



## Development of a Textured Picture Book Equipped with Crosswords as a Media for Learning Biology Sub-Material Epithelial Tissue

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### ABSTRACT

**Purpose of the study:** To test the suitability of textured picture books equipped with crossword puzzles as a learning medium for Biology, epithelial tissue sub-material for class XI semester 1, it was assessed by experts and teachers and reviewed based on the effectiveness of its use.

**Methodology:** This research uses the Research and Development (R&D) method with a 4-D development model. The research samples involved were 18 test students and 16 control students. Qualitative data was obtained from advice from material experts and media experts, quantitative data from the results of assessments carried out by media experts, material experts, teachers and students

**Main Findings:** Based on the assessment of media material experts, it has appropriate criteria (very good) with a percentage of 90.9%, the assessment according to media experts is included in the appropriate criteria (very good) with a percentage of 85.5% and the assessment according to teaching teachers is in the appropriate category (very good) with a percentage of 98.48%. The effectiveness of the media on student grades is in the quite effective category with an average test student score of 6.77 compared to an average control student score of 5.70. The media readability test after use in learning is in the very good category with a percentage of 86.1%.

**Novelty/Originality of this study:** The novelty of this research lies in its innovative approach in presenting learning materials, expanding evaluation methods, and its potential to increase students' understanding and involvement in learning epithelial tissue topics.

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## 1. INTRODUCTION

Biology is a branch of science that studies life and living things. He studied various aspects such as structure, function, evolution, growth, development, reproduction, interaction, and ecology of living organisms [1], [2]. Biology includes various levels of life organizations, ranging from molecular levels (such as DNA and protein) to the level of organisms (such as humans, animals, and plants) and ecosystems (such as the relationship between organisms and their environment) [3]–[5]. Biology also provides a deeper understanding of living organisms and the world around us, allowing us to explain biological phenomena, solve problems, and make decisions based on scientific knowledge [6]–[8]. In education, biology learning plays an important role in

understanding life, fostering critical thinking, increasing science literacy, and preparing students for careers and further studies in the field of biological science.

Learning is the process of gaining knowledge, skills, understanding, or attitude through experience, study, or instructions. This involves receiving information, processing, and use of new knowledge to develop better understanding or to take more effective actions [9], [10]. The following are some important principles in effective learning according to, including :

1. Active: Learning that involves active participation of students, such as discussing, collaborating, or doing practical tasks.
2. Relevant: Learning is relevant to daily life or applied context, so students can see the values and uses of what they learn.
3. Student-centered: focus on learning on the needs, interests, and learning styles of individual students, and enable them to take an active role in the learning process.
4. Collaborative: Collaboration between students, both in small and broad groups, to learn from each other, share ideas, and build mutual understanding.
5. Based on problem solving: learning that involves solving real problems and application of knowledge in relevant contexts.
6. Continuous: Learning as a sustainable process that lasts throughout life, and is not limited to the formal educational environment.

Effective learning requires a combination of good teaching strategies, well-organized materials, a supportive learning environment, student motivation to learn, and the media used when learning takes place. Learning media are tools or means used to convey information or learning material to students in a more visual, interactive and interesting way. According to [11], [12] the following are several types of learning media that are commonly used: print media, projection media, audio media, visual media, audiovisual media, digital media, manipulative media, simulation media, online media. The selection of the type of learning media must be adjusted to the learning objectives, student characteristics, and learning context [13]–[15]. The combination of various types of media can also increase the effectiveness of learning by involving various senses and students' learning styles [16]. Print Media: Includes textbooks, journals, magazines, worksheets, and other printed materials. Print media is often used as a reference source, study guide, and student reading material. Learning through textbooks can be an effective approach in supporting biology learning. Here are some tips according to [17], [18] to maximize the benefits of textbooks:

1. Choose an appropriate textbook: Choose a biology textbook that suits the curriculum and grade level being taught. Make sure the textbook includes content that is complete, clear and appropriate to student needs.
2. Read with understanding: Read the textbook carefully to understand the content well. Pay attention to the structure of the book, the terms used, the pictures and diagrams included, and the examples given. Try to understand biology concepts well before sharing them with students.
3. Explain concepts clearly: Use textbooks as a guide to explain biology concepts to students. Use simple and clear language so students can understand well. If the textbook does not provide adequate explanations, you can provide additional explanations or more detailed examples.
4. Take advantage of activities and exercises: Many biology textbooks provide activities and exercises related to each chapter. Take advantage of this to engage students in active learning. These activities and exercises can take the form of comprehension questions, problem solving, data analysis, or simple experiments. Make sure students have opportunities to apply the concepts they learn.
5. Use pictures and diagrams wisely: Biology textbooks often include pictures, diagrams, or illustrations that help visualize complex concepts. Make use of these images to help students understand better. Explain the pictures in detail and invite students to observe, analyze and compare them with the concepts being studied.
6. Ask questions and discuss: After reading important parts of the textbook, ask students questions to test their understanding. Use open-ended questions that encourage critical thinking and reflection. Apart from that, hold group discussions or class discussions to discuss the concepts studied in the textbook.
7. Assign assignments related to textbooks: Assign assignments to students that involve the use of textbooks. For example, they may be asked to write a summary of each chapter, take important notes, or present important information in the form of a presentation. This will help students to be actively involved with the material in the textbook.
8. Evaluate student understanding: Use the textbook as a reference to evaluate student understanding.

Please note that textbooks are not monotonous and only contain writing . Teachers or educational units can innovate to add new features, for example images and also questions in the form of crossword puzzles [21]. Textbooks equipped with crossword puzzles are a form of learning media that can be used in teaching biology. The combination of textbooks containing pictures, diagrams, case examples and practical activities can provide students with a holistic and in-depth learning experience [22]–[24]. In biology subjects, this is still rarely done in developing textbooks equipped with crossword puzzles.

Research regarding the development of textured picture books with crossword puzzles as a learning medium for epithelial tissue has significant urgency in increasing learning effectiveness and meeting students' learning needs. The current research was carried out with the aim of testing the feasibility of textured picture books equipped with crossword puzzles as a learning medium for Biology, the epithelial tissue sub-material for class XI semester 1, assessed by experts and teachers and reviewed based on the effectiveness of its use, which is the focus of this research. This is also to update previous research conducted by [25], aiming to describe the effectiveness of Flip PDF Professional based e-modules equipped with crossword puzzles on motion systems material for class X students. I Science at MAN 2 Jember. The thing that limits this research is that it only focuses on the feasibility of developing a textbook equipped with crossword puzzles on the epithelial tissue sub-material for class XI at SMAN 7 Semarang. The novelty of this research lies in its innovative approach in presenting learning materials, expanding evaluation methods, and its potential to increase students' understanding and involvement in learning epithelial tissue topics.

## 2. RESEARCH METHOD

In developing learning media in the form of textbooks, the 4-D development method was used, namely define, design, develop and disseminate. The 4-D development method is a systematic and structured approach to designing and developing effective learning [26]–[28]. By following these stages, you can ensure that the learning delivered is in accordance with student needs and achieves the learning objectives that have been set. The advantages obtained from this method are: a more systematic approach, focused on learning objectives, deeper learning content, better adjustment to student needs, can implement continuous evaluation and improvement, and more flexible in transferring learning [29], [30]. The samples involved in this research were students who were grouped into 18 test students and 16 control students. The data collection technique is through direct observation by observing students' conditions when studying epithelial tissue material, observing student learning outcomes on the material, and observing students' attitudes when learning is carried out.

Data was collected through interviews with teachers and students. Teachers were interviewed regarding the media and teaching methods used in class, while students were asked for their opinions regarding the teaching implemented by teachers in class. Documentation is carried out to strengthen the results obtained [31]. Next, a questionnaire will later be given to experts, teachers and students to take opinions and suggestions from the subject and determine the suitability of the product. Data collection using questionnaires is a method commonly used in research and surveys [32], [33]. The following are several techniques that can be applied in collecting data using questionnaires: questionnaire design, validity and reliability, logical arrangement of questions, appropriate measurement scales, open and structured questions, clear instructions and instructions, data management and analysis, statistical testing, and data safety and ethics to maintain respondent confidentiality [34], [35].

Data analysis techniques consisting of qualitative data and quantitative data are carried out differently. Qualitative data was obtained from suggestions from material experts and media experts used in product revisions. Quantitative data is obtained from the results of assessments carried out by media experts, material experts, teachers and students. Quantitative data on assessment scores from experts was analyzed using a rating scale. There are 5 scales that will be used, namely: (1) Score 5 is very good/strongly agree on the Likert scale, (2) Score 4 is good/agree on the Likert scale, (3) Score 3 is quite good/ undecided on the Likert scale, (4) Score 2 is not good/disagree on the Likert scale, (5) Score 1 is not good/strongly disagree on the Likert scale. The percentage range and criteria for qualitative data can be seen in table 1 below.

Table 1. Percentage range and qualitative data criteria

Percentage	Category
81% < score < 100%	Very good
61% < score < 80%	Good
41% < score < 60%	Pretty good
21% < score < 40%	Enough
0% < score < 20%	Not good

## 3. RESULTS AND DISCUSSION

The development of textured picture books equipped with crossword puzzles as a biology learning medium, especially the epithelial tissue sub-material, can be a creative and effective approach in teaching and studying this concept. The following are several steps that can be taken in media development based on research conducted by [36], [37]:

1. Identify learning objectives: Learning objectives to be achieved through the use of this book. For example, learning objectives can focus on understanding the structure and function of epithelial tissue, classification of epithelial tissue, the location and role of epithelial tissue in the body, and so on.
2. Design drawings and illustrations: Create drawings and illustrations that are clear and well depict the structure of epithelial tissue. Choose attractive colors and use appropriate labels or captions to identify the relevant parts of the epithelial tissue.
3. Add texture to images: To enrich the learning experience, add texture to images of epithelial tissue. For example, if you want to depict a squamous stratified epithelium, you can use a different material such as sand paper that mimics the appropriate texture of that epithelium.
4. Include captions and explanations: Provide clear captions and explanations for each image or illustration displayed. Explain briefly the function and characteristics of the epithelial tissue depicted in the picture.
5. Crossword: Includes crossword puzzles related to epithelial tissue. Create questions and clues that direct students to look for words related to epithelial tissue, such as types of epithelial tissue, location of epithelial tissue in the body, or function of epithelial tissue. Crosswords can be a fun way to test students' understanding and improve their ability to remember terms related to epithelial tissue.
6. Practice questions and answers: Includes practice questions related to epithelial tissue. Provides a variety of questions, ranging from simple questions to more complex questions, to test students' understanding of epithelial tissue. Also includes complete answers and brief explanations for each question, so students can examine and understand the concepts better.
7. Review and adjustments: After the book has been developed, review the entire content. Make sure the images, illustrations, descriptions, crossword puzzles and questions included are appropriate to the learning objectives and easy for students to understand. If necessary, make adjustments and improvements before the book is used in learning.

This research produces a product in the form of learning media, a textured picture book equipped with crossword puzzles as a learning media for biology sub-material, epithelial tissue, class XI, semester 1, which can be used as an alternative learning media for high school school students in class XI. The description of the product prototype by the researcher departs from the 4-D learning device development model (Define, Design, Development and Dissemination). Based on the results of interviews, information was obtained that the learning media used by teachers were commonly used media in the form of textbooks and worksheets. The use of the internet as a complement to learning about pictures is given by the teacher to students as a homework assignment to broaden students' insight. The learning media used by the teacher also felt to be less capable of understanding students, especially the original preparation images or observation images under a microscope as the real form of the tissue parts that students were studying. Starting from the analysis of students' needs regarding teaching media, students need media that displays the network shape correctly and displays original images to support understanding. The media needed must also make it easy for students to understand the teaching material and enjoyable to use.

In response to this problem, it is necessary to have supporting media for teachers and students in learning with the criteria of media being easy to understand, fun and arousing students' curiosity [38]–[40]. Researchers then developed media in the form of textured picture books equipped with crossword puzzles. The results of the development of textured picture books equipped with crossword puzzles are expected to increase students' understanding, create a pleasant classroom atmosphere and increase students' learning motivation. Based on the results of the analysis of student performance and needs, 10% of the total students like biology lessons, the implementation of biology learning by teachers can be said to be quite enjoyable with a percentage of 50%. Teachers have used media that are fun for students but are rarely implemented in the classroom. Students' difficulties in epithelial tissue material are mostly found in section n the structure of epithelial tissue with a percentage of 44% and the function of epithelial tissue with a percentage of 44%, while the location of epithelial tissue gets a percentage of 12%. The most important criteria for media that is interesting according to students is that the media contains little writing but is understandable for students. This is proven by getting a percentage of 81.5%, having lots of pictures that make sense with a percentage of 71%, lots of colors with a percentage of 60.5% and questions. in the form of a 50% game.

The results obtained in the student analysis showed that students were actually more interested and enthusiastic about media that had the criteria of little writing, color and fun game forms. These results became the basis for researchers to develop media with criteria that are dominantly of interest to students [41]. For example, using textured picture books with crossword puzzles as a biology learning medium can help students visualize epithelial tissue concepts better, increase their understanding, and engage them in interactive and fun learning [42], [43]. According to [44]–[46], biology textbooks equipped with crossword puzzles have several advantages, including:

1. Improve understanding of concepts: Crosswords allow students to strengthen their understanding of biological concepts by identifying, connecting, and remembering relevant terms. The process of solving crossword puzzles involves critical and analytical thinking, which helps students assimilate concepts better.

2. Expanding vocabulary: In crossword puzzles, students will be exposed to various terms and vocabulary related to biological materials. This helps them expand their vocabulary knowledge and strengthen their understanding of frequently used terms in biological science disciplines.
3. Interactive and fun: Crosswords can provide an interactive and fun learning experience. Students can feel actively involved in the learning process, while honing their problem-solving skills and testing their knowledge in play.
4. Encourages independent learning: Biology textbooks with crossword puzzles provide opportunities for students to study independently. Students can work through crossword puzzles at their own pace, checking their answers, and evaluating their own understanding. This helps develop student independence in studying biology material.
5. Strengthen concept linkages: Crossword puzzles can help students understand the relationships between different biological concepts. When students look for intersecting words in a crossword puzzle, they can see the connections between the concepts, strengthening their understanding of how the concepts relate to each other.
6. Increased information retention: Crossword puzzles can help improve students' information retention. When students try to remember and use biology terms in the context of crossword puzzles, they build stronger connections between the terms and concepts, making it easier for them to remember the information in the long term.
7. Can be used as an evaluation tool: Apart from being a learning medium, crossword puzzles in biology textbooks can also be used as an evaluation tool. Teachers can use crossword puzzles to test students' understanding of biological material and identify areas that still require further understanding.

Overall, biology textbooks with crosswords are an effective learning resource because they combine concept learning with problem solving and fun interactions. This can increase student engagement and help them understand and remember biology concepts better. In developing biology textbooks, validation has been carried out by material experts which can be seen in table 2 below.

Table 2. Material expert validation test results

Assessment aspect	Indicator evaluation	Score validation
Appropriateness	Clarity topic raised in the media	5
	Suitability with applicable curriculum	5
	Suitability material with draft	4
	Completeness material	5
	Depth material	5
Component language	Use Language	4
	Accuracy system language	4
	Accuracy spelling	4
	Consistency use term	3
	Consistency use symbol	5
	Decree writing Name scientific / foreign	5
	Suitability picture with material	3
Supporter presentation material	Identity picture	4
	Material introduction	5
	Addition texture picture no bother understanding	5
	Map draft in accordance with material	5
	Foreword	5
	List fill	5
	Sheet you know You ? ( enrichment )	5
	List References	4
	Puzzles cross	5
	Page book	5
Amount		
	5 x 4	70
	4 x 6	24
	3 x 2	6
		100
Percentage		90.9%

Based on the results of validation by material experts, the content feasibility presentation was 90.9% in the very appropriate (very good) category, then revisions were made according to the material expert's

suggestions. Revision 1 suggested by material experts is the use of language regarding additional tools in epithelial tissue. The use of language that can trigger conceptual errors is replaced by providing pictures so that students can better imagine the real form and avoid errors in understanding the concept. The results of the revision can be seen in Figure 1 below.

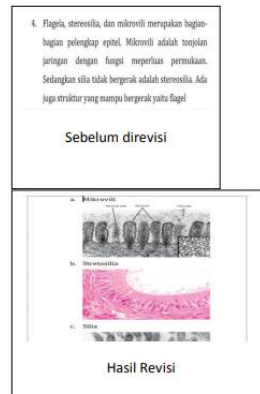


Figure 1. Part 1 revised by material experts

errors in several parts of the general structural image such as fiber details on the basement membrane, microvilli that are not included and details on the capillaries. The results of the revision can be seen in Figure 2 below. Figure 2. Part 2 revised by material expert Revision 3 suggested by material expert exists.

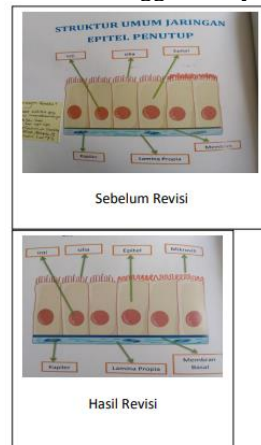


Figure 2. Part 2 revised by material experts

Revision 3 recommended by material experts is to increase the thickness of the image on the basal membrane. The results of the revision can be seen in Figure 3 below.

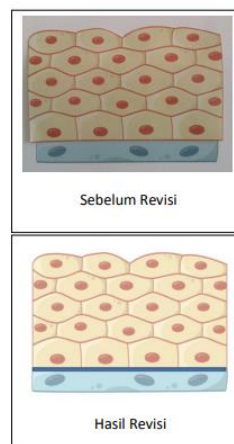


Figure 3. Part 3 revised by material experts

Revision 4 suggested by the material expert was the addition of cubic epithelium to the base of the layered cylindrical epithelium. The results of the revision can be seen in Figure 4 below.

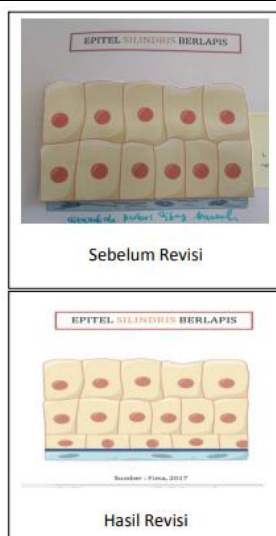


Figure 4. Part 4 revised by material experts

The second validation with material experts is not in the form of quantitative data but in the form of qualitative data from consultations resulting from revisions in the first validation. The results obtained are that the revision is in accordance with the concept and is relevant to the material presented, in this case the material expert has agreed and determined that the material is suitable for further testing. Then, the learning media is tested on media experts to find out the design results of the designs that have been developed. The validation results by material experts are outlined in table 3 below.

Table 3. Media expert validation test results

No.	Aspect evaluation	Indicator evaluation	Score validation
1.	Size book	Appropriate media size used in learning	4
2.	pictorial	Suitability size with the material contained in the media	4
3.		Displaying center good view ( <i>center point</i> )	5
4.	Design part skin	Composition And size element system location	4
5.	/ cover book	Color title	5
6.		Use type letter	4
7.		Placement layout elements consistent based on pattern	4
8.		Giving table in material fill	4
9.		Separation between paragraphs is clear	4
10.		Subtitle placement and number page	5
11.		Quality picture	5
12.	Design fill book	Placement picture	4
13.	pictorial	Use variation letter ( <i>bold, italic, underline, small, etc. </i> )	4
14.		Wide arrangement text	4
15.		Space between line	4
16.		Use composition color on material fill	5
17.		Overall media display	4
18.		Page book	4
		Amount	
		5 x 5	25
		5 x 13	52
			77
		Percentage	85.5%

Based on table 3 regarding the level of achievement of media displays, the percentage was 85.5% which was in the very decent (very good) category, then revisions were made according to suggestions and input from media experts. Revision 1 suggested by media experts is a breakdown of the indicators and goals to be achieved in the media. The results of the revision can be seen in Figure 5 below.

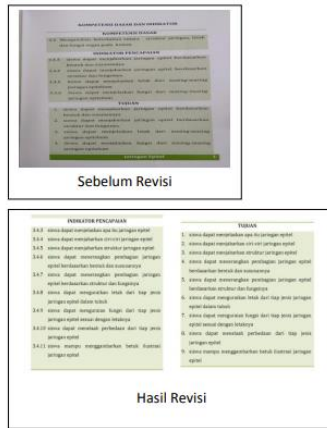


Figure 5. Part 1 revised by media experts

Revision 2 suggested by media experts is the addition of evaluation questions that include all indicators at the end of the media. The results of the revision can be seen in Figure 6 below



Figure 6. Part 2 revised by media experts

Validation has been carried out with material experts and media experts with the revision stage continuing, then the next stage is to carry out validation with the teacher. The results of teacher validation can be seen in table 4 below.

Table 4. Teacher validation test results

No.	Assessment aspect	Assessment indicators	Score validation
1.	Relevance of the material	Clarity topic	5
2.		Material fill	5
3.		Depth material	5
4.		Completeness material	5
5.		Material in accordance with draft applicable biology	5
6.		Picture on the media	5
7.		Media setup	4
8.		The media has display ( colors , images , etc text ) which is interesting	5
9.	Media concepts	Media capable add understanding student	5
10.		The media doesn't boring	5
11.		Appropriate media with stages think student	5
12.	Presentations	Display media	5
13.		Presentation of material on media	5
14.		Ease of use	5
		amount	
		5 x 13	65
		4 x 1	4
			69
		Percentage	98.46%

Based on table 4, the results of the validation test by media teachers obtained a percentage of 98.46% which was included in the very appropriate (very good) category. The results of validation by teachers show that



there are still deficiencies in the media but they can be tolerated without revision. Aims and objectives that are not stated in the media can be expressed when the teacher teaches directly in class so they do not need to be stated in the media. The assessment test for students uses a student assessment rubric to determine the suitability of the revised media before it is used in the next test. The results of the student assessment test can be seen in table 5 below.

Table 5. Student assessment results

No.	Aspect evaluation	Indicator evaluation	Score	percentage
1.	Media display    Media presentation	Interesting media For studied	84	93.3%
2.		Picture texture in interesting media	79	87.7%
3.		Use A little reading No make fed up	80	88.8%
4.		Material presented use simple language and no confusing	79	87.7%
5.		Material in accordance with draft applicable biology	71	78.8%
6.		Picture on the media	80	88.8%
Amount			473	87.59%

The results of the student assessment test showed that the media received a presentation of 87.59% in the very appropriate or very good category. The results of this test show that the media is very suitable for use in classroom learning. Embossed images and lots of pictures make students interested in studying the material using media. Meanwhile, the input obtained from the student feasibility test was the use of cover colors that were not bright enough, the images were slightly broken, and the image captions were a little less clear. The effectiveness test of media use aims to determine the effectiveness of media when used in classroom learning. In this test the researchers used 18 test students and 16 students as control students. The effectiveness of media use is seen from the average score between control students and test students. The results of the average scores of control students and trial students can be seen in table 6 below.

Table 6. Results evaluation student

Average value student control	Average value student test try
5.70	6.77

The results of the average student scores show the difference between students who use media products and only use material summaries. Students who use media are proven to have higher average grades than students who do not use it. Looking at the average student results, it can be said that the media is quite effective in increasing student grades. Previous research conducted by [47], found that guided inquiry-based practice assisted by crossword puzzles for biology subjects on vertebrate material as guidebooks were very helpful as new teaching material innovations. This is in line and updated with research currently being carried out. Because, research into the development of this teaching material has found that textbooks equipped with crossword puzzles are in the very good category and are suitable for use in studying the biology of epithelial tissue sub-materials.

The implication of this research is that it can become a basis for further development in interactive learning. Further testing, further content development, and adaptation for a variety of other biological topics or materials could be explored. Not only that, picture books can help enrich students' learning experiences by combining the use of visuals, text, and active interaction through crossword puzzles. This can help students with different learning styles to be more engaged in understanding the material. The thing that limits this research is that it only focuses on the feasibility of developing a textbook equipped with crossword puzzles on the sub-material of epithelial tissue for class XI at SMAN 7 Semarang.

#### 4. CONCLUSION

Based on the research results on the development of textured picture book media equipped with crossword puzzles sub-material on epithelial tissue, it can be concluded that textured picture books equipped with crosswords as a learning medium for Biology sub-material on epithelial tissue for class XI semester 1 are suitable for use in learning. Feasibility was obtained from material expert validation test results of 90.9% in the very good category, media expert validation test results of 85.5% in the very good category, teacher test results of 98.48% in the very good category, small class trial results regarding assessment feasibility by students is 87.59% with a very good category, the results of large class trials regarding the effectiveness of media use with the average results of trial students 6.77 and control students 5.70 so it can be said to be quite effective in increasing student grades and Readability tests media during use was 86.1% in the very good category.

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## REFERENCES

- [1] Y. Bare and dewi ratih tirto Sari, "Pengembangan Lembar Kerja Mahasiswa (LKM) Berbasis Inkuiri Pada Materi Interaksi Molekuler," *Bioeduin*, vol. 11, no. 1, pp. 2338–7173, 2021.
- [2] D. I. K. Sundra, M. Si, J. Biologi, and K. Pengantar, *Metode dan Teknik Analisis Flora Dan Fauna Darat*, 1st ed. Denpasar: Universitas Udayana, 2016.
- [3] Ismiati, "Pembelajaran Biologi SMA Abad ke-21 Berbasis Potensi Lokal: Review Potensi di Kabupaten Nunukan-Kalimantan Utara," *J. Penelit. dan Pengkaj. Ilmu Pendidik. e-Saintika*, vol. 4, no. 2, pp. 234–247, 2020, doi: 10.36312/e-saintika.v4i2.218.
- [4] D. G. Lestari and H. Irawati, "Literature Review : Peningkatan Hasil Belajar Kognitif Dan Motivasi Siswa Pada Materi Biologi Melalui Model Pembelajaran Guided Inquiry," *BIOMA J. Biol. dan Pembelajarannya*, vol. 2, no. 2, pp. 51–59, 2020.
- [5] T. A. Santosa and E. M. S, "Analisis Masalah Pendidikan Biologi Pada Sekolah Menengah Pertama Di Era Pandemi Covid -19," *J. Rev. Pendidik. dan Pengajaran*, vol. 3, no. 2, pp. 273–278, 2020, doi: 10.31004/jrpp.v3i2.1278.
- [6] E. Sujarwanto, "Pemahaman Konsep dan Kemampuan Penyelesaian Masalah dalam Pembelajaran Fisika," *Diffraction. J. Phys. Educ. Appl. Phys.*, vol. 1, no. 1, pp. 22–33, 2019, doi: <https://doi.org/10.37058/diffraction.v1i1.806>.
- [7] E. Murdani, "Hakikat Fisika dan keterampilan proses Sains," *J. Filsafat Indones.*, vol. 3, no. 3, pp. 72–80, 2020, doi: <https://doi.org/10.23887/jfi.v3i3.22195>.
- [8] T. Hardianti, L. A. Pohan, and J. Maulina, "Bahan ajar berbasis saintifik: Pengaruhnya pada kemampuan berpikir kritis dan keterampilan proses sains siswa SMP An-Nizam," *JIPVA (Jurnal Pendidik. IPA Veteran)*, vol. 4, no. 1, pp. 81–92, 2020.
- [9] J. Jalwis and N. Habibi, "Konstruk Pendidikan Multikultural (Studi Urgensi Integrasi Nilai-nilai Multikultural dalam Kurikulum Pendidikan)," *Tarbawi J. Ilmu Pendidik.*, vol. 15, no. 2, pp. 233–247, 2019, doi: 10.32939/tarbawi.v15i02.453.
- [10] N. K. Masgumelar and P. S. Mustafa, "Teori Belajar Konstruktivisme dan Implikasinya dalam Pendidikan," *GHAITSA Islam. Educ. J.*, vol. 2, no. 1, pp. 49–57, 2021.
- [11] Noptario and A. Prastowo, "Penggunaan Media Pembelajaran Berbasis Audio Visual Pada Mata Pelajaran Matematika Berdasarkan Prinsip Kreatif Dan Menarik Di Sekolah Dasar," *Pendes J. Ilm. Pendidik. Dasar*, vol. 7, no. 2, pp. 754–763, 2022, doi: <https://doi.org/10.23969/jp.v7i2.6642>.
- [12] I. P. G. C. R. Wicaksana, A. A. G. Agung, and I. N. Jampel, "Pengembangan E-Komik Dengan Model Addie Untuk Meningkatkan Minat Belajar Tentang Perjuangan Persiapan Kemerdekaan Indonesia," *J. Edutech Undiksha*, vol. 7, no. 2, p. 48, 2020, doi: 10.23887/jeu.v7i2.23159.
- [13] D. S. Sari and M. N. Wulanda, "Pengembangan lembar kerja mahasiswa berbasis proyek dalam meningkatkan kemampuan berfikir kreatif mahasiswa," *Nat. J. Ilm. Pendidik. IPA*, vol. 6, no. 1, p. 20, 2019, doi: 10.30738/natural.v6i1.4073.
- [14] Z. Zulfah, "Analisis Kebutuhan Pengembangan Soal Berbasis Kearifan Lokal," *J. Cendekia J. Pendidik. Mat.*, vol. 2, no. 1, pp. 1–6, 2018, doi: 10.31004/cendekia.v2i1.27.
- [15] A. Husna, M. Hasan, M. Mustafa, M. Syukri, and Y. Yusrizal, "Pengembangan Modul Fisika Berbasis Integrasi Islam-Sains pada Materi Gerak Lurus untuk Meningkatkan Hasil Belajar Peserta Didik," *J. Pendidik. Sains Indones.*, vol. 8, no. 1, pp. 55–66, 2020, doi: 10.24815/jpsi.v8i1.15539.
- [16] D. Darmaji, A. Astalini, D. A. Kurniawan, F. I. Putri, R. Perdana, and F. Fuldiarman, "Student's need analysis in using ordinary differential equation e-module of Mathematical Physics II," *Momentum Phys. Educ. J.*, vol. 7, no. 1, pp. 107–115, 2023, doi: 10.21067/mpej.v7i1.7092.
- [17] I. P. M. H. Purba, H. Adrianto, and H. T. H. Silitonga, "Penguatan Kompetensi Guru Biologi Sidoarjo Menghasilkan Buku Ajar Bebas Plagiarisme," *Abdi J. Pengabd. dan Pemberdaya. Masy.*, vol. 2, no. 2, pp. 157–166, 2020, doi: 10.24036/abdi.v2i2.69.
- [18] R. Sholihah, F. Roshayanti, and I. B. Minarti, "Multipel representasi tipe nature of models (NoM) dalam buku ajar biologi kelas XI semester 1," *Symp. Biol. Educ.*, vol. 2, pp. 263–272, 2019.
- [19] F. Romadona, Gusmawati, and R. T. Sari, "Pengembangan Handoutdilengkapiteka-Teki Silang Pada Pembelajaran Biologi Materi Pemanasan Global Di Smp N 15 Padang," *J. Esabi (Jurnal Edukasi dan Sains Biol.)*, vol. 3, no. 1, pp. 20–27, 2021.
- [20] M. J. Maknun and S. Nurmalasari, "Pengembangan Media Pembelajaran Teka-Teki Silang 3d Pada Materi Sistem Indra Manusia Untuk Siswa Kelas XI SMA Sederajat," *EDUSCOPE J. Pendidikan, Pembelajaran, dan Teknol.*, vol. 7, no. 1, pp. 1–6, 2021, doi: <https://doi.org/10.32764/eduscope.v7i1.1728>.
- [21] F. P. Sinaga, Jurhana, Yusrita, and M. Hidayat, "Analisis Penggunaan Metode Mengajar (Metode Demonstrasi, Metode Eksperimen, Metode Inquiry, Dan Metode Discovery Di SMA Negeri 11 Kota Jambi)," *Relativ. J. Ris. Inov. Pembelajaran Fis.*, vol. 5, no. 2, pp. 103–110, 2022, doi: <https://doi.org/10.29103/relativitas.v5i2.7830>.
- [22] A. M. Sabil and S. Wilastari, "Identifikasi Penyebab Tidak Optimalnya Kinerja Kompresor Utama Terhadap Pengisian Botol Angin Di Kapal KM. Hari Baru Indonesia," *J. Sains Teknol. Transp. Marit.*, vol. 4, no. 1, pp. 1–6, 2022, doi: 10.51578/j.sitektransmar.v4i1.42.
- [23] P. Kurniati, A. L. Kelmaskouw, A. Deing, B. Bonin, and B. A. Haryanto, "Model Proses Inovasi Kurikulum Merdeka Implikasinya Bagi Siswa Dan Guru Abad 21," *J. Citizsh. Virtues*, vol. 2, no. 2, pp. 408–423, 2022, doi:

- 10.37640/jcv.v2i2.1516.
- [24] M. Listyawati, "Pengembangan Perangkat Pembelajaran Ipa Terpadu Di Smp," *J. Innov. Sci. Educ.*, vol. 1, no. 1, pp. 61–68, 2012.
- [25] H. Uswatun, "Pengembangan E-Modul Berbasis Flip DPF Professional dilengkapi Teka-Teki Silang pada Materi Sistem Gerak untuk Siswa Kelas XI IPA di MAN 2 Jember," Universitas Islam Negeri Kiai Haji Achamd Siddiq Jember, 2022.
- [26] S. Wanto *et al.*, "Kupas Tuntas Penelitian Pengembangan Model Borg & Gall," *Wahana Dedik. J. PkM Ilmu Kependidikan*, vol. 3, no. 2, pp. 46–55, 2020, doi: 10.31851/dedikasi.v3i1.5340.
- [27] D. R. Pattiapon, J. J. Rikumahu, and M. Jamlaay, "Penggunaan Motor Sinkron Tiga Fasa Tipe Salient Pole Sebagai Generator Sinkron," *J. Simetrik*, vol. 9, no. 2, p. 197, 2019, doi: 10.31959/js.v9i2.386.
- [28] T. Mulyeni and L. Lianty, "Modul Pembelajaran Sains dengan Pendekatan Inkuri untuk Mengembangkan Keterampilan Proses Sains Dasar Siswa Tunarungu," *J. Pendidik. Kebutuhan Khusus*, vol. 5, no. 1, pp. 78–88, 2021, doi: 10.24036/jpkk.v5i1.572.
- [29] F. Yolanda and P. Wahyuni, "Pengembangan Bahan Ajar Berbantuan Macromedia Flash," *SJME (Supremum J. Math. Educ.)*, vol. 4, no. 2, pp. 170–177, 2020, doi: 10.35706/sjme.v4i2.3612.
- [30] G. C. S. Dwiqi, I. G. W. Sudatha, and A. I. W. I. Y. Sukmana, "Pengembangan Multimedia Pembelajaran Interaktif Mata Pelajaran IPA Untuk Siswa SD Kelas V," *J. EDUTECH Univ. Pendidik. Ganessa*, vol. 1, no. 1, p. 33, 2019, doi: <https://doi.org/10.23887/jeu.v8i2.28934>.
- [31] M. Mulyati, F. I. Putri, and D. Deswalman, "Efforts to Improve Student Activities and Outcomes in Physics Learning Using the Two Stay Two Stray Technical Cooperative Learning Model at Senior High School," *Integr. Sci. Educ. J.*, vol. 4, no. 1, pp. 30–35, 2023, doi: 10.37251/isej.v4i1.294.
- [32] K. N. Cahyo, Martini, and E. Riana, "Perancangan Sistem Informasi Pengelolaan Kuesioner Pelatihan pada PT Brainmatics Cipta Informatika," *J. Inf. Syst. Res.*, vol. 1, no. 1, pp. 45–53, 2019.
- [33] S. Barnas and I. M. Ridwan, "Perbedaan Gender dalam Pengetahuan, Sikap dan Perilaku Mahasiswa Pendidikan Fisika," *Diffraction*, vol. 1, no. 2, pp. 34–41, 2019, doi: 10.37058/diffraction.v1i2.1328.
- [34] V. H. Pranatawijaya, W. Widiatry, R. Priskila, and P. B. A. A. Putra, "Pengembangan Aplikasi Kuesioner Survey Berbasis Web Menggunakan Skala Likert dan Guttman," *J. Sains dan Inform.*, vol. 5, no. 2, pp. 128–137, 2019, doi: 10.34128/jsi.v5i2.185.
- [35] Jamaluddin, A. W. Jufri, Muhlis, and I. Bachtar, "Pengembangan Instrumen Keterampilan Berpikir Kritis Pada Pembelajaran IPA," *J. Pijar Mipa*, vol. 15, no. 1, pp. 13–19, 2020, doi: 10.29303/jpm.v15i1.1296.
- [36] T. H. Daulae, "Langkah-Langkah Pengembangan Media Pembelajaran Menuju Peningkatan Kualitas Pembelajaran," *Forum Paedagog.*, vol. 11, no. 1, pp. 52–63, 2019, doi: 10.24952/paedagogik.v11i1.1778.
- [37] A. D. Ardhani, M. L. Ilhamdi, and S. Istiningsih, "Pengembangan Media Pembelajaran Berbasis Permainan Monopoli pada Pelajaran Ilmu Pengetahuan Alam (IPA) Kelas IV SD," *J. Pijar Mipa*, vol. 16, no. 2, pp. 170–175, 2021, doi: 10.29303/jpm.v16i2.2446.
- [38] S. Wahyuni, E. Rahmadhani, and L. Mandasari, "Pelatihan Pembuatan Media Pembelajaran Interaktif dengan Menggunakan Powerpoint," *J. Abdidas*, vol. 1, no. 6, pp. 597–602, 2020, doi: 10.31004/abdidas.v1i6.131.
- [39] N. R. H. Meduri, R. Firdaus, and H. Fitriawan, "Efektifitas Aplikasi Website Dalam Pembelajaran Untuk Meningkatkan Minat Belajar Peserta Didik," *J. Teknol. Pendidik.*, vol. 11, no. 2, pp. 283–294, 2022, doi: <https://doi.org/10.34005/akademika.v11i02.2272>.
- [40] M. Baginda, "Nilai-Nilai Pendidikan Berbasis Karakter pada Pendidikan Dasar dan Menengah," *J. Ilm. Iqra'*, vol. 10, no. 2, pp. 1–12, 2018, doi: 10.30984/jii.v10i2.593.
- [41] D. Fakhriyana and S. Riayah, "Optimalisasi Pembelajaran dalam Jaringan (Daring) dengan Media Pembelajaran Video Interaktif Terhadap Pemahaman Matematis Siswa," *J. Pendidik. Mat.*, vol. 4, no. 1, pp. 19–30, 2021, doi: 10.21043/jmtk.v4i1.10147.
- [42] D. Handayani, "Pemanfaatan Youtube pada saat pandemi COVID-19 untuk media pembelajaran Bahasa Inggris dalam meningkatkan vocabulary dan pemahaman siswa," *JUPENDIK J. Pendidik.*, vol. 4, no. 2, pp. 12–18, 2020.
- [43] N. Kania and Z. Arifin, "Aplikasi Macromedia flash untuk Meningkatkan Pemahaman Konsep Matematika Siswa," *JNPM (Jurnal Nas. Pendidik. Mat.)*, vol. 4, no. 1, pp. 96–109, 2020, doi: 10.33603/jnpm.v4i1.2872.
- [44] Rusnah, L. F. Yeni, and R. Marlina, "Respon Siswa Terhadap Majalah Biologi Invertebrata Sebagai Media Pembelajaran Di Kelas X Mipa 2," *EduNaturalia J. Biol. dan Kependidikan Biol.*, vol. 2, no. 2, pp. 43–49, 2021, doi: 10.26418/edunaturalia.v2i2.54619.
- [45] N. Setiyawati, Syamswisna, and A. B. Tenriawaru, "Kelayakan Biodiversity Magazine: Majalah Pada Submateri Pemanfaatan Keanekaragaman Hayati Berbasis Tumbuhan Kosmetik Feasibility of Biodiversity Magazine: Magazine in the Utilization of Biodiversity Based on Cosmetic Plants," *Didakt. Biol. J. Penelit. Pendidik. Biol.*, vol. 5, no. 2, pp. 77–83, 2021, doi: <https://doi.org/10.32502/dikbio.v5i2.4169>.
- [46] A. Rauf and N. Mufidah, "Penggunaan Bahan Ajar Peta Konsep untuk Meningkatkan Penguasaan Mapel Jurmiah dalam Proses Pembelajaran Daring," *Naskhi J. Kaji. Pendidik. dan Bhs. Arab*, vol. 3, no. 2, pp. 79–90, 2021, doi: 10.47435/naskhi.v3i2.683.
- [47] A. Anggraini, Ristonio, Ardi, and R. Yogica, "Analisis Kebutuhan Lkpd Praktikum Berbasis Inkuiri Terbimbing Berbantu Teka-Teki Silang Pada Materi Vertebrata Untuk Peserta Didik SMA," *Fondatia J. Pendidik. Dasar*, vol. 6, no. 4, pp. 1083–1090, 2022, doi: <https://doi.org/10.36088/fondatia.v6i4.2363>.