

Development of e-pocket book learning media on environmental pollution based on environmental issues in Cirebon region

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Abstract: In the Cirebon region, there are several environmental issues exists, one of the problems is pollution. In the context of modern information technology, there's a growing preference for electronic-based educational materials. This study aims to evaluate the environmental pollution levels in Cirebon and develop a e-pocket book as a biology learning resource for high school students. The research follows the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) and utilizes observations, questionnaires, and documentation for data collection. The environmental assessment was conducted in Cirebon city and regency, and the learning media developed at MAN 2 Cirebon City. Results from the Environmental Quality Index (IKLH) indicate moderate pollution levels in Kejaksan District and mild-moderate levels in Talun District. The e-book was created using the Canva application and finalized into a link format compatible with laptops and Android smartphones. It underwent validation by material experts, media experts, biology educators, and student users, receiving favorable feedback with an overall rating of 87.24% deemed very satisfactory. It can be concluded that the development of this e-book on environmental pollution can be used as a learning media.

Keywords: Cirebon environmental issues; e-books; environmental pollution; learning media

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Article history:

Received: 24 September 2023

Revised: 19 February 2024

Accepted: 6 March 2024

Published: 31 March 2024

 10.22219/jpbi.v10i1.29356

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p-ISSN: 2442-3750

e-ISSN: 2537-6204

How to cite: Lesmanawati, I. R., Nada, S., & Nur'aisyah, S. (2024). Development of e-book learning media on environmental pollution based on environmental issues in Cirebon region. *JPBI (Journal Pendidikan Biologi Indonesia)*, 10(1), 339-347.

<https://doi.org/10.22219/jpbi.v10i1.29356>

Introduction

Environmental problems have always been a popular issue facing the world which can be classified into two parts. First, environmental problems that arise as a result of various natural phenomena themselves, for example earthquakes, eruptions, eclipses and so on. Second, environmental problems as a result of human intervention (Avoyan, 2022; McBride et al., 2013). These changes have a significant impact on the inhabitants, although nature can often resolve them by maintaining balance. Therefore, environmental issues should be included in the education curricula (Erich & Popescu, 2010; Goulgouti et al., 2019).

Idi and Safarina (2014) stated that education is something important in a person's life. The function of education is to be able to develop and shape the behavior of individuals or students to be faithful and obedient to God Almighty and have good noble character. The development of education will be in line with the dynamics of society, because the characteristics of society are always developing. The need for learning media is an inseparable thing in the learning process (Suwardiyanto & Yuliandoko, 2017). One of the functions of media is that it can overcome the problem of students' low interest in reading books (Maemunah et al., 2021). One of the factors that can influence the learning process and overcome the problem of low interest in reading books is the application of interactive learning media (Tafonao, 2018; Lutfi et al., 2023). Utilizing smartphone technology which has Android-based application creation features can help educators find out the practical and interesting functions of the smartphone (Adistana et al., 2020; Muyaroah & Fajartia, 2017).

Books are a media that is often used as teaching material. Research by [Mahardika et al., \(2023\)](#) strengthens to motivate students' learning, teachers can choose a variety of learning media, so that the learning delivered will be more meaningful. One effort to increase the variety of learning media is to provide learning resources for students at school by using other textbooks to support the learning package published by the Ministry of Education and Culture. E-pocket books are small print media that can be stored in a e-pocket and are easy to carry anywhere. A e-pocket book is a small, e-pocket book so it is effective for carrying everywhere and can be read whenever needed ([Eliana & Solikhah, 2012](#)). E-pocket books are used as tools that convey information about subject matter and other things in a one-way manner, so that they can develop students' potential to become independent learners.

Teachers can develop textbooks that are appropriate to social and cultural life. This opinion is in line with research by [Keller and Suzuki \(2004\)](#) which states that teaching materials are created by integrating dimensions of scientific literacy, containing tasks or activities, presenting interesting illustrations or pictures. Several researchers have succeeded in developing teaching materials using Android-based smartphones, including research by [Muyaroah and Fajartia \(2017\)](#) states that Android-based mobile learning products are suitable for use in learning and can improve learning outcomes and can be used as learning modules, the results obtained showed that smartphone-based (Android) modules could be used in learning. Apart from that, [Affah et al., \(2018\)](#) conducted research using an Android-based smartphone to use an Android-based e-pocket as biomonitoring teaching material. There is still few information about the development of digital e-pocketbooks on environmental pollution materials. Furthermore, the study mean develop e-pocket book that can used for teaching and to maximize smartphones as a learning medium, as well as filling in the literature gaps regarding related research. The material content in this e-pocket book will be prepared with the aim of making it easier for teachers to convey the material, and changing the behavior of the school community to become skilled at managing waste so that they are aware of the importance of protecting the environment. Moreover, the result of this research later become one of the references for the same research related to the environment pollution teaching materials in the form of digital e-pocket book products.

Method

This type of research uses research and development (R&D) methods with the ADDIE model consisting of from stage Analysis, Design, Development, Implementation and Evaluation by Branch ([Efendi, et al., 2023](#)). The analysis stage consists of analysis of student needs, curriculum analysis, analysis of student characteristics, and analysis of environmental pollution identification research in the Cirebon City and Regency areas. Analysis need required to obtain problems fundamentals at hand in the learning process biology ([Saputri, et al., 2024](#)). Stage Planning (Design) done with formulate details material and create a digital e-pocket book framework. The Development Phase begins with identifying environmental pollution in the Cirebon City and Regency area to fill in the material for creating a digital e-pocket book using the Canva and FlipDF applications in accordance with the framework that has been created. Then testing of the digital e-pocket book was carried out by media experts and material experts. The digital e-pocket book that had been developed and declared suitable for testing by media experts and material experts was then implemented with ten teachers and students from class X Science at MAN 2 Cirebon City. The evaluation stage was carried out by making improvements based on criticism and suggestions from experts, teachers, and students.

This research was conducted in Kejaksaan District, Cirebon City and Talun District, Cirebon Regency to identify environmental pollution, while for the implementation of learning media, namely at MAN 2 Cirebon City. The research was conducted in February – May 2022.

The data collection techniques were used observation, questionnaires, and documentation. Observations were carried out at schools to collect data which will later be used for analysis of student needs, curriculum analysis, analysis of student character, product trials and distribution of questionnaires aimed at finding out the use of learning media. Meanwhile, field observations were carried out to collect data identifying polluted environments in the Cirebon City and Regency areas which will later become material in a digital e-pocket book. Documentation in this research is in the form of photographs during the research. A questionnaire was used to collect data regarding the suitability of the e-pocket book given to experts, Biology teachers and students as test subjects.

The data that has been collected will be analyzed to determine the assessment and opinion of the product produced. The product development process data is descriptive data obtained from material experts, media experts, Biology lecturer/teacher and students in the form of corrections and input. Product quality assessment data was obtained from the results of questionnaires by media experts, material experts and Biology learning practitioners using a Likert scale. Next, the data was analyzed by changing the qualitative assessment to quantitative with the provision of giving a score of 1 (very disagree), 2 (disagree), 3 (agree), 4 (totally agree) ([Widoyoko, 2011](#)). Furthermore, percentage evaluation calculated with formula following (1):

$$P = \frac{S}{N} \times 100\% \quad (1)$$

Information :

P = Score percentage (%)

S = score obtained

N = maximum score (Sugiyono, 2011)

The collected data was analyzed using quantitative descriptive analysis which was presented in a score distribution and percentages for categories with a predetermined assessment scale. A quantitative descriptive analysis aims to quantify the results of the questionnaire according to predetermined indicators by giving predetermined score weights (Mahardika, 2023) . This analysis is used to describe the characteristics of each data obtained.

The percentage of feasibility assessments can be seen in the [table 1](#):

Table 1. Feasibility Assessment

Valuation Percentage	Interpretation
76-100%	Very Worth It
50-75%	Worthy
26-50%	Decent Enough
<26%	Not Worth It

Data in the form of student opinions obtained from a combination of closed and open questionnaires. The scoring used in this research instrument uses the Ghuttman scale, namely the answer "yes" is given a score of 1 , while the answer "No" is given a score of 0 with the provisions stated by Saputri et al, (2024a) and Saputri et al, (2024b) . The percentage is calculated using the Formula (2):

$$Percentage (\%) = \frac{Total\ score\ obtained}{Maximum\ total\ score} \times 100\% \quad (2)$$

Response to a product is considered positive if it gets a percentage $\geq 70\%$. In the closed questionnaire section, data analysis was used using descriptive data analysis techniques (Kiswanto, 2012).

Results and Discussion

This research was carried out in 2 areas, namely the Cirebon City area and Cirebon Regency, the Cirebon City area was carried out in Kejaksan District and the Cirebon Regency area was carried out in Talun District. The pollution identified is air pollution, water pollution, land pollution and noise pollution. The identification results can be seen in the following [Table 2](#):

Table 2. Results of Identification of Environmental Pollution in the Cirebon City and Regency Region

No	Location Name	Location Category	Name Pollution	Parameter
		Settlement	Water	1. Physics Parameters -Temperature: 27 °C -Color: cloudy, whitish green - Strong scent -Taste: bitter 2. Chemical Parameters -pH: 8 3. Biological Parameters -organism: Paramecium sp
1	District Attorney's Office (Cirebon City)	Settlement	Air	1. Physics Parameters -humidity: 59.9% -strong scent -Pollution/dust: thick grayish white smoke 2. Meteorological Parameters -Wind speed: 13.1 km/hour -Temperature: 30 °C 3. Biological Parameters -Organisms: no organisms were found
		Settlement	Land	1. Physics Parameters -Temperature: 27.6 °C at a

No	Location Name	Location Category	Name Pollution	Parameter
		Public facilities	Voice	-depth of 10 cm -Inertia: 59.9 % -Texture: smooth -Black 2. Chemical Parameters -pH : 8 3. Biological Parameters -Organism: not found Noise level : 101 dB
		Settlement	Water	1. Physics Parameters -temperature: 29 °C -Color: brownish green -strong scent -taste: bitter 2. Chemical Parameters - pH: 8 3. Biological Parameters -organism: not detected
2	Talun District (Cirebon Regency)	Open field	Air	1. Physics Parameters -humidity: 52.9% -strong scent -pollution/dust: there is thick, thick white smoke 2. Meteorological Parameters -Wind speed: 11.2 skm/hour -temperature: 29 °C 3. Parameter Biology - organisms: no organisms were found
		Settlement	Land	1. Physics Parameters -temperature: 27.7 °C -humidity: 58.9% -texture: rough, dry -black 2. Chemical Parameters -pH : 8 3. Biological Parameters -organisms: no organisms were found
		Settlement	Voice	Noise Level: 92 dB

According to [Rahma \(2023\)](#), river water pollution is when certain substances enter the river and cause a decrease in water quality to a certain level, so that the water cannot be used for living needs. Based on table 2, it is known that the results of research on water pollution in Kejaksaan District, Cirebon City show that the water temperature is 27 °C, the color of the water is cloudy, whitish green, has a bitter taste, the pH value reaches 8, then observations were made under the microscope, there are protozoa in the form of *Paramecium sp.* [Anisafitri, et al \(2020\)](#) stated that the biggest source of pathogenic bacteria in waters is domestic waste, in this case the waste is directly thrown into the nearest river which should be channeled to a septic tank .

The next identification is carried out from the aspect of air pollution. Air pollution refers to the release of pollutants into the air, pollutants that are detrimental to human health and the planet as a whole ([Mustafa, et al., 2023](#); [Chen et al., 2021](#); [Ferronato & Torretta, 2019](#)). The results of identification in the field showed that the temperature in the observation area reached 30 °C, the humidity had a value of 59.9%, the wind speed was 13.1 km/hour. Picture on every point sample describe that Wrong One reason pollution air is due to the combustion process rubbish on the ground empty that gives rise to smell stings with thick smoke.

The next identification was soil contamination, with the results showing that the soil texture was hard, there were no organisms, the soil color was black, the soil temperature was 27.6 °C with a soil depth of 10 cm. [Rahmatika \(2021\)](#) states that soil temperature will decrease with increasing depth. Soil quality can be seen from the physical properties of the soil. Soil physical properties are the properties of the soil

as seen from the texture, structure, soil consistency, soil color, soil temperature. The physical properties of the soil have a huge influence on the growth and production of plants growing on it (Risaldi, et al., 2023). Picture on every point sample describe that there is various type rubbish in the area observation, good organic waste, or rubbish inorganic. Rubbish organic is originating waste from ingredients remainder creature life like plant and animals, trash kitchen Also is rubbish organic, for example remainder flour, vegetables, skin fruit and foliage (Njira & Nabwami, 2013; Wulandari et al., 2007). Temporary rubbish inorganic is trash that is not can degraded in a way experience. Example rubbish inorganic including: metal, iron, cans, plastic, and rubber (Sari, 2023; Dewi et al., 2014; Olufemi et al., 2022). Rubbish inorganic This usually requires a recycling process repeat or management specifically so you can process return become material new or reduced impact to environment.

Noise pollution is a disturbance in the environment caused by sounds or sounds that cause unrest in living creatures around them (Fitria & Fitrihijadati, 2023). Noise pollution in the observation area received a noise level value of 101 dB. According to Ahmad (2023), sound can begin to damage human ears if the volume level is greater than 85 dB and at 130 dB it will destroy the eardrum. Based on research results and data from the Cirebon City Environmental Quality Index (IKLH), the level of environmental pollution in the Cirebon City area, Kejaksaan District, is in the moderate/moderate category.

Identification of environmental pollution was then carried out in Talun District, Cirebon Regency. Researchers carried out the first identification, namely water pollution, after identification it showed a temperature of 29°C, the water color was brownish, had a bitter taste, a pH value of 8, and after the water samples were examined in Under the microscope there were no protozoa. Researchers then identified air pollution, with the results being a temperature of 29 °C, humidity 52.9%, wind speed 11.2 km/hour. The next identification, namely soil pollution, showed the results that the soil texture was hard, there were absolutely no organisms, the soil color was black, the soil temperature was 27.7 °C. According to Karyati et al (2018), the factors that influence the high and low soil temperatures are solar radiation and vegetation. Noise pollution by getting a noise level value of 92 dB. Based on research results and data from the Cirebon Regency Environmental Quality Index (IKLH) as well as relevant sources, the level of environmental pollution in the Cirebon Regency area, Talun District is in the light-medium category.

The initial stage done in making product e-pocket book, namely drafting. The material was obtained from the results of research identifying pollution in the Cirebon City and Regency areas. The material to be displayed in the digital e-pocket book was created using Microsoft Word first. After the material draft has been completed, the next stage is making the design. The design was created using the Canva application which can be downloaded via Playstore on Android. Then the design containing the material is saved as a file in PDF format. The result in this product is in the form of a link, after the digital e-pocket book has been created in PDF form, a flip book is then created in the form of a link using the professional Flipdf application which can be downloaded via laptop and can be opened via smartphone. The appearance of the digital e-pocket book can be seen in the Figure 1.



Figure 1. E-pocket book view digital: (a) opening section (b) content section (c) closing section

The next stage is product validation by a contain expert, namely Mr. Bambang Ekanara, M.Pd. as a lecturer in the Tadris Biology Study Program, Faculty of Tarbiyah and Teacher Training IAIN Syekh Nurjati Cirebon where he teaches the Introduction to Environmental Science course, and one media expert, namely Mr. Muhsin Riyadi, MA. as a lecturer in the Department of Education Arabic Language, Faculty of Tarbiyah and Teacher Training IAIN Syekh Nurjati Cirebon where he teaches Multimedia Education courses. To ensure the highest quality learning experience, this project incorporated feedback from media experts throughout the development process (Permana & Sari 2018; Ramadani et al., 2021).

Their insights helped refine the e-pocket book, a digital learning resource for environmental science. Once deemed feasible by these experts, the implementation phase began. This involved testing the e-pocket books with a group of 10th grade science students at MAN 2 Cirebon City. This pilot program will provide valuable data on the effectiveness of the e-pocket books in a small class. Media distribution was carried out by sending links to students via WhatsApp by researchers. After the product has been tested, students are asked for their responses or opinions by filling in the questionnaire that has been given. The trial was limited to 10 students of class X Science at MAN 2 Cirebon City and one Biology teacher to determine the response.

Assessment by material experts received a total score of 69 on 21 indicators. If calculated using percentages, the media gets a score of 82.14% so it is included in the very suitable category for use as learning media. Apart from the overall value analysis, the assessment of this media is also known when viewed from each aspect. Based on the assessment of the relevance aspect of the material with 6 indicators, it received a score of 17, an average of 2.83 and the suitability of the media was included in the appropriate category with a percentage obtained of 70.84%. In the aspect of organizing material with 7 indicators, it gets a score of 23, an average score of 3.28 and in terms of percentage it is included in the very appropriate category with a score of 82.14%. In the language aspect, there are 3 indicators that get a score of 12, an average score of 4.00 and in percentage terms they get a score of 100%, so it is included in the category very suitable for use as a learning medium. In the aspect of effects on learning strategies, there are 5 indicators that get a score of 17, an average score of 3.40 and the suitability of the media is included in the very feasible category with a percentage obtained of 85%. If calculated by percentage, the media gets a score of 97.61%, so that based on it it is included in the category of being very suitable for use as learning media.

The assessment of the software engineering aspect with 5 indicators received a score of 25, an average score of 4.00 and media feasibility was included in the very feasible category with a percentage obtained of 100%. In the visual appearance aspect with 8 indicators, it got a score of 30, the average score was 3.75 and in terms of percentage it was included in the very decent category with a percentage of 93.75%. In the language aspect, there are 3 indicators that get a score of 12, an average score of 4.00 and the appropriateness of the media is included in the very appropriate category with a percentage obtained of 100%. In the aspect of effects on learning strategies, there are 5 indicators and get a score of 20, an average score of 4.00 and in percentage terms they get a score of 100%. Based on the results of calculations and theory by [Kiswanto \(2012\)](#), the e-pocket book developed is included in the category of very suitable for use. If you look at the learning media feasibility diagram by media experts, the highest scores are obtained in the software engineering aspect, language aspect, and effect aspect for learning strategies, and those are important aspects as candidate of learning media for student use ([Darma et al., 2020](#); [Lutfi et al., 2023](#)).

Based on the overall assessment by biology teachers, the media received a total score of 66 and an average score of 2.86 on 23 indicators. When calculated by percentage, the media gets a score of 71.73%, so it is included in the category suitable for use as learning media. Apart from analyzing the overall value, you can also find out the assessment of this media if you look at it from each aspect. Based on the assessment of the relevance aspect of the material with 4 indicators, it received a score of 12 with an average score of 3.00 and the suitability of the media was included in the appropriate category with a percentage obtained of 75%. In the aspect of material organization with 7 indicators, it got a score of 21, an average score of 3.00 and in terms of percentage it was included in the appropriate category with a percentage of 75%. In the language aspect, there are 2 indicators that get a value of 5, an average value of 2.50 and media suitability is included in the appropriate category with a percentage obtained of 62.5%. In the aspect of effects on learning strategies, there are 5 indicators and they get a score of 14, an average score of 2.80 and in percentage terms they get a score of 70%. Based on the assessment of the software engineering aspect with 2 indicators, it got a score of 5, an average score of 2.50 and media feasibility was included in the very feasible category with a percentage obtained of 62.5%. In the visual appearance aspect with 3 indicators, it gets a score of 9, the average score is 3.00 and in terms of percentage it is included in the decent category with a percentage of 75%. Based on calculations and [Kiswanto's \(2012\)](#) theory, the e-pocket book developed is included in the category suitable for use. on aspects of material relevance, material organization and visual appearance aspects.

Learning media assessment was also carried out by 10 students at MAN 2 Cirebon City using a questionnaire. The questionnaire for students uses the Ghuttman scale with two alternative answers. The questions in the questionnaire consist of 8 questions which are a combination. Based on assessment recapitulation of answers from 30 class Validation carried out by material and media experts is by collecting suggestions and opinions from material and media experts to carry out revisions. The aspects assessed are the relevance of the material, organization of the material, language, and effects on learning strategies. The percentage results of digital e-pocket book assessment by material experts showed 82.14% (very feasible), media experts at 97.61% (very feasible), Biology teachers 71.73% (decent), and recapitulation for 10 students at 97.5% (very worthy). The overall assessment results

reached 87.24% so that based on [Kiswanto's \(2012\)](#) theory, the e-pocket book developed was considered very feasible.

The use of effective learning media is very important in improving the quality of learning. Learning media can help students learn more easily, effectively, and happily ([Adistana et al., 2020](#); [Maemunah et al., 2021](#); [Damayanti et al., 2024](#)). Interesting and interactive learning media can increase students' interest and enthusiasm for learning. Using appropriate learning media can also meet diverse learning needs and create a fun and memorable learning experience. This ultimately helps students achieve optimal learning outcomes ([Puspitarini & Hanif, 2019](#); [Keller & Suzuki, 2004](#)). Moreover, the use of media that is based on problems around students will present contextual facts that students will understand more easily and will remember in long-term memory ([Lindsey et al., 2014](#)). The use of environmental pollution problems in the Cirebon area will make students more aware of the dangers and prevention of environmental pollution. Using e-pocket books in learning will make students understand concepts and learning materials about the environment and pollution more easily, increase understanding and retention of information, and improve students' critical and creative thinking abilities ([Astuti & Santosa, 2017](#)).

Conclusion

Based on observation results about the environmental problem in the Districts at the Cirebon City and Cirebon Regency it was obtained a specific information as content in a learning media for student. The development of e-pocket book on Environmental Pollution based the environmental issues in Cirebon region have a good result to use as learning media. The e-pocket book on Environmental Pollution is suitable for use as a biology learning medium in environmental pollution material for class X SMA/MA based on validation tests, responses from Biology teachers and students. The results of the digital e-pocketbook assessment percentage by material experts showed 82.14% (very feasible), media experts at 97.61% (very feasible), Biology teachers 71.73% (decent), and recapitulation for 10 students at 97.5% (very worthy). The overall assessment results reached 87.24% with very feasible criteria.

Conflicts of Interest

The author stated has no conflicts of interest in this paper.

Author Contributions

I. R. Lesmanawati: methodology, validation, analysis; **S. Nada:** writing—original draft preparation; and **S. Nur'aisyah:** review and editing.

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