

Implementation popular science book development of herbal planting in an attempt to settle the student's senior high school critical thinking skills

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Article Information	Abstract
Keyword: Critical thinking; Herbal plant; Implementation; Popular science book Kata Kunci: Berpikir kritis; Tanaman jamu; Implementasi; Buku ilmiah populer History: Received : 12/07/2021 Accepted : 20/01/2022	Critical thinking skills are one of the skills to have in the 21st century. The realities of learning that are still applying learning teachers-centered, teachers deliver biology as products and learners memorize factual information. Popular scientific books become one of the means that can be used to settle critical thinking skills. In this study developed popular type scientific books and utilization of plant mental in the village official. This study aims to describe the practicality of popular scientific book expectations developed to improve the critical thinking skills of learners. This research is a development research with formative evaluation that uses the design of Tessmer. The subject of research is 7 students learned for practical and effectively tests. The results showed that the popular scientific books developed were categorized as very practical with a percentage of 100% and received a very good response from students with a percentage of 88.9%. The results of the effectiveness of expectations are categorized as high and there is an increase from meetings 1 to 3 with an average percentage of 81.7%. These results indicate that the popular scientific books developed are very practical and effectively used in training high school students' critical thinking skills. Abstrak Kemampuan berpikir kritis merupakan salah satu kemampuan yang harus dimiliki di abad 21. Realita pembelajaran yang terjadi saat ini masih menerapkan pembelajaran yang berpusat pada guru yang menyampaikan Biologi sebagai produk dan peserta didik hanya menghafal informasi faktual. Untuk itu, penelitian ini bertujuan guna mengembangkan buku ilmiah populer jenis dan pemanfaatan tanaman jamu di Kampung Pejabat sebagai sarana alternatif untuk student centered learning sekaligus melatih kemampuan berpikir kritis. Penelitian ini mengembangkan buku ilmiah populer jenis dan pemanfaatan tanaman jamu di Kampung Pejabat. Penelitian ini merupakan penelitian pengembangan dengan evaluasi formatif Tessmer. Subjek penelitian adalah 7 orang peserta didik dengan analisis statistik deskriptif menggunakan uji kepraktisan harapan dan keefektifan harapan. Hasil penelitian menunjukkan buku ilmiah populer yang dikembangkan terkategori sangat praktis dengan persentase sebesar 100% dan mendapatkan respon yang sangat baik dari siswa dengan persentase sebesar 88,9%. Hasil keefektifan harapan terkategori tinggi dan terjadi peningkatan dari pertemuan 1 sampai 3 dengan rata-rata persentase sebesar 81,7%. Hasil ini menunjukkan bahwa buku ilmiah populer yang dikembangkan sangat praktis dan efektif digunakan dalam melatih kemampuan berpikir kritis siswa SMA.

A. Introduction

The concept of science is a concept that emphasizes strong mental processes in students. The mental process of students in studying science is the ability to integrate knowledge/cognitive schemas of students composed of attributes in the form of skills and values to study natural phenomena (Wisudawati & Sulistiyowati, 2013). Thus, Biology learning directs students to ask questions, find answers and act so that they can help students to gain experience and a deeper understanding of the natural surroundings.

Biology learning can train students from an early age to conduct investigations, so that they can gain direct experience in developing thinking skills to understand and explore the natural surroundings scientifically. Thinking skills are one of the skills that must be possessed in the 21st century, one of which is critical thinking skills that must be mastered by students (Partnership for 21st century skills, 2011)

The reality of learning that occurs is still applying teacher-centered learning, teachers convey Biology as a product and students memorize factual information. The education system focuses more on delivering information rather than developing thinking skills (Zubaidah, 2010). Problems related to the development of critical thinking in learning often go unnoticed where the development of critical thinking is only expected to appear as a mere nurturing effect. This makes students' critical thinking skills less developed. Therefore, it is necessary to apply learning that can connect the knowledge possessed with application in life. Trianto (2014) explained that the learning experience gained in the classroom is not complete and is not oriented towards achieving basic competencies. In line with that, the facts on the ground show that many students tend to be lazy to think independently. The way of thinking developed in learning activities has not touched the affective and psychomotor domains, this is because teachers tend to use less varied learning strategies. Educators should pay attention to reading interest, metacognitive skills, and critical thinking in learning. The increase in these three variables has an effect on increasing cognitive learning outcomes (Antika, 2015). Therefore, critical thinking is the main focus of this research.

Critical thinking skills are one of the thinking processes to solve problems by asking questions, gathering relevant information, and communicating the results that have been obtained (Rikhtehgar et al., 2013). In addition, critical thinking can improve students' understanding, problem solving skills,

think creatively and communicate students' ideas clearly and effectively (Mainali, 2011).

A critical thinker should ideally be curious, knowledgeable, believe in logic, open-minded, flexible, fair-minded in evaluation, honest in the face of personal bias, wise in making judgments, willing to reconsider, and try to solve problems, (Zaini et al. ., 2018). Critical thinking skills can be improved and improved by changing teaching and learning strategies that were originally passive to active so that teachers need to interact with students and get used to asking questions that require students to think critically.

In learning Biology to grow students' critical thinking skills, teaching materials need to be equipped. One type of teaching material that can be developed is Popular Scientific Books (BIP). This book is a written work that contains knowledge based on research results that are presented scientifically using simple, concise and clear language so that it is easily understood by the public and students (Utami, 2017). BIP is a type of book that contains knowledge and presents facts and is written in easy and interesting language (Setiawan, 2017).

Previous research on popular scientific books has been carried out by Setiawan (2017) who developed a survival plant BIP which is intended for students who love nature. In addition, Nurlita (2021) reports that the popular scientific book *Diversity of Pteridophyta in the Tabanio Coastal Forest* is very practical to use as enrichment material in learning Low Plant Botany. Rahmiati (2021) also reports that a popular scientific book that was developed is practically used as enrichment for Low Plant Botany courses.

Biology learning related to the environment can be one of the media to train students' critical thinking skills. Singh & Rahman (2012) explained that an environmental education program must have goals related to awareness creation, knowledge accumulation, positive attitude, problem solving skills and community participation. Biology educators must be able to educate students to learn about their environment. Students learn contextually based on their reality which is usually found in everyday life. Students need to understand natural phenomena in their environment and the ethnic insights or traditional knowledge that accompanies these phenomena.

One of the biological concepts is *plantae*. In this concept there are indicators whose contents are to find out the role of certain types of *plantae* that exist in their environment on the economy and the environment. Medicinal plants related to herbal

medicine are appropriate plants for this indicator. The plants that make up the composition of herbal medicine are very appropriate to be enrichment materials for this Plantae material. Students generally do not get information about herbal plants when in fact these plants are very close to their daily lives. Knowledge of herbal plants can also be the basis for creating independent business opportunities in the field of plants for students who do not continue their studies.

Kampung Pejabat is a learning resource that was chosen as a location that utilizes herbal plants as part of the community's economy. The development of BIP in this study was based on an inventory of plants used as herbal medicine by the people of the Loktabat Herbal Processing & Seller Village (PEJABAT) in Banjarbaru City. The BIP developed is expected to increase students' knowledge of the surrounding herbal plants. Popular scientific books on the diversity of ferns that will be developed in this study will connect students with the objects to be studied through activities contained in popular scientific books. This popular scientific book is expected to be an independent teaching material for high school/MA students that is appropriate to be used to motivate students to study environment-based biology and be able to train their critical thinking skills.

B. Material and Method

This research is a development research with formative evaluation from Tessmer (1993) which consists of self-evaluation, expert review, one-to-one evaluation, and small group evaluation. Research subjects there are 7 students with descriptive statistical analysis using the practicality test of expectations and the effectiveness of expectations.

The practicality data of BIP was obtained from seven students as users using the expectation practicality test instrument for popular scientific books and the responses of seven students as users using a student response questionnaire which was filled out by means of a check by the students in the small group test. While the expected effectiveness data were obtained from the students learning results through test techniques using critical thinking skills questions on aspects of interpretation, analysis, evaluation, inference in small group tests. Critical thinking ability evaluation questions are done by students to assess critical thinking skills. The critical thinking indicator used refers to the critical thinking indicator according to Facione (1990).

The data on the practical results of expectations are categorized using a modified

category from Akbar (2013) which is presented in Table 1 below.

Table 1 Category assessment of student expectations practicality

Percentage	Criteria
85 – 100	Very good
70 – <85	Good
60 – <70	Medium
50 – <60	not good
< 50	very not good

(Source: Akbar, 2013)

The responses of students who were captured using a questionnaire were analyzed descriptively. The student response data obtained will be converted into categories as presented in Table 2 below.

Table 2 Percentage of student's responses

Percentage	Criteria
80% < R ≤ 100%	Very Good
60% < R ≤ 80%	Good
40% < R ≤ 60%	Less good
20% < R ≤ 40%	Not good

(Source: Adapted from Fatmawati, 2014)

Data on the effectiveness of the expectations of popular scientific books seen from the results of evaluating students' critical thinking skills after being given BIP, then categorized based on critical thinking skills:

Table 3 BIP expectation effectiveness percentage

Percentage	Criteria
90.6 – 100%	Very high
75.6 – 90.5%	High
60.6 – 75.5%	Medium
40.6 – 60.5%	Low
0 – 40.5%	Very low

(Source: Sugiono, 2013)

- 1) Knowing the magnitude of the increase in critical thinking includes indicators of interpretation, analysis, evaluation, inference. Critical thinking ability is calculated using the normalized gain value formula (N-Gain or g) as follows (Hake, 1999).

$$g = \frac{\text{Spottest} - \text{Spretest}}{\text{Smaksimal} - \text{Spretest}}$$

Description:

g : gain value

Spretest : pre-test score

Spottest : post-test score

- 2) To find out the criteria for the high and low normalized gain (N-gain) it can be classified as follows:

Table 4 Classification of N-Gain

G score	Criteria
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Medium
$g < 0.3$	Low

(Source: Hake, 1999)

C. Results and Discussion

1. Practicality

Data on the practicality of expectations of BIP were collected using an instrument of practicality of expectations against popular scientific books. The results of the expected practicality test are presented in Table 5.

Table 5 Practicality test results

No.	Statement	Yes (%)
1.	Are the contents of the BIP easy to learn and understand?	100
2.	Can the instructions given to acquire critical thinking skills be understood?	100
3.	Is the time allotted to learn BIP enough?	100
4.	If the time exceeds the predetermined schedule, can you continue studying outside of study hours?	100
5.	Has the BIP content related to critical thinking skills never existed before?	100
6.	Has the method of teaching BIP never been implemented before?	100
7.	Are the learning materials interesting to study?	100
Mean score		100
Criteria		Very practical

The advantages of popular scientific books that have been developed make this teaching material very practical. The advantages of the popular scientific books that were developed include the fact that they contain local potential and the plant species used in popular scientific books are original images, making it easier for students to identify the medicinal plant species being studied. In addition, the addition of sentences or critical thinking indicators (interpretation, analysis, evaluation and inference) in the book also causes this BIP to be practically used in training students' critical thinking skills. As explained by Sugiyono (2013) which states that the high practical value of teaching materials can help students understand biological concepts independently. The display of one of the contents of the BIP can be seen in Figure 1.

Student responses were given after students participated in learning activities using BIP "Types and utilization of herbal plants in the Pejabat

Based on the expected practicality test results in Table 5 above, the BIP "Types and Utilization of Herbal Plants in the Pejabat Village" obtained test results with an average of 100% which means popular scientific books are very practical for students to use in learning. All aspects of practicality hope to get a very good category based on student responses to the instrument. These results show that the substance contained in the BIP is interesting to learn and can be understood by students.

Nieveen (1999) explains that product development is said to be practical if the product is easy to run by students or teachers and is richer than student textbooks. Thus the practicality test is not only a stage to test the practicality of popular scientific books when used, but more than that this stage is a means to enrich popular scientific books rather than ordinary student books.

village". The results of student responses can be seen in Table 6.

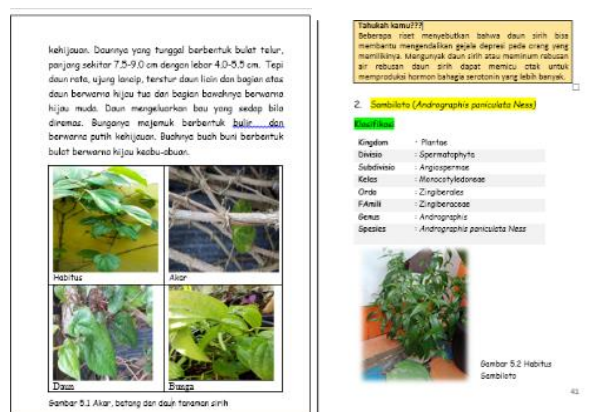


Figure 1 Figure of BIP display

Based on Table 6, it can be seen that the students' responses were very positive towards learning using BIP. Types and utilization of herbal plants in the Pejabat village were developed by

showing a percentage of 88.9% and were in the very good category.

These results indicate that students are interested in following the lesson, they are happy with the learning atmosphere, are active in digging up information, and arouse their curiosity. As research conducted by Astuti et al. (2021) stated that a positive response was shown by Abdul Kadir High School students who indicated that students

were happy with learning using BIP entitled "Types of Shrimp in Tabanio Coastal Waters". This is because they have never before learned to use BIP, whose material is often found in the environment where they live. Millah, et al (2012) explained that the results of positive student responses were generally caused by good textbooks. A good textbook will certainly make it easier for students to understand the material being taught.

Table 6 Students response results

No.	Statement	(%)
1.	This popular scientific book contains sentences that encourage me to think critically	85,7
2.	The presentation of the material in this BIP encourages me to discuss with other friends	85,7
3.	This BIP material fueled my curiosity	89,3
4.	This BIP adds to my understanding of herbal plant material	92,9
5.	This BIP display is interesting	89,3
6.	This BIP makes me happy to study biology	89,3
7.	Using this BIP adds to my curiosity	82,1
8.	This BIP makes my study more focused and coherent	82,1
9.	This BIP provides motivation to learn the material	92,9
10.	By using this BIP, it makes learning biology not boring	100
Mean score		88,9
Criteria		Very good

These results indicate that students are interested in following the lesson, they are happy with the learning atmosphere, are active in digging up information, and arouse their curiosity. As research conducted by Astuti et al. (2021) stated that a positive response was shown by Abdul Kadir High School students who indicated that students were happy with learning using BIP entitled "Types of Shrimp in Tabanio Coastal Waters". This is because they have never before learned to use BIP, whose material is often found in the environment where they live. Millah et al. (2012) explained that the results of positive student responses were generally caused by good textbooks. A good textbook will certainly make it easier for students to understand the material being taught.

The material contained in the BIP, namely a review of the history of herbal medicine, herbal medicine in the millennial era and types of herbal plants used by residents in the Pejabat village gave students interest to read it. In addition, the addition of various pictures of herbal plants is interesting to read. From these things, students become interested and interested in reading and finally follow the lesson well. As reported by Irwandi, et al. (2019) that students who have a high interest in learning will make it possible for their greater efforts to obtain good learning outcomes as well.

The use of BIP encourages students to think and discuss with their friends. This is because in the BIP there are certain colored sections

containing sentences that make critical thinking indicators which encourage students to discuss with their friends. This means that here students are actively involved in finding answers to problems in learning. As described by Duron, et al. (2006) which states that teacher-centered learning is very difficult to improve critical thinking skills, learning must be student-centered and involve students actively in learning, so students will think critically.

The practicality of BIP is also inseparable from the learning method in using BIP which utilizes the surrounding environment in this case is the official village as a learning resource so as to facilitate students' understanding of the material. This learning strategy emphasizes the learning process based on real facts in everyday life. The learning material is directly experienced through learning activities. According to Hadi & Anazifa (2016) environmental learning makes a person experience an increase in thinking skills, skills, and awareness of environmental issues.

2. Effectiveness

The effectiveness of popular scientific books is obtained from the achievement of indicators of critical thinking skills carried out by students through small group tests. The small group test aims to obtain data on the effectiveness of expectations through evaluation results that contain critical thinking indicators which include

interpretation, analysis, evaluation and inference. The following is a summary of the results of the evaluation of critical thinking skills which is presented in Table 7.

Table 7 Summary of critical thinking ability evaluation results

Meeting	Indicator			
	1	2	3	4
1	71,4	66,7	64,3	71,4
2	85,7	82,1	80,9	85,7
3	92,9	92,9	90,5	95,2
Mean	83,3	80,6	78,6	84,1
Overall mean	81,7			
Category	High			

Description:

1 = Interpretation; 2 = Analysis; 3 = Evaluation; and 4 = Inference

Based on Table 7; critical thinking skills after using popular scientific books have increased in every indicator. The interpretation indicator obtained an average of 83.3% which was included in the high category. Likewise, the analysis indicators get an average of 80.8% in the high category, the evaluation indicators with an average of 78.6% in the high category and inference indicators with an average of 84.1% in the high category. From these data, it can be seen that the evaluation indicators for meeting 1 still get low scores compared to other indicators. Overall effectiveness is in the high category.

The improvement of students' critical thinking skills is then normalized using N-gain. The results of the N-gain test for critical thinking abilities are presented in Table 8.

Table 8 N-gain test results of students' critical thinking skills

No.	Indicator	N-gain	Criteria
1.	Interpretation	0.8	High
2.	Analysis	0.8	High
3.	Evaluation	0.7	Medium
4.	Inference	0.8	High

Based on Table 8; above, it can be seen that the N gain indicators for interpretation, analysis and inference are in the high category. While the evaluation indicators are included in the medium category. After being converted as a whole, the students' critical thinking indicators have an average N-Gain value of 0.8 which is in the high category. This means that the developed BIP is effectively used in learning seen from an increase in the aspect of critical thinking skills.

This indicates that BIP types and utilization of herbal plants in the official village are effectively used in learning and in improving students' critical thinking skills. In line with research conducted by Fajeriadi (2018), Astuti (2021) and Ridhana (2021) which state that popular scientific books are effectively used in improving student learning outcomes and critical thinking skills.

Based on a more in-depth search, data is obtained that popular scientific books that are used continuously can improve students' critical thinking skills effectively. This can be seen at each meeting on the effectiveness data of student learning outcomes when working on evaluation questions that always increase at each meeting. This increase in critical thinking skills is evidenced by the results of the N-gain which is categorized as high. The results of the effectiveness of expectations on critical thinking indicators are explained as follows:

a. Indicator of Interpretation

Interpretation indicator is the ability where students can understand and express the meaning of a problem. Based on the data on critical thinking skills, there was an increase in the interpretation indicators from the first meeting to the third meeting. In the interpretation indicator the N-Gain value obtained is 0.8 with a high category.

Students' interpretation ability has increased by obtaining high scores because in the learning process using BIP students are oriented to identify problems and seek information by using BIP to solve these problems. Students are directly involved in determining the problem to be solved. The development of interpretation indicators in the BIP can be seen in Figure 2. The development of indicators is contained in a yellow box to make it visible and attract attention.

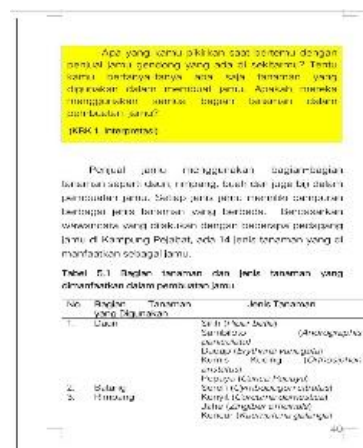


Figure 2. Development of interpretation indicators figure

Students' ability to interpret will make it easier for them to determine problems regarding the types and uses of herbal plants in the official village. In line with the opinion of Haryani (2011) which explains that critical thinking skills can be started from interpretation by using the thoughts or knowledge possessed to understand a problem. With this ability, it is hoped that it will have an impact on increasing students' sensitivity in seeing problems that often arise in their daily lives. Furthermore, if students are sensitive to a problem, they will of course also be able to provide good hypotheses or predictions to deal with problems that exist in their environment.

b. Indicator of Analysis

Analysis is the ability to identify and conclude the relationship between statements, questions, concepts, descriptions, or other forms. Based on the data on critical thinking skills, there was an increase in the analytical indicators from the first meeting to the third meeting. In the analysis indicator the N-Gain value obtained is 0.8 with a high category.

Students' analytical skills have increased because in the learning process using BIP students analyze the data found during observation. To prove it, students connect the information in the problem with the BIP given to solve the problem. The development of analytical indicators in the BIP can be seen in Figure 3.

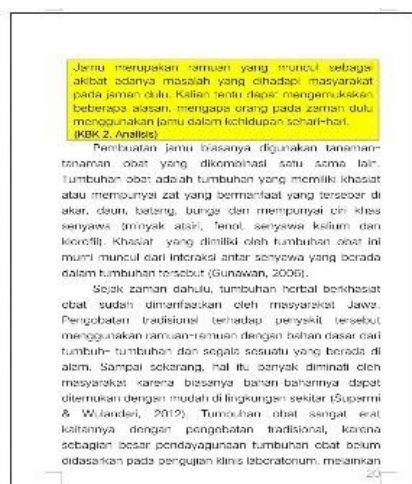


Figure 3 Development of analysis indicators figure

This ability can be used by students to analyze the types and uses of herbal plants in the official village. With this ability, it is hoped that it will have an impact on students' analytical skills on a problem that will foster a better understanding of concepts because students play a role in finding concepts that are in accordance with the problems

to be solved and avoiding concepts that are not related to the problem, thus requiring students to think critically. . Thus the thinking ability of students will increase. This is in line with the opinion of Amir (2015) that critical thinking is not just ordinary thinking which only understands a concept or a problem without being able to identify and explore problems to find further solutions, because critical thinking requires higher mental and intellectual abilities.

c. Indicator of Evaluation

Evaluation is the ability to access the credibility of the statement/representation and to be able to logically access the relationship between statements, descriptions, questions, and concepts. Based on the critical thinking skills data contained in Table 4, it can be clearly seen that there was an increase in evaluation indicators from meeting one to meeting three. Although the average on this indicator is lower than the other indicators. In the evaluation indicator the N-Gain value obtained is 0.7 with a medium category. The development of evaluation indicators in the BIP can be seen in Figure 4.

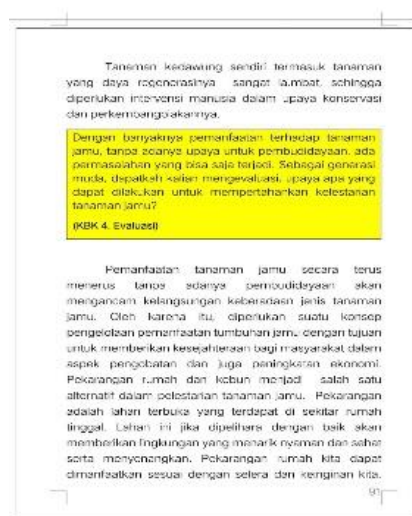


Figure 4. Development of evaluation indicators figure

The low indicator of the ability to carry out evaluations is due to the lack of students' ability to assess the arguments of a problem and students are accustomed to obtaining information from the teacher. In BIP, the development for this indicator is also less so that students are less trained in conducting evaluations. In line with what was stated by Priyadi, et al (2018) that the low ability to evaluate can be seen from students having difficulty connecting one concept to another and their study habits which only accept concepts from the teacher.

d. Indicator of Inference

Inference is drawing conclusions from the solution to the problem appropriately. Based on the critical thinking skills data contained in Table 8, it can be clearly seen that there was an increase in the inference indicators from meeting one to meeting three. In the inference indicator the N-Gain value obtained was 0.8 with a high category.

The ability to inference or draw conclusions has increased because in the learning process using BIP students are involved in making conclusions from a problem that has been made, then students prove the truth of the opinions put forward in assumptions by conducting more in-depth analysis. In conducting the analysis students consider a variety of different information obtained from BIP and other relevant sources. If there are differences of opinion between students, the teacher must act in directing them to get the correct conclusion. Thus, conclusions can be obtained which are considered to be defensible and justified. This is in accordance with what was expressed by Facione in Martyanti & Suhartini (2018) that inference ability is defined as the ability to identify and obtain the elements needed to make reasonable conclusions, make hypotheses, consider relevant information and conclude the consequences of data, situations, questions or other forms of representation. In other words, the ability to inference relates to the ability to make reasonable conclusions. With this skill, it is hoped that it will have an impact on students' ability to make decisions in their daily lives. The development of inference indicators in BIP can be seen in Figure 5.

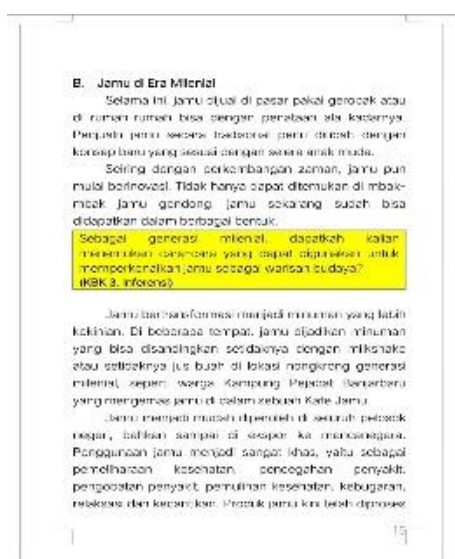


Figure 5. Development of inference indicators figure

D. Conclusion

Popular scientific books developed are categorized as very practical with a percentage of 100% and get a very good response from students with a percentage of 88.9%. The results of the effectiveness of expectations are categorized as high and there is an increase from meetings 1 to 3 with an average percentage of 81.7%. It can be concluded that the popular scientific books developed are stated to be practical and effective for use in learning and can train students' critical thinking skills based on the results of practical expectations and the effectiveness of expectations.

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