validity, practicality, and effectiveness. The development design used was a design of Tessmer adaptation, including self-evaluation, expert testing, individual testing, and only up to small group tests. The object of research was a popular scientific book developed. Simultaneously, the research subjects consisted of 3 lecturers of Master Education of Biology, Lambung Mangkurat University, and five senior high school students of Abdul Kadir Panyipatan. Data were collected using the techniques of observation, questionnaires, and tests. The results showed that a popular scientific book was declared very valid based on expert validation results, while based on individual tests, the popular scientific book was declared very good. The popular science book that has been developed was considered practical because the results of student responses are 96.5% with very practical criteria. The result of the implementation of the popular science book was an average of 93.3%. The popular scientific book was declared effective because students' critical thinking skills increased in the Small Group, with 94.5% and N-Gain of 0.8 on high criteria. This popular scientific book has a systematic and structured writing flow. This book contains a discussion with high values of local potential. The design used is simple but easy to understand, and includes species identification, and displays original images taken directly from the coastal forest of Tabanio. All of these are the hallmarks of this popular science book.

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan validitas, kepraktisan, dan keefektifan pengembangan buku ilmiah populer jenis udang di perairan pesisir Tabanio. Metode penelitian ini menggunakan model pengembangan Plomp dan Nieveen yang dibatasi pada tahap *prototyping phase* dimana *evaluasi formatif* berdasarkan Tessmer yang terdiri dari evaluasi diri, pendapat ahli, uji perorangan, dan hanya sampai uji kelompok kecil. Objek dalam penelitian ini ialah buku ilmiah populer yang dikembangkan, sedangkan subjek penelitian terdiri dari 3 dosen Magister Pendidikan Biologi ULM dan 5 siswa SMA Abdul Kadir Panyipatan. Teknik pengumpulan data dilakukan dengan observasi, angket dan tes. Hasil penelitian menunjukan buku ilmiah populer dinyatakan sangat valid berdasarkan hasil validasi ahli, sedangkan berdasarkan uji perorangan buku ilmiah populer ini dinyatakan sangat baik. Buku ilmiah populer yang telah dikembangkan dinyatakan praktis karena hasil respon siswa sebesar 96,5% dengan kriteria sangat praktis, dan hasil keterlaksanaan Buku ilmiah populer rata-rata 93,3%. Buku ilmiah populer dinyatakan efektif karena hasil kemampuan berpikir kritis siswa yang mengalami peningkatan pada Small Group dengan rata-rata 94,5% dan N-Gain sebesar 0,8 pada kriteria tinggi. Oleh karena itu, buku ilmiah populer "Jenis Udang di Perairan Pesisir Tabanio" ini dapat digunakan sebagai bahan pengayaan untuk melatihkan kemampuan berpikir kritis siswa SMA.

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A. Introduction

Competition in this era of globalization not only requires human resources who master science, but also requires human resources who have complex thinking skills, critical thinking, problem-solving, creativity, and metacognition. Prayitno *et al*. (2016) explained that learning to think critically means that students learn how to ask, when to ask, and what reasoning methods are used. The ability to think critically is the concentration power of the mind to the results of observations that can be trusted to carry out an effective reflective thought process in the learning process (Hartati *et al*., 2015).

Critical thinking makes it easier for students to understand the material, and concepts can be remembered over a longer period because these concepts are discovered by students themselves (Ilaah & Yonata, 2015). The quality of learning can be influenced by several aspects, including professional teaching, the use of interesting and varied teaching methods, positive student learning behavior and a conducive atmosphere for learning, and the use of appropriate learning media to support the learning process (Nurjanah *et al*., 2016). This is in line with Mardiah *et al*. (2018) that the learning activities of students will increase because in the learning process students are given a medium that can help them in the learning process.

Putra, AP (2017) stated that the importance of learning media is because of its function to clarify or enrich the information given orally and attract students' attention to learn. One of the learning media is printed media such as books. The use of appropriate media in the teaching and learning process in addition to helping teachers in explaining the problems that are being studied is also very instrumental in stimulating students and making the media a learning resource (Emda, 2011). The types of learning resources according to AECT (Association of Education and Communication Technology) (1977) are divided into six types, namely: messages, people, materials, tools, techniques, and the environment.

Environment-based learning leads to meaningful learning to find concepts and connect them to real-life so that students understand them more easily the material because it is directly related to everyday life (Mumpuni, 2013). Meaningful learning can improve students' critical thinking skills (OECD, 2015). Thus, the existence of the natural surroundings is a potential that can be used to support student activities in the learning process (Brahim, 2007). Participating directly in the surrounding environment, students can easily understand the material because students make observations in concrete situations (Setiyoningsih, 2017). Students will feel more challenged because students are dealing directly with real objects. Thus, students not only understand the material provided by the teacher in an abstract lecture,

Environment-based learning is believed to be one of the lessons that can improve students' critical thinking skills (OECD, 2015). Environment-based learning is classified as contextual learning that can stimulate, train, and develop students' skills in critical thinking. However, the fact is that there are still many teachers who use live teaching materials or just buy ready-made materials. Teachers should plan, seek, make and compile the teaching materials themselves. Thus, the risk is very possible if the teaching materials used are not contextual, unattractive, monotonous, and not following the needs of students (Zuriah *et al*., 2016). Mardiah *et al*. (2018) explained that students will try to recognize things they have just discovered and relate them to the knowledge they already have so that their cognitive structures develop. Therefore, the development of learning resources in the form of popular scientific books based on local potential is an effort to improve students' critical thinking skills regarding crustacean material. This is in line with the results of research by Dela & Putra (2018), namely the use of popular scientific books in the learning process has a positive impact on students because they can increase student interest in learning. The increased interest in student learning will affect student learning outcomes later. The increase in learning outcomes means that the understanding obtained by students during the learning process is excellent.

B. Materials and Method

The type of research used is development research which refers to Tessmer's formative evaluation. The formative evaluation step used is based on Tessmer (1998) which consists of 5 steps, namely self-evaluation, expert review, one-to-one evaluation, small group evaluation. However, this research is only focused on preliminary research to produce initial products (Popular Scientific Book of Shrimp in Tabanio Coastal Waters), followed by formative evaluation (with Tessmer's 1998 model) to produce popular scientific books that are valid, practical, and effective on students critical thinking skills.

A more concise research method can be seen in table 1.

BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan
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Table 1 Subjects and research objects

No.	Research purposes	Research subject	Type of Data	Data Instruments	Data collection technique	Data analysis technique
1	Validity	3 ULM master lecturers	Expert opinion	Validation sheet	Giving a checklist on the questionnaire	Descriptive
2	The practicality of the Content	3 Students	Student response to the BIP structure	Practicality sheet contents	Giving a checklist on the questionnaire	Descriptive
3	Hope Practicality	5 students of class XI	Student responses to the contents of the BIP	Hope practicality sheet	Giving a checklist on the questionnaire	Descriptive
4	Effectiveness of Hope	5 students of class XI	Students' ability to answer LKPD	LKPD and Assessment Sheet	Through assignments given to students who refer to the CBC according to Watson	Results of student answers

C. Results and Discussions

1. The validity of Popular Scientific Books

BIP validity data entitled "Types of Shrimp in Tabanio Coastal Waters" obtained from expert opinion steps carried out by validators who come from experts who are also lecturers of ULM Biology Education Masters. The validity data were also obtained from the individual test steps carried out by 3 high school students of Abdul Kadir.

Table 2 Suggestions from the validator

Validator	Suggestions
1	book title The writings are checked again Image layout is adjustable
2	Suitability of setting and description of images for each chapter Improvements to the title of each image in the book content Each picture in the title of each chapter is given a meaningful explanation/sentence Statements whose contents foster critical thinking skills Sentence fixes Photo fix (original image) Additions to the Glossary and biographies of lead authors The writings are checked again Inner cover repair Check standard language
3	Layout, title, and image (at the beginning of each chapter, the image and description should be 1) Input image caption in explanation Each picture is given an identity (how many pictures and description. Distinguish between the outer cover design (there is a picture) and the inner cover.

Source: Results of data processing

Table 3 Results of expert validation on BIP entitled "Types of Shrimp in the coastal waters of Tabanio"

Aspect	Average Score (%)
A. Coherence aspect.	81.25
B. Readability aspect.	91.67
C. Vocabulary aspects: expressions, work, choice, exaggeration.	87.5
D. Active and passive aspects of the voice.	100
E. The aspect of hedging value: Words that mean uncertainty.	83.33
F. Format	91.67
G. Writing method	83.33
H. Application aspects, implications.	100
I. Aspect definition and explanation.	83.33
J. Other stylistic aspects of the device: narrative, humor, analogy.	86.11
Percentage (%)	**88.82**

Source: Results of data processing

BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan
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a. Expert Review

There are several suggestions from the three validators for the BIP entitled "Types of Shrimp in Tabanio Coastal Waters" that have been developed. These suggestions can be seen in table 2.

Based on the suggestions of the three validators listed in Table 2, the researcher has made revisions based on these suggestions. After the revision was carried out, the three validators conducted an assessment of the BIP entitled "Types of Shrimp in Tabanio Coastal Waters". The summary of the BIP validity is presented in Table 3.

Based on the results of expert validation by 3 validators listed in Table 3 above, BIP entitled "Types of Shrimp in the coastal waters of Tabanio"Get an average value of 88.82%, this percentage is included in the very valid criteria or can be used without revision. This is in line with Pammai (2014) who developed a popular scientific book on orchid diversity in Merauke, which yielded an average of 82.53%, which means that this popular scientific book is very suitable to be used as a source of information about orchids in Merauke, Papua Province.

The popular scientific book on shrimp species in Tabanio waters with 5 types of shrimp has the advantage of improving high school students' critical thinking skills in studying arthropods, especially crustaceans. Cover BIP presented original images of shrimp in the waters of Tabanio are easily visible and can attract students' attention in studying the shrimp material, so that can generate interest and attention in learning. As explained by Arsyad (2011), that easy to see and attractive media can make students moved and motivated to pay attention to messages conveyed through these media.

The description of the material in the BIP is the types of shrimp in the coastal waters of Tabanio which are complete regarding morphological characteristics, benefits, classification, and conservation. The presentation of complete material in BIP helps students to find out information about the material being studied so that a meaningful learning process is created. By presenting complete information about shrimp, students can streamline the data collection process. The results of observations with full accuracy can be carried out by students if students have guidelines in collecting data so that they can foster students' cognitive function (Munadi, 2008).

The pictures presented in the BIP are the original animal species shrimp in the coastal waters of Tabanio. The animals around are one of the learning resources that can be optimized for the achievement of quality animal learning processes and outcomes. These native animals enrich students' insight and knowledge because they learn more accurately and can optimize the potential of their five senses to communicate with these animals. This is following the opinion of Hamalik (1995) that media through live images will foster regular and continuous thinking. Color images can also attract the reader's attention longer than black and white images (Monica & Laura, 2011). This is in line with the research by Ripani *et al*. (2018), that teaching materials will look attractive if accompanied by several pictures or illustrations that clarify the content of the material that is easy for students to understand.

BIP presentation is made simple, so it is easy to use, not boring, and can be learned anytime and anywhere because it is easy to carry. This is consistent with Sudjana & Rivai (2011) that easy-to-use teaching materials help simplify teaching tasks. BIP as a popular scientific paper is written in a simple, concise, and dense language that can attract reading interest, and is easily understood by a wide audience (LIPI, 2012).

The language used is not too standard, that teaching materials that use non-standard language structures will make the learning materials clearer in meaning so that students can better understand them and allow them to master the learning material, namely the type of shrimp. This is supported by LIPI (2012) that BIP as a popular scientific work is written in a popular language style and is not bound by the rules of scientific writing, will attract reading interest and be easily understood by a wide audience.

Statements to practice students' critical thinking skills are presented on certain pages in the developed BIP. These statements motivate students to instill the concept of critical thinking when studying parts of the material that are displayed in certain parts of the BIP. The frequent finding of these statements will cause students to become trained to think about things related to the material being studied that will have a positive impact on their critical thinking skills. According to Putra (2017), one of the factors that influence students' critical thinking is the mastery of problem concepts and prerequisite materials (initial concepts), and their application. This means that students who can formulate problems correctly have a good understanding of the concept of invertebrates.

Every shrimp displayed in the BIP are presented with the names of the regions. The names of the regions for the animals around them will make it easier for students to improve their understanding. Besides, by displaying local names, it will increase students' curiosity to learn more

BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan
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details and practice critical thinking skills about the material being studied, especially shrimp species.

As explained by Victorino (2004) that the local potential used as teaching material will foster a sense of belonging which will eventually be easily understood by using its common sense.

b. One-to-one Evaluation

The individual test was conducted on 3 high school students of Abdul Kadir High School. This individual test is usually called the student readability test. This step was taken to assess the appearance and presentation aspects of the BIP entitled "Types of Shrimp in the coastal waters of Tabanio"The individual test results are presented in Table 4.

Based on Table 4, it can be seen that the BIP is entitled "Types of Shrimp in the coastal waters of Tabanio" Getting a percentage of 3.8% is classified as a very good criterion. This is in line with Khairoh & Nurhayati (2014) who developed an integrated science storybook that gets 88.33% readability, which means that the book has very feasible criteria. This is reinforced by Setiawan (2017) who developed a popular scientific book entitled "Survival Plants in the Bromo Tengger Semeru National Park Area," which resulted in the popular scientific book getting very good criteria on readability tests or individual tests.

Table 4 Individual test results by Abdul Kadir High School students

Assessment Aspects	Validation score (%)			Average (%)
	1	2	3	
Views of Popular Scientific Books Presentation Aspects of Popular Scientific Book Material	3.8	3.5	4	3.8
Validation category	**Very good**	**Good**	**Very good**	**Very good**

Source: Results of data processing

The practicality of BIP based on the content of the material is due to the superiority of BIP being developed, namely the content or material containing the types of shrimp found around students, especially those living in the coastal waters of Tabanio which is complete about general characteristics, special characteristics, and benefits accompanied by The pictures displayed in the BIP are images with colors that match the original animals, making it easier to identify the type of shrimp being studied. This is reinforced by several studies including Yusma (2011) who stated that BIP developed was in the very practical category, then strengthened by Fitriansyah (2018) who stated that the BIP developed was also in the very practical category.

BIP assessment entitled "Types of Shrimp in the coastal waters of Tabanio"In individual tests must also pay attention to the aspect of the presentation. The individual test results in Table 3 show that this BIP received very good criteria, these results cannot be separated from the BIP development process which has taken seriously the aspects of presentation and appearance. The presentation of material or concepts in BIP is carried out coherently and systematically so that it will increase student motivation to learn. The above statement is in line with Suswina (2016), which explains that the clutter of the contents of teaching materials makes it easier for students to learn and also guides students to get used to thinking coherently. Then it is reinforced by Suherli (2008) who states that the presentation of material in a book must be systematic, straightforward, and easy to understand so that it can motivate readers to find out more about the material presented.

2. The practicality of Popular Scientific Books

a. Student Response

Student responses were obtained from a small test step conducted on 5 high school students of Abdul Qadi High School who took part in learning on a small scale. Student response data can be seen in Table 5.

Based on Table 5 regarding student response data, it is obtained an average of 96.54%, which is the percentage of strongly agree. These results indicate that students respond positively to learning using BIP entitled "Types of Shrimp in the coastal waters of Tabanio".

The positive responses shown by Abdul Kadir High School students show that students are happy with learning to use BIP entitled "Types of Shrimp in the coastal waters of Tabanio". This is because they have never previously studied using BIP, whose material is often found in their neighborhood. Also, the BIP has been equipped with illustrations of various kinds of pictures that match the material so that it can foster and increase student interest in learning new material. This is in line with Dalman (2014) who explains that a BIP should have popular language, not be tied to standard scientific writing and an attractive image display so that it can attract readers to read the contents of the BIP material.

BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan
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Table 5 Student response data

No.	Aspect	Total				
		1	2	3	4	5
1.	Legibility	19	19	18	18	18
2.	Contents	16	16	16	16	16
3.	Presentation	16	16	15	16	16
Total		**51**	**51**	**49**	**50**	**50**
All Score Total				**251**		
Percentage (%)				**96.54**		

Source: Results of data processing

Students' positive responses to BIP can also be created because in its development it has paid attention to various aspects, one of which is by adjusting the presentation and appearance of the material so that it is easily understood by students at the secondary education level. This is under Barnawi and Arifin (2015) who explain that the presentation, appearance, and depth of material in a book including BIP must be following the level of education and follow the development of science and technology.

b. Practical hope (Small group test)

Practicality data of the popular scientific book "Types of Shrimp in Tabanio Coastal Waters" from the results of the small group test are in the form of practicality and fulfillment of expectations. The following is the small group practicality trial data which can be seen in Table 6.

Based on the results of the small group practicality test, the results obtained are as in Table 6, explaining popular scientific books obtained test results with an average of 100%, which means that popular scientific books are expected to be very practical to use for further tests and are used as enrichment material for Biology subjects in practicing critical thinking skills students.

The data on the practicality of popular scientific books that have been described are also supported by data on the results of the implementation of the use of scientific book products which are contained in Table 7.

Table 6 Practicality Test Results of Small Group Popular Scientific Books

No.	Question	*Small-Group* (%)
1	Are the contents of Popular Scientific Books easy to learn and understand the contents?	100
2	Can the meaning of the instructions given to acquire critical thinking skills (interpretation, assumptions, deduction, and inference) be understood?	100
3	Is the time provided for studying Popular Scientific Books?	100
4	If the study time exceeds the predetermined schedule, can we continue studying outside the study hours?	100
5	Has the content of Popular Scientific Books related to critical thinking skills (interpretation, assumptions, deduction, and inference) never existed before?	100
6	Has the method of teaching Popular Scientific Books never been implemented before?	100
7	Is the learning material interesting to learn?	100
	Total	**700**
	Average	**100**

c. Fulfillment of expectations (Use of BIP)

Based on the results of the small group implementation test of the popular scientific book "Types of Shrimp in Tabanio Coastal Waters", the results obtained dAta student activity obtained from the results of observations from observers to students who are learning. This student activity is one of the data used to see the practicality of the BIP entitled "Types of Shrimp in Tabanio Coastal Waters". The results of observations of student activities can be seen in Table 7.

The implementation of the Use of Popular Scientific Book Products (BIP) is one of the data to measure practicalityBIP entitled "Types of Shrimp in Tabanio Coastal Waters".Based on the data contained in Table 7, observations on the implementation of the learning implementation plan were obtained results that were 93.3% of the part that was implemented and 6.7% that was not carried out. These results illustrate that the BIP that has been developed can be said to be practically used in learning. Thing It shows, that the popular scientific book "Types of Shrimp in Tabanio Coastal Waters" is in the Very Good category to be used as enrichment material for Biology subjects in improving students' critical thinking skills.

The high level of student activity is triggered by the learning material contained in the BIP that is easy to understand, interesting and also following the circumstances the student lives in, which makes students more interested in following the learning

BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan
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process well. This interest will make students feel they have to follow the learning to completion. This can be seen clearly from the activities that students bring up in learning. This is in line with Jannah and Dwiningsih (2013) who explain that student textbooks must be textbooks that contain subject matter that is easy to learn and understand and can motivate students to always learn and are interested in learning them because teachers do not always accompany students to learn.

Table 7 Small Group Implementation Test Results Popular Scientific Books

No.	Statement	*Small-Group* (%)	
		Yes	No.
1	Students read the front (table of contents, instructions, and explanation of contents)	100	0
2	Students read the introductory information	100	0
3	Students read descriptions of general information	100	0
4	Students look at pictures along with captions in popular scientific books	80	20
5	Students look at the writing on the colored box	80	20
6	Students read about facts about the type of shrimp (crustacean)	100	0
7	Students read the glossary	80	20
8	Students use popular scientific books when making observations	100	0
9	Students use popular scientific books when doing data analysis	100	0
Total		**840**	**60**
Average		**93.3**	**6,7**

Source: Results of data processing

3. The Effectiveness of Popular Scientific Books

Effectiveness data BIP entitled "Types of Shrimp in Tabanio Coastal Waters" obtained from a small group test step that results in the effectiveness of expectations. Based on a summary of the data on students' critical thinking skills through LKPD and evaluation questions when using popular scientific books which are listed in Table 8.

Based on the data in Table 8 above, it can be seen that the results on the pretest stated that there were no students who completed with an average score of 50. While in the posttest all students completed with an average value of 92. From the results of these data, the percentage of classical completeness stated to reach 100%. The percentage of cognitive learning outcomes meets the very good category because it is above the 75-80% completeness range of learning outcomes. The learning outcome data analyzed using the N-Gain competency indicator can be seen in Table 9.

The learning outcomes contained in table 8 are further analyzed using N-Gain per competency achievement indicator which can be seen in Table 9 below.

Table 8 Small Group Effectiveness Test Results of Popular Scientific Books

No.	CBC indicators	Before Using BIP		After Using BIP	
		Average Score (%)	**Category**	**Average Score (%)**	**Category**
1	Interpretation	55.84	Moderate	91.11	Very well
2	Assumption	41.67	Less	92.22	Very well
3	Deduction	50.00	Moderate	95.00	Very well
4	Inference	47.50	Less	100.00	Very well
N				**5**	

Source: Results of data processing

Table 9 N-Gain Test Results for Students' Critical Thinking Ability

No.	CBC indicators	Pre Test	Post Test	N-Gain	N-Gain average
1	Interpretation	55.84	91.11	0.80 *	0.89 *
2	Assumption	41.67	92.22	0.87 *	
3	Deduction	50.00	95.00	0.90 *	
4	Inference	47.00	100.00	1.00 *	

Source: Results of data processing

Information: * = High; and ** = Moderate

Based on the results of the small group effectiveness test table in table 9, the results show that the interpretation indicator on the effectiveness of the small group before using popular scientific books was 55.84 and after using popular scientific books was 91.11 categorized as high. The assumption indicator on the effectiveness of the small group before using popular scientific books is

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41.67 and after using popular scientific books is 92.22 which is categorized as high. The deduction indicator on the effectiveness of the small group before using popular scientific books is 50.00 and after using popular scientific books is 95.00 categorized as high. Then the inference indicator on the effectiveness of small groups before using popular scientific books is 47.00 and after using popular scientific books is 100.00 categorized as high. The study using BIP was entitled "Types of Shrimp in Tabanio Coastal Waters" on each competency achievement indicator with an average N-Gain of 0.89. These results indicate that changes in student learning outcomes are at high criteria.

The involvement of students in the environmental education process will improve critical thinking skills so that the material is easy to understand and remember. That is, increasing the ability to think critically can improve students' cognitive abilities. Increasing students' cognitive abilities can improve Indonesia's education rank which is still low based on the mapping of The Learning Curve 2013. According to Ilaah & Yonata (2015), critical thinking can help students understand the material, and concepts can be remembered over a longer period because the concept is found. by students. In line with that, Antika (2015) states that increasing students' critical thinking in learning is one of the variables to improve student cognitive learning outcomes. Putra, et. al., (2019), stated that all cognitive knowledge results were in a complete category and critical thinking skills were in the high category. This means that all students have a good understanding of the concept of deepening the material presented.

D. Conclusion

Development research with the Tessmer design has succeeded in producing a popular scientific book (BIP) entitled "Types of Shrimp in Tabanio Coastal Waters" with the following criteria: (1) Popular scientific books that have been developed are declared very valid based on expert opinion includes coherence, legibility, vocabulary, active and passive voice, hedging, definitions and explanations, other applications, implications and styles whereas based on individual testing this popular scientific book is declared very good; (2) Popular scientific books are easy to use because of the practicality of the content is well-based ease of understanding book content, book structure, use of words, the meaning of images, free of typos, and cover design. It is easy to use because the practicality of expectations is also fulfilled, students give a positive response when using this book, and (3) The popular scientific book developed is declared effective hopefully based on the cognitive learning outcomes of students who get an average score of 94.58 with a percentage of classical completeness that is stated to reach 100% and an increase in students' critical thinking skills as a whole gets an N-gain value of 0.89 with the category high.

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