



## Science Literacy -Based Pocket Book on Environmental Pollution and Climate Change in Junior High Schools

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### ABSTRACT

Research on the development of an integrated science pocket book based on scientific literacy on environmental pollution and climate change aims to see the validity, practicality and response of students. This study used ADDIE's research development (R&D) which consisted of Analysis, Design, Development, Implementation, and Evaluation. But in this research only reached the development stage. Data is collected through a questionnaire. After analyzing the needs and designing an integrated science literacy-based pocket book, the research proceeded to the development process. Scientific literacy consists of 4 aspects, each aspect has its own indicator code. At the pocket book development stage it was validated by five experts, namely, material experts, media experts and 2 teachers. The results showed that the validation of material, media, pedagogic experts , and 2 teachers was 3.42 with a very valid category. The results of the practicality test obtained a score of 81.84 which can be categorized as very practical, and the results of the student response test obtained a score of 86.05 in the very good category . In conclusion, the development of integrated science pocket books based on scientific literacy on environmental pollution and climate change is stated to be very valid, practical and very well used by students in the learning process.

## 1. Introduction

The development of science and technology ushered in society entering the global era. Each individual is required to be able to develop their ability to compete at the international level. One of the government's efforts to obtain human resources in order to compete in the global era is to make efforts to improve the quality of education. In the implementation of education, there are educational process standards that include planning, implementing, evaluating results, and monitoring

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the learning process. In its implementation, the teacher is defined as one of the important components of the successful implementation of the educational process. However, facilities and infrastructure are also needed to support the learning process, such as textbooks as learning resources (Afifah, et al., 2020).

The availability of relevant textbooks really helps the learning process in schools. Textbooks can support the realization of student centered learning (SCL), where the paradigm of learning in schools is directed more towards students as learning subjects and teachers only as facilitators (Husada, et al, 2020). The factors that influence the results of students' scientific literacy are the selection of textbooks and the low scientific accuracy of students. The low learning outcomes are probably caused by the textbooks used in the learning process. Science textbooks based on scientific literacy must have several basic categories. These basic categories are science as a body of knowledge, science as an investigative nature, science as a way of thinking, and the interactions of science, technology and society (Anugraheni, 2017).

Based on the problems found, it is necessary to have practical learning resources that are able to help students to remember a lot of material more easily and can make these students think critically in order to foster an attitude of curiosity and foster a sense of liking in solving problems that arise during the learning process. . Thus it is necessary to simplify textbooks so that students are more interested in and understand the lessons well and can be easily carried during learning to the field. One of the practical learning resources used in learning is a pocket book. A pocket book is a small book that contains solid, concise and clear material that can be stored in a pocket and is easy to carry anywhere (Andani , 2018).

Scientific literacy is needed by students in this era of globalization because education at this time should lead to a process of activities that can shape students to be able to face the era of globalization . That is, learning activities are not only oriented towards mastery of knowledge, more than that, learning activities should be oriented towards the learning process and the implementation of knowledge (Asyhari, 2015).

The material used in this pocket book is even semester biology material for class VII, namely environmental pollution and climate change material. This material was taken because there are still many students whose scores are below the KKM (75) during daily tests because this material requires students to remember a lot of material, and also environmental pollution and climate change material is one of the materials that can use the surrounding environment as a place of learning and Know the impact of climate change caused by a polluted environment. This scientific literacy-based pocket book was developed as an effort to facilitate students in understanding the types of pollution, the factors that cause pollution, the impact of pollution on ecosystems, and efforts to overcome environmental pollution in life, as well as climate change that will occur as a result of environmental pollution and is expected to be able to help students realize the importance of protecting the environment through reading experiences. In addition, scientific literacy-based pocket books can be examples of learning

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resources that can be developed by every science teacher in order to create a conducive teaching and learning atmosphere and enrich teacher creativity.

## 2. Methodology

R &D). The development model used is an adaptation of the ADDIE development model for designing learning systems. According to Desy (2017), the stages carried out in the ADDIE research model are Analysis, Design, Develop, Implementation, and Evaluation.

In developing an integrated science literacy-based pocket book using the ADDIE model on environmental pollution and climate change, researchers carried out research up to the development stage ( Develop ) . This is in line with the research objectives of developing an integrated science pocketbook based on scientific literacy, which is to find out the validity, practicality, and response test of using an integrated science pocket book based on scientific literacy, and find out to what extent this integrated science pocket book based on scientific literacy is acceptable to students and encourages students to learn about environmental pollution. and better climate change.

Subjects in product validation were media experts, material experts, pedagogic experts, and 2 teachers. Meanwhile the subjects for practicality were 5 teachers, and the subjects for the integrated science literacy-based pocket book response test were 84 class VII students of SMPN 2 Rimba Melintang. The object of research was an integrated science literacy-based pocket book on environmental pollution and climate change and 84 class VII students of SMPN 2 Rimba Melintang as a limited trial of the developed pocket book. Data collection was carried out in the odd semester of the 2021/2022 school year. Collection technique the data used in this development study is in the form of a questionnaire.

The questionnaires used were validation questionnaires, practicality questionnaires and product trial questionnaires. The validation sheet was given to media experts, material experts and 2 teachers to evaluate the application of the developed scientific literacy-based pocket book. Pocket book validity analysis is determined based on the percentage of criteria presented in Table 1:

Table 1 . Validity Criteria

No	Score Average Interval	Category
1	$3.25 \leq x < 4$	Very Valid
2	$2.5 \leq x < 3.25$	Valid
3	$1.75 \leq x < 2.5$	Invalid
4	$1 \leq x < 1.75$	Invalid

(Sugiyono, 2015)

The questionnaire used in the form of a practicality questionnaire was used to see the practicality of the pocket book. The practicality analysis of pocket books is determined based on the percentage of criteria presented in Table 2.

Table 2. Practicality Aspect

No	Score%	Criteria
1	$80 < x \leq 100$	Very practical
2	$60 < x \leq 80$	Practical
3	$40 < x \leq 60$	Practical enough
4	$20 < x \leq 40$	Less practical
5	$0 < x \leq 20$	Not practical

(Riduwan, 2009)

Product trial questionnaires were given to class teachers to find out their responses to the integrated science literacy-based pocket book that was developed. The data obtained from the class teachers were then analyzed and concluded. Likewise, a pilot questionnaire was given to 84 class VII students to check their responses to the scientific literacy-based integrated science pocket book that is being developed. Analysis of student responses to pocket books was determined based on the percentage of criteria presented in Table 3.

Table 3. Questionnaire Response Analysis

No	Average score interval	Validity Category
1	$85 \leq x \leq 100$	Very good
2	$75 \leq x < 85$	Well
3	$65 \leq x < 75$	Enough
4	$< 65$	Not enough

(Sugiyono, 2010)

### 3. Results and Discussion

The product resulting from this R&D research is in the form of an integrated science literacy-based pocket book on environmental pollution and climate change that has been validated. The research results are presented based on the stages of research and development based on the ADDIE model.

#### *Analyze Stage*

Analyze Phase The initial stage of the research is the analysis phase. The analysis carried out in this study was a needs analysis which included student analysis and learning resource analysis, as well as obtaining an overview of the pocket books needed by teachers and students. The analysis was carried out by interviewing class VII teachers at Rokan Hilir Middle School. This interview asks about learning resources commonly used in Biology lessons. The results of interviews with class VI teachers regarding the use of learning resources, namely the teacher used learning resources in the form of printed books and LKPD. In the interviews, the teacher also conveyed problems related to the learning resources used, for example the learning resources used were thick and uninteresting so that students lost their enthusiasm for learning, and the learning process still depended on the teacher's explanation ( *teacher centered* ).



The pocket book provides instructions for indicators of scientific literacy, where these instructions serve to provide directions to students to distinguish each indicator of scientific literacy, provide an understanding of the science sections listed in the material presented in the pocket book coded with numbers 1 to 4.

3) Design the contents of a pocket book based on scientific literacy  
The content design page can be seen in Figure 3 below:

-Science as a body

- Science as a way of thinking



- Science as a way of investigating interaction

-Science-technology-society



Figure 3. Science Literacy Based Pocket Book Contents Design

The contents design of the scientific literacy-based pocket book is made in color and is equipped with pictures related to the material, the material is presented with explanations and is presented as attractively as possible, in this book it is equipped with scientific thinking texts and discussions related to facts and evidence. Each material is associated with an indicator of scientific literacy which is marked with an orange number code.

**Development Stage**

the development stage is to produce Prototype II . The results of Prototype II are scientific literacy-based pocket book products on environmental pollution and climate change. Furthermore, at the development stage validation is carried out. The validity of scientific literacy-based pocket books can be measured using validity instruments .

**1. Material Expert Validation Results**

The validator's assessment of material validation includes aspects of content feasibility and language feasibility. Based on the analysis of material validation data obtained from the material validator.

Table 4 . Material Validation Average Score Recapitulation Content Eligibility Aspects

Aspect	Indicator	No Items	Validator Score					Average Indicator
			V1	V2	V3	V4	V5	
Content Eligibility	Compatibility of KI and KD	1	4	4	4	4	4	4
	Indicator suitability	2	3	3	3	3	4	3,2
	The truth of the facts	3	3	4	3	3	4	3,4
	Material clarity	4	3	3	3	4	3	3,2
	Systematics	5	3	4	4	3	4	3,6
	Material equipment	6	3	4	3	3	4	3,4
	attractiveness	7	3	4	3	4	3	3,4
	Average			3,1	3,7	3,2	3,4	3,7
Category			4	1	8	2	1	SV
			V	S	S	S	S	
				V	V	V	V	

Information:

V : Valid

SV : Very Valid

According to the researcher, the content feasibility aspect has the highest score because the product being developed already has suitability and accuracy in compiling text or material , the material presented in a pocket book based on scientific literacy is also complete and interesting, because it is accompanied by pictures, besides that it is equipped with truthful facts and concepts. so easy to understand.

The highest category in the content feasibility aspect is a systematic indicator, this is because the developed pocket book is based on Basic Competencies, indicators and learning objectives that have been determined besides that the material is presented sequentially. While the lowest indicator is the suitability of the indicators and the clarity of the material, this is because the language used to present material in concepts and illustrations does not yet describe concrete examples (which are often encountered by students).

Table 5. Recapitulation of the Average Score of Material Validation Aspects of Language Feasibility

Aspect	Indicator	No Items	Validator Score					Average Indicator
			V1	V2	V3	V4	V5	
Language Eligibility	Appropriateness of students	8	4	3	4	3	3	3,4
	term accuracy	9	3	4	3	4	4	3,6
	Word clarity	10	3	3	3	4	4	3,4
	Sentence suitability	11	3	3	3	3	4	3,2
	convenience	12	3	4	4	3	3	3,4
	The link between scientific literacy	13	3	4	3	3	4	3,4
	Average			3,16	3,5	3,33	3,33	3,66
Category			V	SV	SV	SV	SV	SV

Information:

V : Valid

SV : Very Valid

Based on the results of the validation of the lowest scoring criteria for material validation on KD 3.8 material on environmental pollution and climate change on the feasibility aspect Language is an indicator of sentence suitability, according to the researcher because the pocket book that was developed contained several sentences which did not consist of subjects and predicates and there were still sentences which were in language and the writing system is not in accordance with EYD, in addition to that the pocket book that is developed is not yet perfect in terms of sentence conformity and linkage with scientific literacy. The highest assessment criterion on the aspect of language eligibility is an indicator of the accuracy of terms, the terms used in the pocket book are straightforward or not convoluted in accordance with Theory.



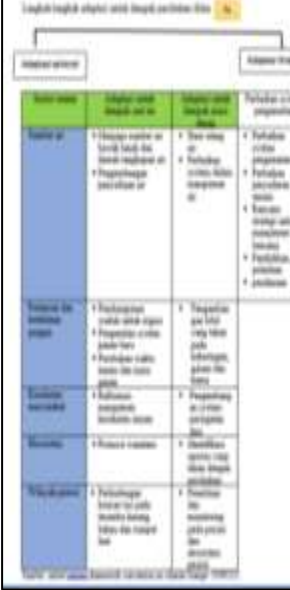

Table 6. Recapitulation of the Average Material Validation Score

No	Aspect	Validation Score	Validation Category
1	Content Eligibility	3,45	Very Valid
2	Language Eligibility	3,40	Very Valid
	Average Validation Score	3,42	Very Valid



Material validation for the development of scientific literacy -based pocket books on KD 3.8 on environmental pollution and climate change from 2 aspects are in the Very Valid Category. Based on the results of this validation, the science literacy-based science pocket book on air pollution and climate change is feasible to use. There are several suggestions and improvements to follow-up that will be carried out from the validation results as shown in Table 7.

Table 7 . Suggestions and Follow Up by Material Validators

NO	SUGGESTION	BEFORE	AFTER															
1	Images should be evaluated so that all images can be easily understood by students	 <p>Berpikir Ilmuwan</p> <p>Gambar 1 Daun yang jatuh ke sungai</p> <p>Gambar 2 orang membuang sampah ke sungai</p>	 <p>Ayo Berpikir</p> <p>Gambar di bawah ini menunjukkan beberapa hal yang terjadi di lingkungan kita. Gambarnya tentang apakah itu? Coba pikirkan.</p> <p>Terjadinya perubahan lingkungan akan memengaruhi keberadaan atau kelangkaan makhluk hidup.</p> <p>Gambar 1 Daun yang jatuh ke sungai</p> <p>Gambar 2 orang membuang sampah ke sungai</p>															
2	The preparation of the material is improved so that it is easy to understand and understand	 <p>Langkah-langkah dalam mengelola sampah</p> <p>Alasan tidak</p> <p>Alasan harus</p> <table border="1"> <thead> <tr> <th>Kategori</th> <th>Alasan tidak</th> <th>Alasan harus</th> </tr> </thead> <tbody> <tr> <td>1. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> </tr> <tr> <td>2. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> </tr> <tr> <td>3. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> </tr> <tr> <td>4. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> <td>1. Tidak ada tempat sampah</td> </tr> </tbody> </table>	Kategori	Alasan tidak	Alasan harus	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	2. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	3. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	4. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	 <p>Dampak lingkungan akibat sampah yang tidak dikelola dengan baik</p> <p>Alasan lingkungan kita menjadi semakin rusak</p> <ol style="list-style-type: none"> <li>1. Dampak dan akibatnya</li> </ol> <p>Dampak perubahan iklim dapat dirasakan oleh masyarakat dan hal ini merupakan tantangan bagi masyarakat dalam kehidupan kita.</p>
Kategori	Alasan tidak	Alasan harus																
1. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah																
2. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah																
3. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah																
4. Tidak ada tempat sampah	1. Tidak ada tempat sampah	1. Tidak ada tempat sampah																

## 2. Media Expert Validation Results

Media validity is an assessment related to the appearance and presentation of the developed pocket book.

Table 8 . Recapitulation of the Mean Validation Score of the Media Feasibility Aspect of Presentation

Aspect	Indicator	No Items	Validator Score					Average Indicator
			V1	V2	V3	V4	V5	
Eligibility of Presentation	Writing system	1	4	4	3	3	4	3,6
	Presentation logic	2	4	3	3	3	4	3,4
	Presentation clutter	3	4	3	3	3	4	3,4
	Images and symbols	4	4	3	3	3	3	3,2
	Structure fittings	5	4	3	3	3	3	3,2
	Average Category			4 SV	3,2 V	3 V	3 V	3,6 SV

Information:

V : Valid

SV : Very Valid

Based on the results of the validation of the lowest scoring criteria for media validation is on the presentation feasibility aspect, namely on the image and symbol indicators and the completeness of the structure. The highest scoring criterion for media validation is on the feasibility aspect of presentation, namely on the systematic writing indicator, this is because the pocket book that has been prepared is presented sequentially, starting from *the cover* , title, preface, table of contents, competencies, basic competencies, and indicators, scientific literacy , materials, quizzes, daily tests and reference lists.

Table 9. Recapitulation of the Mean Validation Score of the Media Graphical Feasibility Aspect

Aspect	Indicator	No Items	Validator Score					Average Indicator	
			V1	V2	V3	V4	V5		
Graphical eligibility	Book size	6	4	4	3	3	4	3,6	
	Use of letters	7	4	3	3	3	4	3,4	
	Use of color	8	3	3	3	3	4	3,2	
	Legibility	9	4	3	4	4	3	3,6	
	Layout	10	4	3	3	3	4	3,4	
	Font size	11	4	3	3	3	3	3,2	
	Describe content	12	4	4	3	4	4	3,8	
	Consistent	13	4	3	3	3	3	3,2	
	Letter variations	14	4	3	3	4	4	3,6	
	Loading destination	15	4	4	3	4	4	3,8	
	Average Category			3,9 SV	3,3 SV	3,1 V	3,4 SV	4 SV	3,48 SV

Information:

V : Valid

SV : Very Valid

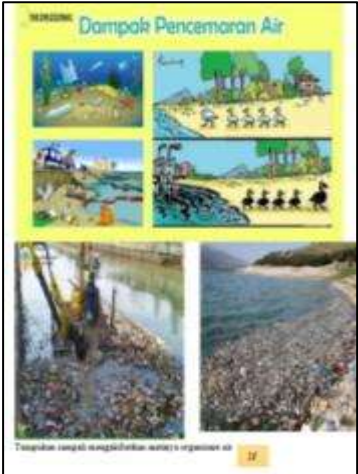

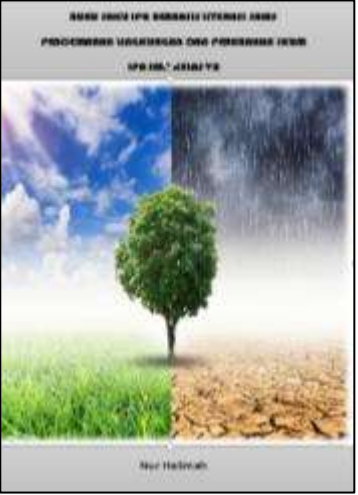

Based on the results of the validation, the lowest scoring criteria for media validation is on the aspect of graphic feasibility, namely on the indicators of using color and font size . The highest rating criterion for media validation is on the aspect of graphic feasibility, namely on indicators that describe content and contain goals.

Table 10 . Recapitulation of the Average Score of Media Validation

No	Aspect	Validation Score	Validation Category
1	Eligibility of Presentation	3,36	Very Valid
2	Graphic Eligibility	3.48	Very Valid
	Average Validation Score	3,42	Very Valid

Media validation for the development of scientific literacy-based pocket books on KD 3.8 and 3.9 on environmental pollution and climate change material from 2 aspects are in the Very Valid Category and are suitable for use . There are several suggestions and improvements to follow-up that will be carried out from the validation results seen in Table 11 following.

Table 11 . Suggestions and Follow Up by Media Validators

NO	Suggestion	Before	After
1.	The images should be presented in accordance with the facts and concept		
2.	Sharpen cover colors and images		

### 3. Practicality Test

The practicality test was assessed by 5 respondents. This practicality test is designed in such a way that it is applied in the learning process without any initial simulation in learning.

Table 12 . Average Practicality Aspects of Appearance and Language

No	Aspect	Criteria Evaluation	Respondent					Total Score	Flat
			N S	Y. S	J	J M	WH		
1		Systematic	3	3	3	3	4	16	
2		Instruction	3	3	4	4	3	17	
3		Picture	3	3	3	3	4	16	
4	Display and Language	Color	3	3	4	3	3	16	82.85 (Very Practical)
5		Font size	3	3	4	4	3	17	
6		EYD	3	3	4	4	4	18	
7		Easy to understand language	3	3	4	3	3	16	

Based on the results of the practicality test on the display and language aspects of the pocket book, the results of the development obtained an average score of 82.85 and in the very practical category . Overall, the display and language aspects of the pocketbooks resulting from the development are considered to be systematic and good. The highest indicator in terms of appearance and language aspects is Enhanced Spelling (EYD) where systematic scientific literacy-based pocketbooks use language appropriate to EYD. The lowest indicator is color, because some pictures/illustrations/photos that can cause students to have misconceptions are replaced with clearer pictures.

Table 13 . Average Practicality Aspects of Attractiveness

NO	Aspect	Criteria Evaluation	Respondent					Total Score	Flat
			N S	Y. S	J	J M	W H		
1		Interesting cover	3	3	3	3	3	15	
2	attractiveness	Picture clear	3	3	4	3	3	16	81.00 (Very Practical)
3		Help understanding	3	3	4	4	3	17	
4		Sparking passion	3	3	3	4	3	16	
5		Packaging	3	3	4	4	3	17	

The second aspect of the practicality test is the attractiveness aspect. The attractiveness aspect obtained an average score of 81.00 in the very practical category. The highest indicator on the attractiveness aspect is helping understanding and packaging. The lowest indicator on the attractiveness aspect is the cover. The cover was originally designed with unattractive colors and images that had little to do with the material.

Table 14 . Average Practicality Aspects of Use

No	Aspect	Criteria Evaluation	Respondent					Total Score	Flat
			N S	Y. S	J	J M	W H		
1	Use	Cognitive boost	3	3	3	3	3	15	81.67
2		Easy	3	3	4	4	3	17	Very
3		Independent	3	3	4	4	3	17	Practic al

The next aspect in the practicality test carried out is the aspect of use. The use aspect obtained an average score of 81.67 in the very practical category. The highest indicator on the aspect of use is easy and independent. The developed scientific literacy-based pocket book is easy to use and can be carried anywhere because of its practical size. The lowest indicator on the use aspect is cognitive stimulation.

Table 15 . Average Practicality

No	Assessment Aspects	Average Score	Category
1	Display and language	82.85	Very Practical
2	attractiveness	81.00	Very Practical
3	Use	81.67	Very Practical
<b>Average</b>		<b>81.84</b>	<b>(Very Practical)</b>

Table 15 shows that the mean value of the practicality test is 81.84 in the very practical category. This shows that the use of science literacy-based pocket books on environmental pollution and climate change in its application is very practical and easy to understand and very helpful in the learning process.

#### 4. Student Response Test (Large Scale)

A limited trial was conducted to find out how students responded to the scientific literacy-based pocket book that had been developed. The response assessment was carried out using a student response questionnaire.

Table 16. Average Student Respondents

No	Assessment Aspects	Average Score	Category
1	Appearance	86.6	Very Good
2	Function	85.5	Very Good
<b>Average</b>		<b>86.05</b>	<b>( Very Good)</b>

Table 16 shows that respondents by students obtained a score of 86.05 in the Very Good category for use in the learning process. The response of students during the limited trial was very good. The advantages of the scientific literacy-based pocket book that has been developed are: (1) small in size so that it is easy to carry anywhere, and makes it easy for students to study it anywhere, (2) equipped with pictures, so that it looks attractive and makes it easier for students to understand the explanation of the material, (3) The pocket book that was developed is made

in *full color* so that it makes students more interested in reading and learning it, (4) stimulates students to use scientific knowledge, identify problems, draw conclusions based on evidence and make decisions on a problem, (5) examples contained in the material Pocket books are examples related to everyday life, and (6) are a variety of learning resources other than textbooks.

Several studies have also shown good responses in the use of pocket books based on scientific literacy. Research Rahmawati, et al (2013) that the percentage shown from the results of the student response questionnaire states that pocket book teaching materials have very good benefits for students. In line with Khabibah's opinion (in Yamasari, 2010) if the percentage of student responses is above 85% then towards the pocket book is very positive. Students feel helped by having pocket book teaching materials and want pocket books to be used in learning not only in respiration material but also in other material.

The presentation of facts, concepts and theories is supported by colorful illustrations that make it easier and motivate students to learn the material. According to James W. Brown et al in Sudjana (2007) from the results of Seth Spauldin's research on how students learn through pictures, it is concluded that: (a) Picture illustrations are teaching tools that can attract students' learning interest effectively. (b) Picture illustrations help students read textbooks, especially in interpreting and remembering the contents of the accompanying text material.

#### **4. Conclusion**

Based on the results of the research that has been done, it can be concluded that: Validity of the Development of an Integrated Science Literacy-based Pocket Book on Environmental Pollution and Climate Change obtained a very valid category for use by students, for practicality obtained a very practical category and for student responses Development of an Integrated Science Literacy-based pocket book on environmental pollution and climate change material get very good category. It can be seen from the results in the field Development of an Integrated Science Literacy-based pocketbook on environmental pollution and climate change able to become a learning resource that can help the teaching and learning process and foster students' interest in reading in the learning process.

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