Available online at BIOMA: Jurnal Ilmiah Biologi
Websites:http://journal.upgris.ac.id/index.php/bioma/index
BIOMA: Jurnal Ilmiah Biologi, 13 (1), April 2024, 14-28
DOI: https://doi.org/10.26877/bioma.v13i1.361

THE DEVELOPMENT OF MULTIMEDIA POWERPOINT PRESENTATION TO IMPROVE UNDERSTANDING OF THE HUMAN CIRCULATORY SYSTEM OF JUNIOR HIGH SCHOOL STUDENTS IN PAPUA

Ibnu Rusid[1], I Nyoman Sudana Degeng[2], Nurmida Catherine Sitompul[3]*
[1]Magister in Educational Technology, Sekolah Pascasarjana, University of PGRI Adi Buana
Jl. Dukuh Menanggal XII/4 Surabaya, Jawa Timur, Indonesia 60234
[2]Departement of Educational Technology, State University of Malang
Jl. Semarang No. 5 Malang, Jawa Timur, Indonesia 65145
[3]Magister in Educational Technology, Sekolah Pascasarjana, University of PGRI Adi Buana
Jl. Dukuh Menanggal XII/4 Surabaya, Jawa Timur, Indonesia 60234
**Corresponding author:nurmida.catherine.s@unipasby.ac.id*

ARTICLE INFO

Article history

Submission	2024-01-27
Revision	2024-03-12
Accepted	2024-04-20

Keywords:
Biology Subject,
Human Circulatory System,
Junior High School,
Multimedia PowerPoint

ABSTRACT

The use of PowerPoint presentations (PPT) is chosen because it is accessible without the need for an internet connection, making it a suitable solution for schools in Papua that lack infrastructure. This research aims to develop a multimedia PowerPoint for junior high school students in a school with a lack of infrastructure to enhance students' understanding of the human circulatory system. The research method used is research and development (Borg & Gall Model). Questionnaires were used for assessment, and data analysis was conducted using percentages. The product is reviewed by three experts: (1) The average assessment from content experts was 93%; (2) The average assessment from instructional media experts was 100%; and (3) The average assessment from instructional design experts was 89%. The results indicated that it's feasible. The product also received an assessment from the junior high school students, which consisted of three stages as follows: (1) The average assessment from one-to-one evaluation was 88%; (2) The average assessment from small group evaluation was 90%; and (3) The average assessment from field testing was 91%. Multimedia PowerPoint is feasible as instructional media for teaching the human circulatory system to junior high school students, particularly in the Papua region, which lacks infrastructure.

INTRODUCTION

The characteristics of biology content were abstract concepts, numerous scientific terminologies, terms derived from foreign languages, examples from international books that are not well-known, and content that is not relevant to everyday life (Kelly-Laubscher et al., 2017). Media is used to enhance the delivery of learning contents and improve the overall quality of instruction in biology (Wahyuddin et al., 2022). Teachers who deliver learning content need media so that the message can be conveyed correctly. Innovation in Information and Communication Technology (ICT) has brought massive influences that direct the use of digital media (Hasanah et al., 2023), but still, many teachers nationwide are not skilled using digital media (Darmawan et al., 2022). This happens because of many factors, such as the complexity of the media itself or because the infrastructure is not always available in some schools. But keep in mind that the sophistication of media does not mean that it can convey learning content appropriately. A relatively simple medium can be an effective instructional medium if it meets the concept of an effective medium (Castro-Alonso et al., 2021).

Although there have been many digital media, PowerPoint (PPT) remains the media that best meets the needs of teachers. The PPT program that emerged in 1987 continues to develop in line with the development of ICT and is increasingly interactive because it can be used in conjunction with other media such as videos, games, sources on the internet, and so on (Astutik, 2021). The role of PPT as an instructional medium is very necessary because the message or information conveyed by the teacher can be represented on the slides, avoiding verbalism that often obscures the intended meaning. The PPT slides may have drawbacks, but the use of this medium makes it very easy and provides better access to students when taking notes and listening to teacher explanations than chalk writing (Onivehu & Ohawuiro, 2018; Stacy & Cain, 2015). Research findings prove that active learning in biology can be done with a combination of using PPT slides, videos, writing on the board, or demonstration methods (Khan et al., 2013). An effective PPT for conveying information must be designed and developed using instructional design principles for preparing effective presentations (Mahajan et al., 2020). Characteristics of biology content include processes that occur in schools in areas with incomplete infrastructure, such as the city of Asgon, Papua. Developing PPT slides can be a solution. Characteristics of biology content include processes that occur in nature that require

certain types of media for the delivery of information. Advances in the fields of communication and information technology (ICT), digital media, and the Internet of Things have allowed learning materials to be displayed in their original form. Many experts have developed digital media, for example, 3-dimensional media for human body content (Permatasari et al., 2022), animation-based instructional media with music and song lyrics on cell division material (Wahyuddin et al., 2022), and scientific approach-based interactive instructional media for biology on the topic of the auditory system (Fadhillah et al., 2017). Meanwhile, media development with the internet includes, for example, Instagram-based biology animation instructional media for junior high school students (Mokalu et al., 2021) and PPTs with online learning (Rhodes & Barshick, 2021). The use of these media requires supporting devices and cannot be applied in schools in areas with a lack of infrastructure, such as in the city of Asgon, Papua. The delivery of the content of biology subject matter in this area requires a type of media that can be developed into interactive multimedia without depending on the internet network. The appropriate instructional media is PowerPoint Extended or Multimedia PowerPoint.

Microsoft PowerPoint (PPT) is commonly used for learning and is a computer program from Microsoft used for presentation purposes (Microsoft, 2024). The PPT can be arranged in simple or complex formats or as an extended PowerPoint. Extended PowerPoint can facilitate various media formats, making it a multimedia PPT. Teachers who use the lecture method are encouraged to integrate PPT into the teaching process (Adebanjo, 2020) because, without media, the lecture technique is less effective. In addition, when students are not actively engaged in the lectures, they may lose focus, become bored, and even fall asleep in class. It is different when students actively participate in learning activities. The use of PPT slides has been proven to be a pedagogical tool (Dukhan et al., 2019) that fosters interaction between teachers, students, and contents. The PPT has been proven to improve biology lessons for 10th graders in the Philippines (Taculod & Arcilla, 2020) and high school students in Nigeria (Okereke & Nzewi, 2020). The use of PPT-based discovery learning methods has been shown to increase understanding of the human circulatory system (Sariam & Harahap, 2022).

The capabilities of multimedia PPT are very beneficial when optimized in biology lessons in schools that do not yet have complete and sophisticated facilities (Onivehu & Ohawuiro, 2018). Teachers in Papua must always think imaginatively and innovatively

when facilitating learning according to the available facilities in the school. The findings of an interview conducted by researchers on November 9, 2022, with Teacher Leoni Amanda and Teacher La Ode Syarifudin, who teach biology in Class VIII of SMP Negeri 1 Asgon Papua, According to Ibu Leoni, grade VIII students of SMP Negeri 1 Asgon, Papua struggle with small and large blood circulation during biology lessons. This is because some students only know the names of organs and cardiovascular systems, so distinguishing and explaining the small and large circulatory systems takes a long time. Students need help understanding information about the circulatory system because it is difficult to imagine, and the explanations or demonstrations are often brief rather than thorough. The lack of engaging media makes it challenging for many students to stay involved in the learning process, and some seem to only appreciate the teacher's presence in class. This is evident in students who attempt to navigate through various literary works independently, while others remain passive and show a lack of understanding of the circulatory system material. When the material is presented only once, it is difficult for students to fully comprehend it, and some struggle to retain the information long after the lesson ends.

The average grade VIII student at SMP Negeri 1 Asgon Papua scored between 60.37 and 65.52 on the KKM scale, which is far below the standard score. Abstract and challenging topics are only sometimes considered good by students, and students may need help with them. Therefore, according to Mrs. Leoni, the challenges students face must be addressed immediately and appropriately so that they do not occur repeatedly and maximize the learning outcomes students achieve. One of these strategies is the creation of learning media that can involve students, not only as observers and listeners but actively involved in the learning process. Based on the results of the reference and preliminary studies as above, this study intends to develop a multimedia PPT. This developed product should pass feasibility tests by some experts and by students or users, which can direct students to cooperate in PowerPoint-based learning. Another advantage of PPT development is that it can provide conditions that make it easier for educators to monitor the activities of students. Apart from that, this medium has the advantage that it can be flexible and easily implemented. Given that schoolchildren are very close to multimedia, researchers felt it was necessary to develop a multimedia PPT on the human circulatory system for grade VIII SMP Negeri 1 Asgon.

MATERIALS AND METHODS

Research Design

The methodology of this research is Research and Development (R & D), and aims to produce multimedia PowerPoint. The Borg and Gall Model was used as procedure to produce the Multimedia PowerPoint in this research project (Putri et al., 2023). This model is one model of instructional design with systems approach that views learning as a collection of interrelated components that all work together to achieve a defined goal. When instructional developers concentrate on "what learners need to know," the systems approach to learning works best. The correctness of the analysis of this method of the learning component of the system determines how successful it will be.

Borg and Gall model has ten stages as follows: (1) Preliminary research and information gathering; (2) planning; (3) development of the initial form of the product; (4) preliminary field tests; (5) main product revision; (6) major field tests; (7) field trial products; (8) operational field tests; (9). revision of finished products; (10) measuring and using products (deployment and application) (Rafiuddin et al., 2024). This study was conducted through research and development. Not all stages of this model are carried out until the resulting product is suitable for use as teaching material in the school where this product is evaluated (until step 9).

Data Analysis

Data collected from the results of product reviews and tests is processed using qualitative descriptive data analysis techniques. Data from expert interviews and discussions as well as the results of individual and small group trial questionnaires are processed using a qualitative descriptive analytical approach. Qualitative descriptive analysis is performed by classifying data from questionnaire comments and improvement ideas. The results of this research then become the basis for product modification. The descriptive statistical analysis approach handles data from expert review questionnaires, one-to-one evaluation, and small group evaluation in the form of descriptive percentages. The following equation is used to determine the proportions of each topic in expert review and students tests:

$$\text{Percentage} = \frac{\sum(Jumlah\ pilihan\ x\ bobot\ pilihan)}{N\ x\ bobot\ tertinggi}\ X\ 100\%$$

The percentage criteria used to make decisions in improving product development are as follows:

Table 1. Percent Score Scale of Each Subject for Description of Classification Test (Arikunto, 2010)

Rating Scale	Classification	Information
81%-100%	Very good	No revision required
66%-80%	Good	No Revision Required
56%-65%	Not Good	Needs revision
0%-55%	Very bad	Needs revision

RESULTS AND DISCUSSION

Product Development

The following are two examples of slides from product development, namely Figures 1 and 2. Figure 1a shows a photo of blood thrombosis, and Figure 1b shows a video where blood trombosit moves on the heart organ as if it were happening in the human body so that students can observe the circulation of blood (thrombosis).

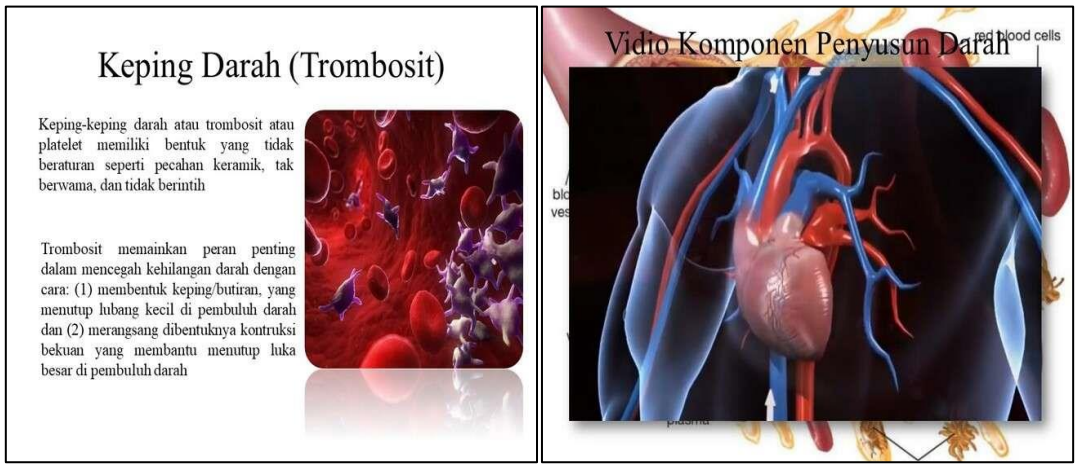

Figure 1. (a) Slides and (b) videos of the the circulation of blood (thrombosis)

Figure 2a shows a slide or photo of the circulatory system, and Figure 2b shows the blood circulating in the human vascular system that can be observed by students as it happens in the human body. Multimedia PowerPoint is able to display two forms of material in different ways that make it easier for students to learn both blood and circulatory components.

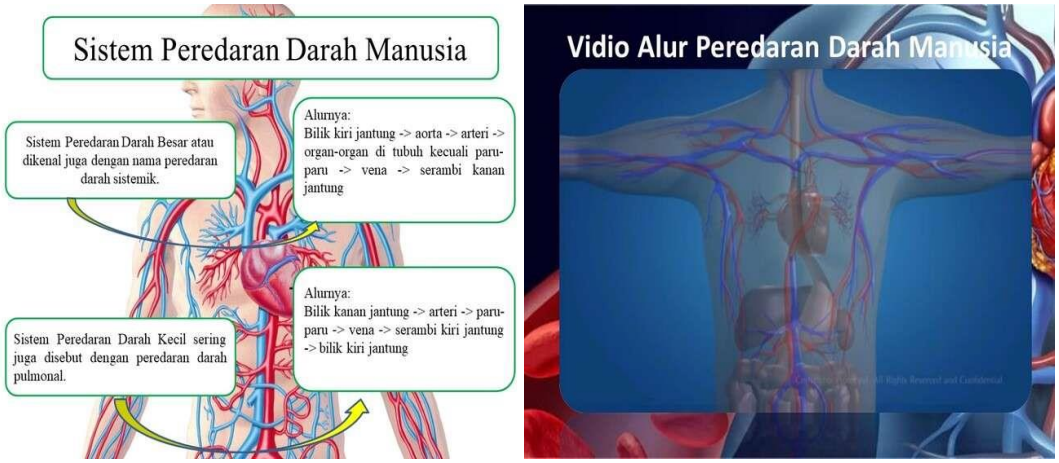

Figure 2. (a) Slides and (b) videos of Human circulatory vessels

Content Expert Review

To determine the feasibility of the media, a percentage of each piece of data collected from the expert review of the material is calculated. The development of the multimedia PPT on the human circulatory system is included in the very good category according to the percentage gain (93%), so it is suitable for use in grade VIII SMP Negeri 1 Asgon Papua.

Table 2. Content Expert Review Result

No	Criteria	Score average	Feasibility
	Contents' aspect		
1	Indicator description	4	Very Feasible
2	Elaboration of activity objectives	4	Very Feasible
3	Description of the content.	4	Very Feasible
4	Presentation of content in accordance with the characteristics of contextual learning.	4	Very Feasible
5	Packaging of contents in accordance with the integrated thematic characteristics of the 2013 curriculum	4	Very Feasible
6	Presentation of content accordance with the principles of enrichment.	3	Very Feasible
7	Task description	3	Very Feasible
8	Description of the questions	4	Very Feasible
9	Description of the assignment answer key	4	Very Feasible
10	Description of the answer key to questions	3	Very Feasible
11	Time allocation for each indicator activity	4	Very Feasible
12	Editorial of Content	4	Very Feasible
13	Editorial of tasks	3	Very Feasible
14	Editorial of questions	4	Very Feasible
15	Supporting the growth of human values	4	Very Feasible
	Total	56	
	Percentage	93%	

Instructional Media Expert Review

A percentage of each piece of data collected from the media expert review is calculated to determine the feasibility of the media that has been created. The multimedia PowerPoint created on the human circulatory system is 100% effective. According to the validation assessment of multimedia learning media experts, this achievement is included in the very good group. Therefore, using this multimedia PowerPoint to teach about the human circulatory system at SMP Negeri 1 Asgon Papua is a good idea.

Tabel 3. Instructional Media Expert Result

No	Criteria	Score	Feasibility
	Contents' aspect		
1	Completeness of PPT parts	4	Very Feasible
2	Completeness of text in PPT title slides	4	Very Feasible
3	Completeness and clarity of the instruction manual.	4	Very Feasible
4	Completeness of the type and size of the letters.	4	Very Feasible
5	The attractiveness of the PPT display design.	4	Very Feasible
6	The attractiveness of illustrations (photos, drawings, charts and symbols) in PPT	4	Very Feasible
7	Accuracy of language usage.	4	Very Feasible
8	Accuracy in composing words/sentences.	4	Very Feasible
	Total	32	
	Percentage	100%	

Instructional Design Expert Review

A percentage of each piece of data collected from the media expert test is calculated to determine the feasibility of the media that has been created. The multimedia aspect of the Human Circulatory System PPT reached 89%. According to the validation assessment of multimedia learning media experts, this achievement is included in the very good group. Therefore, using this multimedia PPT to teach about the Human Circulatory System at SMP Negeri 1 Asgon Papua is a good idea.

Tabel 4. Instructional Design Expert Review Result

No	Criteria	Score	Feasibility
	Content's aspect		
1	Binding quality.	4	Feasible
2	The attractiveness of the cover design.	4	Feasible
3	Typing *layout* accuracy	5	Very Feasible
4	Consistency in the use of headings, sub spacing and material typing.	4	Feasible
5	Clarity of writing/typing.	5	Very Feasible
6	The completeness of the components in each textbook chapter.	4	Feasible
7	Accuracy of the way the content is presented.	5	Feasible
	Total	31	
	Percentage	89%	

One-to One Evaluation

One-to-one evaluations are needed to determine whether the first multimedia PPT design is appropriate for the human circulatory system. The participants were three students from grade VIII who have high, medium, and low abilities. A percentage of each piece of data was calculated to determine the extent to which a developer's media viability has been assessed. The aspect produced by a multimedia PPT of the human circulatory system reaches 88%. According to the classification of individual learning multimedia evaluation, % of these achievements belong to the very good group. Therefore, using this multimedia PPT to teach about the human circulatory system at SMP Negeri 1 Asgon Papua is a good idea.

Table 5. One-to-One Evaluation Result (N = 3 students)

No	Descriptionn	Persentage
	Content's Aspect	
1	Is the material easy to understand?	87%
2	Can you understand the content well?	93%
3	Can the presentation material be motivating?	87%
4	Is the material in line with your wishes?	80%
5	Is the material presented in accordance with the real situation in the field?	93%
6	Is the teacher's material thoroughly reviewed?	87%
7	Does the teacher in the interpretation of the material refer to you?	87%
8	Does the teacher give clear instructions every time he teaches?	93%
9	What is the material presented with images?	93%
10	Does the overall content encourage you to learn it more easily?	80%
	Appealing Aspect	
11	Do teachers' teaching strategies make you more active?	80%
12	Does the way teachers teach motivate you to learn?	93%
13	Do teachers often have discussions when teaching?	93%
14	Do you always ask questions when something is not clear?	87%
15	Are you happy when your teacher gives you a group assignment?	93%
16	Do you always do assignments with pleasure?	80%
17	Is the material explained by the teacher accompanied by examples that please you?	93%
18	Do teachers often teach with humor?	87%
19	Does the teacher always give assignments at the end of the lesson?	93%
20	Does the teacher's sajia as a whole satisfy you?	80%
	Percentage Mean	88 %

Small Group Evaluation

A small-group evaluation is required to determine if the first multimedia PPT design is appropriate for the human circulatory system. There were nine students with high, medium, and low abilities who participated in this activity. The developer displayed an introductory multimedia PPT presentation about the human circulatory system and

asked students to complete the attached questionnaire. The percentage of each feature from the small group trial data is calculated to determine the extent to which the viability of the developed media has been assessed—90% of the aspects that Multimedia PPT develops on the Human Circulatory System. According to the classification of small-group multimedia learning evaluation, this achievement percentage falls into the excellent category. Therefore, this multimedia PPT is feasible to teach about the human circulatory system in junior high school.

Table 6. Small Group Evaluation Result (N = 9 Students)

No	**Descriptions**	Total	Percentage
	Content's Aspect		
1	Is the material easy to understand?	40	89%
2	Can you understand the content well?	41	91%
3	Can the presentation material be motivating?	41	91%
4	Is the material in line with your wishes?	40	89%
5	Whether the material presented is in accordance with the real situation in the field?	42	93%
6	Is the teacher's material thoroughly reviewed?	41	91%
7	Does the teacher in the interpretation of the material refer to you?	40	89%
8	Does the teacher give clear instructions every time he teaches?	40	89%
9	What is the material presented with images?	43	96%
10	Does the overall content encourage you to learn it more easily?	41	91%
	Appealing Aspect		
11	Do teachers' teaching strategies make you more active?	41	91%
12	Does the way teachers teach motivate you to learn?	40	89%
13	Do teachers often have discussions when teaching?	42	93%
14	Do you always ask questions when something is not clear?	38	84%
15	Are you happy when your teacher gives you a group assignment?	40	89%
16	Do you always do assignments with pleasure?	39	87%
17	Is the material explained by the teacher accompanied by examples that please you?	40	89%
18	Do teachers often teach with humor?	41	91%
19	Does the teacher always give assignments at the end of the lesson?	41	91%
20	Does the teacher's sajia as a whole satisfy you?	41	91%
	Percentage Mean		90%

Field Trials

All 21 students following field tests were studying in the 2022–2023 school year. The data collected from the field test were used to determine the feasibility of the created medium, and the completion rate for the multimedia aspects of the Human Circulatory System PPT was found to be 91%. According to the classification of the multimedia learning field test, this achievement percentage places it in the "very good".

Table 7. Field Trials Result (N = 21 Students)

No.	Description	Percentage
	Content's aspect	
1	91	89%
2	97	93%
3	97	91%
4	93	89%
5	98	91%
6	97	93%
7	95	89%
8	94	89%
9	97	93%
10	96	93%
11	96	91%
12	93	89%
13	96	93%
14	89	87%
15	94	91%
16	94	89%
17	90	87%
18	96	91%
19	93	89%
20	95	93%
Percentage Mean		91%

Percentage Mean

Instructional media is central to the learning content delivery strategy (Degeng & Degeng, 2018). The success of biology learning is largely determined by the right instructional media and the characteristics of diverse learning materials (Samuel, 2024). One of the instructional variables that can be a barrier is the condition of schools that are not able to provide the expected instructional media. The selection of instructional media development using extended PowerPoint for circulatory system learning was determined considering that this medium can meet the selection criteria (Kareem, 2018). Extended PPT or multimedia PPT can display the content of the human circulatory system as it is originally happening in the human body (Perdana et al., 2020). This learning product has displayed detailed concepts as much as possible because this multimedia can explain human circulatory system events more realistically so that students can learn according to actual conditions.

This development product has been evaluated by three experts and shows that this learning medium meets the feasibility of the experts. This is in support of previous research where the feasibility of PPT as an alternative to online learning based on the assessment of content experts is included in a very feasible category (Darmawan et al.,

2022). The feasibility of this product is not only assessed by experts but also by users, namely students. The results of one-to-one evaluation tests and field trials show that this development product is feasible as an instructional medium for the human circulatory system. The development of digital media is very rapid, so currently learning the human circulatory system can be taught with augmented reality (Gregorcic & Torkar, 2022), but this cannot be done in schools with a lack of infrastructure. The development of Multimedia PoworPoint is a suitable instructional medium, considering both the characteristic content of the human circulatory system and the school's facility conditions.

CONCLUSION

The results of the development of multimedia PowerPoints on the human circulatory system can be concluded as follows: (1) Based on the review results from content experts, the average assessment is 93%. Therefore, the multimedia PPT on the human circulatory system falls into the "very good" category. (2) Based on the review results from instructional media experts, the average assessment is 100%. Therefore, the multimedia PPT on the human circulatory system also falls into the "very good" category. (3) Based on the review results from instructional design experts, the average assessment is 89%. Therefore, the multimedia PowerPoint on the human circulatory system falls into the "very good" category. (4) Based on the results of the one-to-one evaluation, the average assessment is 88%. Therefore, the multimedia PPT on the human circulatory system falls into the "very good" category. (5) Based on the results of the small group evaluation, the average assessment is 90%. Therefore, the multimedia PPT on the human circulatory system falls into the "very good" category. (6) Based on the results of the small group evaluation, the average assessment is 91%. Therefore, the multimedia PowerPoint on the human circulatory system falls into the "very good" category. The multimedia PPT is a feasible instructional medium for teaching the human circulatory system to junior high school students that lacks infrastructure.

CONCLUSION

We would like to express our sincere thanks to Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas Ahmad Dahlan (LPPM UAD) for their funding support in this research.

REFERENCES

Arikunto, S. (2010). *Prosedur penelitian : suatu pendekatan praktik*. Rineka Cipta.

Astutik, S. (2021). Penggunaan Media Video Pembelajaran Dan Power Point Dalam Mata Pelajaran Tik Kelas Vii Di Smp Negeri 1 Gurah. *Science, Engineering, Education, and Development Studies (SEEDS): Conference Series*, *4*(2), 80–86. https://doi.org/10.20961/seeds.v4i2.56735

Castro-Alonso, J. C., de Koning, B. B., Fiorella, L., & Paas, F. (2021). Five Strategies for Optimizing Instructional Materials: Instructor- and Learner-Managed Cognitive Load. *Educational Psychology Review*, *33*(4), 1379–1407. https://doi.org/10.1007/s10648-021-09606-9

Darmawan, H., Simanjorang, M. M., & Nasution, H. (2022). Pengembangan Perangkat Pembelajaran Berbasis ICT Memanfaatkan Power Point, Filmora, Whtasapp Grup, Google Classroom, dan Google Formulir Untuk Meningkatkan Keefektifan Pembelajaran. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 848–858. https://doi.org/10.31004/cendekia.v6i1.1291

Degeng, I. N. S., & Degeng, P. D. (2018). *Ilmu Pembelajaran: Klasifikasi Variabel untuk Pengembangan Teori dan Penelitian*. Yayasan Taman Pustaka Kristen Indonesia.

Dukhan, S., Brenner, E., & Cameron, A. (2019). The Influence of Lecturers' Expectations of Students' Role in Meaning Making on the Nature of their Powerpoint slides and the Quality of Students' Note-making: A First-year Biology Class Context. *African Journal of Research in Mathematics, Science and Technology Education*, *23*(1), 100–110. https://doi.org/10.1080/18117295.2019.1598625

Fadhillah, R., Djulia, E., & Diningrat, D. S. (2017). The Development of Scientific Approach-Based Interactive Learning Media of Biology on the Topic of Auditory System for High School Students. *International Journal of Humanities, Social Sciences and Education*, *4*(12), 127–133. https://doi.org/10.20431/2349-0381.0412016

Gregorcic, T., & Torkar, G. (2022). Using the structure-behavior-function model in conjunction with augmented reality helps students understand the complexity of the circulatory system. *Advances in Physiology Education*, *46*(3), 367–374. https://doi.org/10.1152/ADVAN.00015.2022

Hasanah, N., Inganah, S., Prasetyo, B., & Mariyanto, A. (2023). Learning in the 21st Century Education Era: Problems of Mathematics Teachers in the Use of Information and Communication Technology-Based Media. *JEMS (Journal of Mathematics and Science Education)*, *11*(1), 275–285.

Kareem, A. A. (2018). The use of multimedia in teaching biology and its impact on students' learning outcomes. *The Eurasia Proceedings of Educational & Social Sciences*, *9*(1), 157–165. https://dergipark.org.tr/download/article-file/531778

Kelly-Laubscher, R. F., Muna, N., & van der Merwe, M. (2017). Using the research article as a model for teaching laboratory report writing provides opportunities for development of genre awareness and adoption of new literacy practices. *English for Specific Purposes*, *48*, 1–16. https://doi.org/10.1016/j.esp.2017.05.002

Khan, T. M., Hassali, M. A., & Rasool, S. T. (2013). A study assessing the impact of different teaching modalities for pharmacy students in a Cardio-Pulmonary Resuscitation (CPR) course. *Saudi Pharmaceutical Journal*, *21*(4), 375–378. https://doi.org/10.1016/j.jsps.2012.11.002

Mahajan, R., Gupta, K., Gupta, P., Kukreja, S., & Singh, T. (2020). Multimedia Instructional Design Principles: Moving from Theoretical Rationale to Practical Applications. *Indian Pediatrics*, *57*(6), 555–560. https://doi.org/10.1007/s13312-020-1854-2

Mokalu, Y. B., Repi, R. A., & Ngangi, J. (2021). Developing instagram-based biology animation learning media for junior high school student during covid-19 pandemic in Manado. *International Journal of Advanced Education and Research*, *6*(3), 45–48. www.alleducationjournal.com

Okereke, I. E. ., & Nzewi, U. M. (2020). SCHOOLS : THE CHALLENGES OF IMPLEMENTATION. *Journal of the Nigerian Academy of Education*, *16*(1), 159–171. https://journals.ezenwaohaetorc.org/index.php/JONAED/article/view/1459

Onivehu, A. O., & Ohawuiro, O. E. (2018). Effect of Powerpoint Presentation on Students' Cognitive Achievement in Geography. *Romanian Review of Geographical Education*, *VII/1*, 46–60. https://doi.org/10.23741/rrge120184

Perdana, M. A., Sidabutar, M., & Sungkono. (2020). *Developing Interactive Learning Multimedia for Blood Circulatory System Materials for Elementary School Students*. *511*(Yicemap 2019), 128–135. https://doi.org/10.2991/assehr.k.201221.028

Permatasari, M. I., Pratiwi, I., Sazwita, R. A. A., & Saifuddin, M. F. (2022). BioDigital human: Media pembelajaran di era new normal. *Bioma : Jurnal Ilmiah Biologi*, *11*(1), 50–60. https://doi.org/10.26877/bioma.v11i1.9723

Putri, S. N., Anak Agung Gede Agung, & I Kadek Suartama. (2023). E-module with the Borg and Gall Model with a Contextual Approach to Thematic Learning. *Journal for Lesson and Learning Studies*, *6*(1), 27–34. https://doi.org/10.23887/jlls.v6i1.57482

Rafiuddin, Budiningsih, C. A., Suwarjo, Megawati, Puspitasari, E., & Harefa, E. (2024). Development of a Social Sciences Learning Model Based on Local Wisdom Pangngadakkang Tupanrita By Utilizing Digital Resources To Improve Prosocial Behavior of Elementary School: Students South Sulawesi Province, Indonesia. *Revista de Gestao Social e Ambiental*, *18*(8), 1–28. https://doi.org/10.24857/rgsa.v18n8-062

Rhodes, D. V. L., & Barshick, M. R. (2021). Adapting a Bacterial Unknowns Project to Online Learning: Using Microsoft PowerPoint To Create an Unknowns

Identification Simulation. *Journal of Microbiology & Biology Education*, *22*(2), 1–2. https://doi.org/10.1128/jmbe.00104-21

Samuel, A. (2024). *Instructional Media as a Correlate of Teaching and Learning of Science Subjects at Secondary School Level: Teachers' Perception Amburah Samuel*. *4*(2), 127–139.

Sariam, S., & Harahap, H. S. (2022). The Influence of Powerpoint-Based Discovery Learning Models on Biology Student Learning Outcomes. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *12*(1), 127–134. https://doi.org/10.30998/formatif.v12i1.12000

Stacy, E. M., & Cain, J. (2015). Note-taking and handouts in the digital age. *American Journal of Pharmaceutical Education*, *79*(7), 107. https://doi.org/10.5688/ajpe797107

Taculod, N. J., & Arcilla, F. J. (2020). Enhancing the Academic Performance and Learning Interest in Biology of Grade 10 Students Using Expanded PowerPoint Instruction. *SMCC Higher Education Research Journal*, *2*(1). https://doi.org/10.18868/cte.02.060120.05

Wahyuddin, W., Jamilah, J., Damayanti, E., & Maulana, A. (2022). Development of animation-based learning media with music and song lyrics on the cell division material at Al-Bahra High School Jeneponto Regency. *Bioma : Jurnal Ilmiah Biologi*, *11*(2), 151–164. https://doi.org/10.26877/bioma.v11i2.11490