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# Developing Interactive Media in Environmental Pollution Learning

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ABSTRACT
*This study aims to explore the development of interactive media for learning about environmental pollution and to test how suitable the media is as a learning tool. The methodology used in this study is research and development, which consists of four stages, namely: (1) identification of potential and problems, (2) data collection, (3) product design, and (4) design validation. The data collection technique used in this study is a questionnaire distributed to four validators, consisting of two supervising lecturers and two experts to assess the feasibility of the learning interactive media related to the theme of environmental pollution that has been developed. From the results of the study, it can be concluded that: (1) the design of the learning interactive media related to environmental pollution consists of devices such as an infocus, laptop, and Compact Disc. (2) The development of learning interactive media about environmental pollution, based on the results of the feasibility test and recommendations from expert validators on the questionnaire is declared suitable for use as a biology learning interactive media with very high criteria.*

ABSTRAK
Penelitian ini bertujuan untuk mengeksplorasi pengembangan media interaktif untuk pembelajaran mengenai pencemaran lingkungan serta untuk menguji seberapa layak media tersebut sebagai alat pembelajaran. Metodologi yang digunakan dalam studi ini adalah penelitian dan pengembangan, yang terdiri dari empat tahapan, yaitu: (1) identifikasi potensi dan masalah, (2) pengumpulan data, (3) perancangan produk, dan (4) validasi desain. Teknik pengumpulan data yang digunakan dalam penelitian ini adalah kuesioner yang disebarkan kepada empat validator, terdiri dari dua dosen pembimbing dan dua ahli untuk menilai kelayakan media interaktif pembelajaran terkait tema pencemaran lingkungan yang telah dikembangkan. Dari hasil penelitian, dapat disimpulkan bahwa: (1) desain media interaktif pembelajaran terkait pencemaran lingkungan terdiri dari perangkat seperti infokus, laptop, dan piringan optik digital. (2) Pengembangan media interaktif pembelajaran tentang pencemaran lingkungan, berdasarkan hasil uji kelayakan dan rekomendasi dari validator ahli pada kuesioner dinyatakan layak digunakan sebagai media interaktif pembelajaran biologi dengan kriteria sangat tinggi.

## PRELIMINARY

Education serves as a tool and means that supports, guides, develops, and directs toward a better life, not only for individuals but also for others. To facilitate the teaching and learning process, educators can utilize various learning models or methods and supporting media. These supporting media can include models, textbooks, transparencies, videotapes, computer-based media, and others (Ayuningrum, 2014). Learning is the joining of interacting components that have integrity with each other. An important thing that must be done in the learning process is to practice process skills, so that students are more active in acquiring their own attitudes, skills, and knowledge. The lack of teacher consistency in teaching, namely the inconsistency between the plans that have been made and the process carried out, has an impact on student difficulties in learning and students are mostly less active in learning activities ( Nursafiah, et al., 2020). The lessons that are expected in the present are learning processes that involve students in the learning process, student activities in learning that are expected such as seeing, asking, responding,

concluding, the joy of the learning process can improve learning outcomes (Yassir, 2015).The use of media in the learning process significantly influences learning effectiveness, because students' ability to listen to a teacher's lecture is only half the teacher's speaking speed. As a result, over a certain period of time, students' attention begins to wane and they tend to feel bored due to the teacher's rather monotonous movements. Research by Mc. Keachy shows that students' concentration can only last for ten minutes if the learning method used is a lecture (Silberman, 2009) in (Prasetyanto, et al., 2011).

The implementation of a learning also greatly affects the success of the learning process. In the learning process there are several components that influence each other, including teachers and students. Thus, teachers must be able to choose the right learning with the conditions when the learning process takes place. One of the things that teachers can do at school is to utilize the media available at school so that students can be directly involved in teaching and learning activities ( Yassir, et al., 2025). The use of instructional media in the learning process, particularly in science subjects, will contribute to the effectiveness of the learning process itself. One way to achieve learning objectives is through the use of instructional media. Therefore, selecting instructional media is a crucial part of planning or designing learning, ensuring interaction between students and teachers, students with other students, and students with other learning resources (Megawati et al., 2015).

Biology learning is a process of discovery and emphasizes providing hands-on learning experiences. High school biology, particularly in grade 10, on environmental pollution is one topic that directly relates to everyday life (Syahputra, dkk 2022). Environmental pollution is a significant issue that requires analysis and solutions. This is due to the need of every living creature for natural resources and other essential elements of the environment. By (Sompotan, 2022) Environmental pollution occurs because of human activities themselves who cannot process and utilize the environment properly so that it has an impact on human health and safety Therefore, understanding environmental pollution is crucial for students to build environmental awareness and concern (Yassir, et al., 2024). The topic of environmental pollution was chosen because Southeast Aceh Regency is rich in natural resources, such as fresh air, clean water, and fertile soil. Therefore, the environment surrounding students, especially in Southeast Aceh, can be utilized as a learning medium in Biology lessons, particularly regarding environmental pollution. Crucial for learning more about the various forms of pollution, what causes them, and how to effectively and sustainably reduce their impacts. Academics and practitioners can leverage this study to gain intellectual and practical insights that will help them create solutions that can be implemented by all parties (Salsa Bila 2025).

Therefore, researchers want to introduce natural resources to students through the development of interactive learning media regarding environmental pollution, to increase students' insight and support their learning process, as well as as a substitute for direct observation of environmental pollution in the field. Interactive media is media that presents audio and visuals containing learning messages, including concepts, principles, procedures, theories and applications to help understanding learning material (Riyana, 2007). This interactive media introduces students to the potential of Southeast Aceh Regency, explains issues related to that potential, delivers material, analyzes situations in the area, and conducts reflection. This relates to the environmental conditions surrounding the students. Therefore, in the learning process, students are not only required to understand the theory presented but also to be able to find applicable solutions to protect their environment. As the need for innovation in the digital era grows and the complexity of problems faced by society increases, R&D methods are becoming increasingly relevant to be applied, not only in the fields of technology and industry, but also in the social, health and education sectors (Rahayu, 2025). Based on this, media is needed in the learning process that can improve student learning outcomes so that they gain a comprehensive understanding of existing phenomena. To prove this, it is important to develop videos using the research and development (R and D) method, a very effective strategy for improving practice (Sukmadinata, 2009). Development is a process or method used to improve something to make it better or more perfect. Research and development methods are also defined as a research method used to produce a specific product and test its effectiveness (Sugiyono, 2011). Research and development can also be defined as a series of steps to create new products or refine existing products in a responsible manner (Sujadi, 2002). In a previous study conducted by (Nurul, 2010) on the development of a mangrove ecosystem learning video as a learning resource for students, it was concluded that the average expert assessment of the video was 88.89%, meeting the criteria of very good (La Hadisi, et al., 2025). Furthermore, research by (Rachmawati, 2014) regarding the development of

biomonitoring video media as an independent learning resource for water pollution sub-material shows that the quality of the video media developed was assessed as very good by experts, with a percentage reaching 94%.

## METHOD

The characteristics of development research are related to problems or potentials that are faced or want to be solved in education and occur in relation to innovative efforts in learning, all forms of development, whether media, models, approaches, or learning methods, must be effective (Okpatrioka, 2023). The development of learning media interactive uses research and development methods. This method is a process used to develop and validate educational products. Research and Development (R&D) is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2010). Research stages are a series of activities carried out in the research process. Based on the steps of implementing research and development strategies that are attempted to create a particular product and to evaluate the effectiveness of the product, the steps include: Identification of Potential and Problems, Information Collection, Product Design, Design Validation, Design Revision, Product Trials, Product Revisions, Usage Trials, and Large-Scale Production. This study only reached the design validation phase, assessing the suitability of the interactive learning media created for use in the learning process. This was due to time and funding constraints for proceeding to the next research phase.

### *Potential and problems*

This research can begin with the presence of an opportunity or issue. Opportunities refer to anything that, if utilized, can add value to the product being studied. Empowerment will lead to improved quality and can increase income or profits from the product. Issues can also be viewed as opportunities if we are able to capitalize on them. This approach focuses on identifying specific problems and finding solutions through research and innovation. This approach is often used in engineering or hardware development, where specific needs or technical problems drive the innovation process (Zamsiswaya, 2024). In this research, opportunities and issues arise from the low public awareness in Southeast Aceh regarding environmental conservation, which has resulted in the surrounding environment becoming polluted. Limited class hours result in infrequent learning activities on environmental pollution, compounded by teachers' lack of interest in using learning media, especially on the topic of environmental pollution. As a result, students can become bored, sleepy, and uninterested in participating in the lesson.

### *Data collection and literature study*

After objectively identifying the potential and problems, the next step is to collect various information and literature reviews that can be used as references in planning a specific product that is expected to address these issues. This research aims to find concepts or theoretical foundations that support a product. After objectively identifying the potential and problems, the next step is to collect various information and literature reviews that can be used as references in planning a specific product that is expected to address these issues. This research aims to find concepts or theoretical foundations that support a product. In this stage, researchers collected data through observations in several high schools in Southeast Aceh, as well as investigating literature studies from previous researchers on interactive media, literature on the feasibility of interactive media, criteria for developing effective interactive media, and also on material concepts that aim to identify problems in learning activities and create solutions that have potential value (

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### *Product design*

Before the product design proceeds to the next stage, the product design (model, textbook, etc.) needs to be validated. Validation of the product design is carried out by colleagues, such as lecturers or teachers in the same field of study or expertise (Slamet, 2022). The products produced in research and development research products are varied. Product designs must be realized in images, so that they can be

used as a guide for evaluating and creating them and making it easier for others to get started. The product design in this study consists of a series of tools that include an infocus, laptop and Compact Disc.

### *Design Validation*

Design validation is the step used to evaluate whether a product is acceptable. The product validation process can involve several experts or professionals with experience assessing newly created products. In this study, validation will be conducted by two supervising lecturers as validation experts and two other lecturers as validators. By utilizing a questionnaire completed by each validator, the primary objective is to determine the extent to which aspects of the interactive media's feasibility for learning have been achieved.

## FINDINGS AND DISCUSSION

The table 1. Results of the Feasibility Test of Learning Interactive Media on Environmental Pollution

| No | Observed media statements | Value | Percentage | Information |
|---|---|---|---|---|
| 1. | Regularity of interactive media Served | 9 | 90% | Very high |
| 2. | Image availability which is served | 8 | 80% | Tall |
| 3. | Interactive media lighting | 9 | 90% | Very high |
| 4. | Background selection | 9 | 90% | Very high |
| 5. | Explanatory design in interactive media | 9 | 90% | Very high |
| 6. | The appearance of interactive learning media is interesting | 9 | 90% | Very high |
| 7. | Clarity of interactive media in the narrative section | 8 | 80% | Tall |
| 8. | Clarity of voice in Explain | 8 | 80% | Tall |
| 9. | Sound effects | 8 | 80% | Tall |
| 10. | Background color Contrast | 8 | 80% | Tall |
| 11. | Clear description | 9 | 90% | Very high |
| 12. | Interactive media is clearly visible | 9 | 90% | Very high |
| 13. | The flow of material in Interactive | 9 | 90% | Very High |
| 14. | Conformity in Scene | 9 | 90% | Very High |
| 15. | Conformity of examples/illustrations with Material | 8 | 80% | Tall |
| 16. | Scene suitability with material | 9 | 90% | Very high |
| 17. | Use of interactive media quite easy | 9 | 90% | Very High |
| 18. | Easy in its operation | 9 | 90% | Very High |
| 19. | Can be used many times | 10 | 100% | Very High |
| 20. | Not easily damaged | 8 | 80% | Tall |
| Overall Results | | 174 | 87% | Very High |

The table 1. Media statements above shows that the interactive learning media for environmental pollution received the following percentages for each item:

1. Item 1 in the media assessment, which states "The regularity of the interactive media presented," received a score of 9 with a percentage of 90%, representing a very high criterion.
2. Item 2 in the media assessment, which states "The availability of the images presented," received a score of 8 with a percentage of 80%, representing a high criterion.
3. Item 3 in the media assessment, which states "The lighting of the interactive media," received a score of 9 with a percentage of 90%, representing a very high criterion.
4. Item 4 in the media assessment, which states "Background selection," received a score of 9 with a percentage of 90%, representing a very high criterion.
5. Item 5 in the media assessment, which states "The design of explanations in interactive media," received a score of 9 with a percentage of 90%, representing a very high criterion.
6. Item 6 in the media assessment which states "The interactive learning media's appearance is engaging" received a score of 9 with a percentage of 90%, representing a very high criterion.

7. . Item 7 in the media assessment, which states "The clarity of the interactive media's narrative" received a score of 8 with a percentage of 80%, representing a high criterion.
8. . Item 8 in the media assessment, which states "The clarity of the voice in explaining" received a score of 8 with a percentage of 80%, representing a high criterion.
9. Item 9 in the media assessment, which states "sound effects" received a score of 8 with a percentage of 80%, representing a high criterion.
10. Item 10 in the media assessment, which states "contrasting background color" received a score of 8 with a percentage of 80%, representing a high criterion.
11. Item 11 in the media assessment, which states "the explanation is clear" received a score of 9 with a percentage of 90%, representing a high criterion.
12. Item 12 in the media assessment, which states that "Interactive media is clearly visible," received a score of 9 with a percentage of 90%, representing a very high criterion.
13. Item 13 in the media assessment, which states that "the flow of material in interactive media" received a score of 9 with a percentage of 90%, representing a very high criterion.
14. Item 14 in the media assessment, which states that "appropriateness in the scene" received a score of 8 with a percentage of 80%, representing a high criterion.
15. Item 15 in the media assessment, which states that "appropriateness of examples/illustrations to the material" received a score of 8 with a percentage of 80%, representing a high criterion.
16. Item 16 in the media assessment, which states that "appropriateness of the scene to the material" received a score of 9 with a percentage of 90%, representing a very high criterion.
17. Item 17 in the media assessment, which states that "using interactive media is quite easy," received a score of 9 with a percentage of 90%, representing a very high criterion.
18. Item 18 in the media assessment, which states "easy to operate," received a score of 9 with a percentage of 90%, representing a very high criterion.
19. Item 19 in the media assessment, which states "can be used repeatedly," received a score of 10 with a percentage of 100%, representing a very high criterion.
20. Item 20 in the media assessment, which states "not easily damaged," received a score of 8 with a percentage of 80%, representing a high criterion.

The table 2. Results of the Feasibility Test for Material Assessment on Learning Interactive Media on Environmental Pollution Material in the Material Statement.

| No | Statement Material Observed | Value | Percentage | Information |
|---|---|---|---|---|
| 1. | Suitability of interactive media on environmental pollution material | 9 | 90% | Very high |
| 2. | Material according to the purpose learning | 10 | 10% | Very high |
| 3. | Material presented in interactive media in accordance with facts and data | 9 | 90% | Very high |
| 4. | Material presented in interactive media according to with the concept of environmental pollution | 9 | 90% | Very high |
| 5. | Suitability of illustrations to the material presented in interactive media | 9 | 90% | Very high |
| 6. | Environmental pollution material presented in interactive media that is easy to understand | 9 | 90% | Very high |
| 7. | Conformity of examples/illustrations with explanations Material | 90 | 90% | Very high |
| Overall results | | 64 | 91% | Very high |

The table 2. Material statements above shows that interactive media for environmental pollution received the following percentages for each item:
1. Item 1 in the material assessment, which states "the suitability of interactive media for environmental pollution" received a score of 9 with a percentage of 90%, representing a very high criterion.
2. Item 2 in the material assessment, which states "the material is in accordance with learning objectives," received a score of 10 with a percentage of 100%, representing a very high criterion.

3. Item 3 in the material assessment, which states "the material presented in the interactive media is in accordance with facts and data," received a score of 9 with a percentage of 90%, representing a very high criterion.
4. Item 4 in the material assessment, which states "the material presented in the interactive media is in accordance with the concept of environmental pollution," received a score of 9 with a percentage of 90%, representing a very high criterion.
5. Item 5 in the material assessment, which states "the suitability of illustrations to the material presented in the interactive media," received a score of 9 with a percentage of 90%, representing a very high criterion.
6. Item 6 in the material assessment, which states that "environmental pollution material presented in interactive media is easy to understand," received a score of 9 with a percentage of 90%, representing a very high criterion.
7. Item 7 in the material assessment, which states that "the examples/illustrations match the material explanation," received a score of 9 with a percentage of 90%, representing a very high criterion.

## CONCLUSION

The development of interactive learning media on environmental pollution material, based on the results of the feasibility test and expert validator recommendations on the questionnaire sheet, was declared suitable as a biology learning medium in the form of interactive media on environmental pollution material with a percentage of 87% with very high criteria. Meanwhile, based on the results of the feasibility test for assessing the material on interactive media on environmental pollution material on material statements with a percentage of 91% with very high criteria.

The clarity aspect of the presentation in question is that interactive media is developed clearly in its presentation, both in terms of the material delivered and the displays contained in the interactive media on environmental pollution material. With the aim, it is hoped that students can more easily understand the material presented in interactive media on environmental pollution material. Thus, students can be more active and creative in the learning process on environmental pollution material because interactive media can stimulate hearing (audio) and sight (visual).

The aspect of ease of access refers to the interactive media developed being easy to access. In this access, the intended use of the media is the use of interactive learning media in the form of compact discs which is quite easy because it does not require special skills in its operation so that anyone can use it. Then it can be used repeatedly so that it makes it easier for students to understand the material because it can be repeated if the lesson is not understood. Then with this interactive media students can study together or in groups at school or study alone at home thus the quality of learning enjoyment and student learning outcomes will increase.

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