RESEARCH ARTICLE

The development of video learning media on cell division subtopic for ninth grade students

F. Fitriyani [a,1], Ruqiah Ganda Putri Panjaitan [a,2,*], T. Titin [a,3], Zhu Caiping [b,4]

[a] Department of Biology Education, Faculty of Teacher Training and Education, Tanjungpura University, Jl. Prof. Dr. Hadari Nawawi, Bansir Laut, Pontianak, West Kalimantan 78124, Indonesia

[b] Guangxi University School of Liberals Arts, East Daxue Road No.100, Xixiangtang District, Nanning, Guangxi 530004 China

[1] pipitttttt04@gmail.com; [2] ruqiah.gpp@fkip.untan.ac.id*; [3] titin@fkip.untan.ac.id;

[4] 1483724844@qq.com

Abstract: The cell division process that occurs within the body cannot be directly observed, making the cell division material difficult to learn. Difficulties in studying cell division material can be aided by using learning media that can visualize the material effectively. The objective of this research is to develop science learning videos on the subtopic of cell division for Grade IX and to assess their suitability as learning media. This research adopts a Research and Development (R&D) methodology with five stages including potential and problems, data collection, product design, design validation, and design revision. The subjects in this research are validators from the field of biology expertise. The instrument used for data collection is the validation sheet. The data analysis techniques employed include qualitative data analysis and quantitative data analysis. The results of this research obtained CVR and CVI values of 1.00 with a valid category, indicating that the developed science learning videos on the subtopic of cell division are suitable for use in learning. Therefore, this learning media can be a recommendation in the learning process on subtopic cell division.

Keywords: cell division; media suitability; learning video

For correspondence:
ruqiah.gpp@fkip.untan.ac.id

Article history:
Received: 10 October 2024
Revised: 8 November 2024
Accepted: 11 November 2024
Published: 19 November 2024

10.22219/jpbi.v10i3.36851

© Copyright Fitriyani *et al*. This article is distributed under the terms of the Creative Commons Attribution License

p-ISSN: 2442-3750
e-ISSN: 2537-6204

How to cite:
Fitriyani, F., Panjaitan, R. G. P., Titin, T., & Caiping, Z. (2024). The development of video learning media on cell division subtopic for ninth grade students. *JPBI (Jurnal Pendidikan Biologi Indonesia), 10*(3), 1011-1019 https://doi.org/10.22219/jpbi.v10i3.36851

Introduction

Science learning encompasses factual, conceptual, and principle-based knowledge related to phenomena in life, including living organisms and their surroundings (Hamidi et al., 2022; Nehm, 2019; Selje-Aßmann et al., 2019). Furthermore, science learning serves as a means to develop knowledge, cultivate critical and scientific thinking patterns, and enhance skills for daily life (Ningsih, 2020; Suwastini et al., 2022). Moreover, science learning is a complex discipline, thus achieving successful learning necessitates a systematic (Suwastini et al., 2022) and meaningful learning process (Abu-Ghaneema, 2018; Andrews et al., 2023; Mkimbili, 2019). The success of learning is supported by several factors such as the curriculum, learning strategies (Ningsih, 2020; Suwastini et al., 2022), teachers, students, and the use of media in learning (Prasetya et al., 2021; Suwastini et al., 2022).

Learning media serves as a means or tool used to convey information or materials in teaching (Widyaningrum et al., 2022). The use of learning media aims to assist teachers in clarifying the learning materials presented (Failasufah & Setyasto, 2023). The selection of learning media should consider its effectiveness and suitability in supporting the competencies that students need to fulfill (Anggraini & Putra, 2021; Widyaningrum et al., 2022; Ghufron et al., 2024). Factors to consider in assessing the suitability of learning media include the type of material (Surata et al., 2020), students' learning styles, ease of media use (Surata et al., 2020), facilities available to students, teachers, and schools (Kingsley, 2019; Mansur & Utama, 2021), and students' characteristics (McKenzie, 2009). Some examples of learning media include pictures, torso models (Surata et al., 2020), *Power Point* presentations (Surata et al., 2020; Ghufron et al., 2024), flashcards (Hidayati, 2023), puzzles (Yulinda & Saifuddin, 2022),

encyclopedias (Rostikawati et al., 2021; Kristi et al., 2023), and learning videos (Lorensa et al., 2022; Surata et al., 2020).

Learning videos are a tool for delivering instructional material that can combine elements of images, sound, and text simultaneously (Vital-Rumebe et al., 2021; Zhang & Taranikanti, 2024). Learning videos can help improve learning outcomes by visualizing materials that cannot be directly studied, making learning more practical and effective (Kusumah, 2024; Sugihati et al., 2024). Purba et al. (2023) research stated that learning videos are suitable for use because they can enhance students' understanding by presenting simple and concrete materials. Furthermore, the use of learning videos is also deemed appropriate because they receive positive responses from students (B. P. W. Purba et al., 2023). In the context of biology education, learning videos are utilized in several topics such as the respiratory system (B. P. W. Purba et al., 2023), circulatory system (K. R. Purba et al., 2017), viruses (Ananda et al., 2023), water cycle (Hani et al., 2024), and ecosystems (Giannakos et al., 2016; Lorensa et al., 2022). Based on literature reviews, biology learning videos are developed from various sources such as textbooks, direct experiences (B. P. W. Purba et al., 2023), and previous research findings (Panjaitan et al., 2020; Lorensa et al., 2022).

The subtopic of cell division is one of the subtopics covered in the biology subject for 9th Grade Junior High School. The subtopic of cell division explores the purpose and methods by which cells in the body reproduce (Fikri & Famelia, 2023; Hidayati, 2023), the causes of growth and reproduction in humans, as well as the wound healing process in the body (Jonah & Tobi, 2022; Hidayati, 2023). Moreover, during the learning process, students are required to have a deeper understanding of the subtopic of cell division as formulated in the learning objectives. The learning objectives that students must achieve in studying the subtopic of cell division are to understand the purpose of cell division, know the locations where mitosis and meiosis cell divisions occur, comprehend the phases of mitosis and meiosis cell divisions, and understand the characteristics and traits of daughter cells produced from mitosis and meiosis cell divisions.

Common difficulties encountered in studying the subtopic of cell division include the fact that its processes occur inside the body and cannot be directly observed, making it challenging to learn (Yakob et al., 2020; Jonah & Tobi, 2022). Merely observing through a microscope or relying solely on verbal instruction from teachers is often insufficient. To address these challenges, various learning media have been developed, such as digital puzzle-based media (Yulinda & Saifuddin, 2022), comic books (Yu & Sumayao, 2022), digital comics (Mufaqih & Juanengsih, 2023), and flashcards (Hidayati, 2023), There is even the use of video with an active knowledge sharing learning model (Hikmah et al., 2023). This media only contains concepts from various learning sources but does not present research results. As the results of previous research by Panjaitan et al. (2020) and Lorensa et al. (2022) that learning media can also be develop by presenting research results. Thus, this research develops learning video media on subtopic cell division for class IX SMP by presenting the results of research on experiment the healing capacity of diabetic gangrene of brotowali (*Tinospora crispa* L.) ointment. Furthermore, it is hoped that media developed is suitable for use in the learning process.

Method

The research conducted is a development or *Research and Development* (R&D) study that follows up on previous research. The product developed in this study is a science learning video on the subtopic of cell division for Grade IX. The research and development steps are based on Sugiyono (2021), consisting of ten stages. However, in this study, it progressed only up to the fifth stage out of the ten, including (1) potential and problems; (2) data collection; (3) product design; (4) design validation; and (5) design revision, due to time constraints. The first stage is potential and problems. Concerning potential, there is research on the capacity of diabetic gangrene healing by the brotowali ointment (*Tinospora csrispa* L.), which will be added to the media. Panjaitan et al. (2020) state that presenting research findings in learning can provide experiences and examples of concept application in real-life learning. Furthermore, the problems identified are related to the difficulty in learning the subtopic of cell division because its processes cannot be directly observed. In line with this, a learning video will be developed to help visualize the subtopic of cell division, supplemented with the presentation of research findings on diabetic gangrene healing. The second stage involves data collection. In this stage, research is conducted on the efficacy of brotowali ointment in treating diabetic gangrene and the collection of materials on cell division. Next is the third stage, which is product design. This stage consists of several steps referring to Astuti et al. (2021) with modifications, including conceptualizing or structuring the video, preparing tools and materials, creating storyboards, drafting video scripts, and editing. After the design stage, it proceeds to the fourth stage, which is design validation. Validation is carried out by biology experts using a validation sheet containing three aspects with eleven assessment criteria referring to Astuti et al. (2021) with some modifications. These aspects include format (motion display, image display, readability of text, layout of text and images, completeness of video structure, systematic video arrangement, and audio), content (suitability of video material description with learning objectives and

ease of understanding the presented material), and language aspects (ease of understanding language and completeness of sentences and information required by students). The assessment scores on the validation sheet use a *Likert* scale referring to Suwastini et al. (2022) as presented in Table 1. The final stage is design revision, where improvements are made based on suggestions and feedback from validators.

Table 1. Likert scale rating categories

No	Score	Description
1	Score 1	Strongly Disagree
2	Score 2	Disagree
3	Score 3	Agree
4	Score 4	Strongly Agree

The data analysis methods used in this research are qualitative descriptive analysis and quantitative descriptive analysis. Qualitative descriptive analysis is utilized to analyze the feedback and suggestions from validators as a reference for improving the learning video. Quantitative descriptive analysis is employed to analyze the scores obtained through validation. After obtaining the scores, the data are then analyzed by calculating the Content Validity Ratio (CVR) and Content Validity Index (CVI) (Kristi et al., 2023; Lorensa et al., 2022; Aprilianti et al., 2024). The equations used refer to Lawshe (1975) and are presented in Formula 1, where (ne) is the number of experts who agree and (n) is the total number of validators.

$$\mathrm{CVR} = \frac{ne - n/2}{n/2} \quad (1)$$

In calculating the CVR value, there are rules, namely if the number of validators who agree is less than half of the total number of validators, then the CVR value is negative; if half of the number of validators agree, then the CVR value is 0; if the number is more than half of the total number of validators who agree, the CVR value is in the range of 0-0.99, and if all validators agree, then the CVR value is 1.00. After determining the CVR values for each criterion, the calculation of CVI is continued using Formula 2. The learning video media is considered valid or suitable for use if it meets the minimum value based on Lawshe (1975) with five validators, which is 0.99.

$$\mathrm{CVI} = \frac{\Sigma CVR}{Total\ Item\ Test} \quad (2)$$

Results and Discussion

The video media is technology-based media (Ilesanmi, 2023). The development and use of technology-based learning media is in line with current advances in the world of education, where in 21st century education students are emphasized to be able to build cognitive abilities accompanied by digital literacy and the ability to master technology well (Yalcin-Incik & Incik, 2022; Ilesanmi, 2023). Apart from that, the development of technology-based learning video media is in accordance with the characteristics of current students who prefer and are interested in technology-based things, this is because today's students were born and live side by side with technological developments (Yalcin-Incik & Incik, 2022; Bucata, 2023). Therefore, the development and use of technology-based learning media in the form of learning videos developed in this research is relevant for use in current learning.

In this research, based on the analysis of potentials and problems in the first stage, a science instructional video for Grade IX will be developed focusing on the subtopic of cell division. In the second stage, data collection includes research findings related to the effectiveness of brotowali ointment in treating diabetic gangrene and a summary of the subtopic of cell division. The third stage involves product design, where the concept or structure of the instructional video is established. It consists of sections such as cover, basic competencies, learning objectives, an overview of the subtopic of cell division along with research findings, conclusion, references, and student worksheets (LKPD). The predetermined learning objectives are as follows: (1) students can understand the objectives of cell division through the instructional video, (2) students can identify the locations of mitosis and meiosis division through the instructional video, (3) students can explain the phases of mitosis and meiosis division along with their characteristics through the instructional video, (4) students can correctly identify the characteristics of daughter cells from mitosis and meiosis division through the instructional video, and (5) students can present a model of mitosis and meiosis division based on group work effectively. Next, the tools used are a smartphone with the assistance of editing applications such as Canva and CapCut, with materials sourced from the Grade IX Semester 1 Science textbook from 2018, along with relevant articles and images related to the research. Additionally, this product design stage produces

storyboards and video scripts, followed by the editing process to create the instructional video. The fourth stage involves validating the instructional video by validators, with the final results presented in Table 2.

Table 2. Validation results of grade IX cell division subtopic instructional video by validators

Aspect	Criteria	CVR	Description
Format	Motion display	1.00	Valid
	Image display	1.00	Valid
	Readability of text	1.00	Valid
	Layout of text and images	1.00	Valid
	Completeness of video structure	1.00	Valid
	Systematic video arrangement	1.00	Valid
	Audio	1.00	Valid
Content	Suitability of video material description with learning objectives	1.00	Valid
	Ease of understanding the presented material	1.00	Valid
Language	Ease of understanding the language	1.00	Valid
	Completeness of sentences and information required by students	1.00	Valid
	CVI Value	**1.00**	**Valid**

Description:
CVR (Content Validity Ratio): Validity scores for each criterion
CVI (Content Validity Index): Overall validity score (average CVR value)

Next, based on the validation results, suggestions and feedback were obtained from validators regarding the format aspect, namely reducing the volume of accompanying music in the learning objective scenes and adding captions to the introductory scene of the cell division video.
Based on the validator's assessment, the eleven criteria grouped into three aspects received a CVR value of 1.00. Overall, the video obtained a CVI value of 1.00, indicating its validity, thus making the instructional video on the subtopic of cell division suitable for use in the learning process. Furthermore, the first aspect of media validation is the format aspect, consisting of seven assessment criteria, the first of which is motion display. The video developed in the study displays both mitosis and meiosis cell division phases at a moderate pace, allowing learners ample opportunity to understand the material well (Figure 1). Additionally, the video developed in this research presents varied images and texts with animations and transitions to avoid monotony. The animations used are characterized by simple and harmonious movements. Prasetya et al. (2021) and Lorensa et al. (2022) stated that the addition of effects in instructional videos can enhance students' attraction to the instructional video.

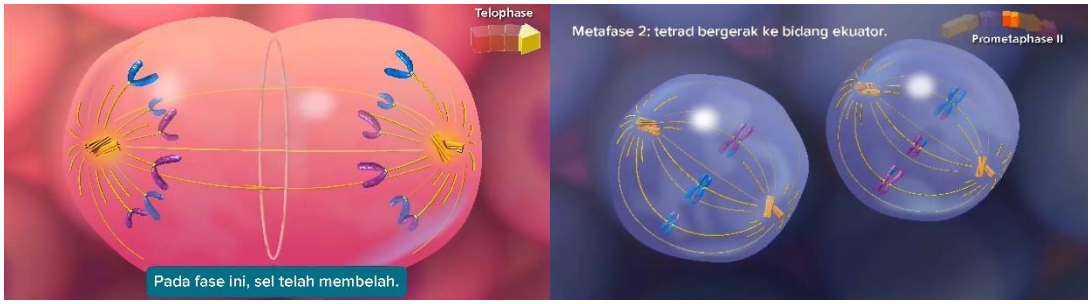

Figure 1 The presentation in the instructional video on the process of cell division

The format aspect in the second assessment criterion is image display. This instructional video presents images that support the topic of cell division with clear, non-pixelated, and unblurred quality. Additionally, the images presented in the video are vibrant, making them visually appealing to learners. According to Prasetya et al. (2021), images convey their own messages, and presenting clear and attractive images can help students stay focused and engaged in learning materials. In this developed instructional video, images are always accompanied by text to enhance the clarity of the message being conveyed.
The format aspect in the third criterion is readability of text. Based on the validation results, the text in this instructional video is presented with simple fonts, appropriate text sizes, and attractive colors that contrast with the video background, ensuring clear readability. Furthermore, text readability is an essential element to support the clarity of the material being conveyed and determine the achievement of the learning process (Prasetya et al., 2021; Lorensa et al., 2022). The format aspect in the fourth criterion is the layout of text and images. In relation to this, images and text in this instructional video on

the cell division subtopic are proportionally arranged with appropriate spacing. All elements in the video must be arranged in such a way that there is no overlap and no misinformation is received by learners (Astuti et al., 2021; Lorensa et al., 2022). The assessment criteria for image display, layout of images and text, and readability of text in the format aspect above are presented in Figure 2.

(a) (b)

Figure 2. (a) The presentation in the instructional video demonstrates high-quality image display and proportional arrangement of both images and text (b) The choice of text color contrasts effectively with the background video

The fifth criterion, on the format aspect, specifically evaluates the completeness of the video's structure. The developed video has been structured comprehensively, covering aspects such as the cover, basic competencies, learning objectives, content related to cell division, a list of references used, and worksheets to support students' skill competencies (see Figure 3). This aligns with the findings of Lorensa et al. (2022) and Anggraini and Putra (2021). Both studies suggesting that a well-organized video structure can enhance the direction of the learning process (Figure 3).

Figure 3. The presentation in the video demonstrates a comprehensive video structure

Furthermore, in terms of format, the systematic arrangement of the video is the sixth criterion. The instructional video developed in this research presents material starting from simple concepts to more complex ones, covering cell definition, the purpose of cell division along with examples and research findings on diabetic gangrene healing, types of cell division, the locations of mitosis and meiosis, cell parts involved in the division process, phases of mitosis and meiosis, and characteristics of daughter cells resulting from mitosis and meiosis (Figure 4). The organized material sequence aims to create coherence among the topics (Astuti et al., 2021) and to train students to think systematically (Amini & Usmeldi, 2022). Regarding the last criterion, which is the audio aspect, the instructional video on the cell division subtopic developed in this study is supported by clear narration articulation and appropriate background music. The selection of suitable background music significantly influences the learning atmosphere. Moreover, the delivery of the narrator when presenting the instructional material can engage students to remain focused, attentive, entertained, and even stimulate their emotions (Prasetya et al., 2021).

Figure 4. The presentation in the video demonstrates the delivery of content starting from simpler concepts to more complex ones

Based on the content aspect, the assessment consists of two criteria. The first one is the alignment of the material presented with the learning objectives. In this regard, the content in this instructional video is presented in line with the learning objectives, covering the objectives of cell division along with the research findings on diabetic wound healing by using brotowali ointment, the locations of mitosis and meiosis cell division, the phases of mitosis and meiosis division, as well as the characteristics of daughter cells resulting from mitosis and meiosis. The alignment between the material presented to students and the learning objectives should be continuous to support meaningful learning processes (Ilesanmi, 2023; Prasetya et al., 2021). Next, the content format in the second criterion is the ease of understanding the presented material (Figure 5). The material in this developed video is presented clearly. Astuti et al. (2021) and Purba et al. (2023) stated that content presented clearly, concisely, and without convolution greatly aids students in understanding the material presented.

Figure 5. The presentation in the video demonstrates material that aligns with the learning objectives and utilizes easily understandable language

(a) (b)

Figure 6. (a) The presentation in the instructional video demonstrates the use of language suitable for the characteristics of the students and (b) The presentation of term definitions

In the language aspect, there are two criteria. The first one is the use of easily understandable language. The language used in delivering the material in this instructional video is easy to understand as it is presented in proper and correct Indonesian language, tailored to the characteristics and educational level of the students (Figure 6). Aligning with this, adapting to the developmental level and language comprehension abilities of students in delivering the material is crucial to avoid misunderstandings and prevent double interpretations (Amini & Usmeldi, 2022). The second criterion in the language aspect is the completeness of sentences and information. This instructional video also presents information with complete sentences that are essential for students. All the material presented in this developed video

supports students' understanding of the cell division subtopic. According to Astuti et al. (2021) and Ilesanmi (2023) complete and interconnected sentences will build a solid understanding for students as information recipients. Additionally, this instructional video includes definitions of terms used in delivering the material, particularly related to the research findings on the capacity of brotowali ointment in healing diabetic gangrene, to ensure that information is effectively conveyed. Consistent with Panjaitan et al. (2020); Lorensa et al. (2022); and Huang et al. (2024), attention to the use of infrequently used words is necessary to ensure comprehensive delivery of information.

Conclusion

The instructional video media was developed through five stages: potential and problem analysis, data collection, product design, design validation, and design revision. Based on the validation results of the grade IX cell division instructional video, with three aspects assessed—format, content, and language-a CVR and CVI score of 1.00 was obtained, categorizing it as valid. Therefore, the instructional video is deemed suitable for use in the learning process.

Acknowledgment

The author would like to thank the leadership of the Faculty of Teacher Training and Education, Tanjungpura University and the organizers of the Merdeka Belajar Kampus Merdeka (MBKM) program for funding this research.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

R. G. P. Panjaitan and **F. Fitriyani**: writing original draft preparation and editing, **F. Fitriyani** and **T. Titin**: methodology and analysis; **R. G. P. Panjaitan, T. Titin**, and **Z. Caiping**: review and editing.

References

Abu-Ghaneema, E. (2018). Meaningful learning: The main constitutive and consecutive components and their presence in science teaching. *Yearbook of Pedagogy*, *41*(1), 183–192. https://doi.org/10.2478/rp-2018-0013

Amini, R., & Usmeldi, U. (2022). Developing the interactive e-module based on integrated learning for primary school students. *International Journal of Information and Education Technology*, *12*(4), 272–279. https://doi.org/10.18178/ijiet.2022.12.4.1615

Ananda, Y., Rahmatan, H., Samingan, S., Huda, I., & Mudatsir, M. (2023). Application of the video-assisted problem based learning model to Increase student learning motivation in virus material. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6230–6237. https://doi.org/10.29303/jppipa.v9i8.4766

Andrews, D., Van Lieshout, E., & Kaudal, B. B. (2023). How, where, and when do students experience meaningful learning? *International Journal of Innovation in Science and Mathematics Education*, *31*(3). https://doi.org/10.30722/IJISME.31.03.003

Anggraini, P. A. D., & Putra, D. B. K. N. S. (2021). Developing learning video with Addie model on science class for 4 th grade elementary school students. *Proceedings of the 2nd International Conference on Technology and Educational Science (ICTES 2020)*, *540*, 413–421. https://doi.org/10.2991/assehr.k.210407.273

Aprilianti, M., Panjaitan, R. G. P., Titin, T., & Lestari, L. A. (2024). Feasibility of a pocket book on breast milk and family planning sub materials based on an inventory of plants that facilitate breast milk. *Jurnal Pendidikan Sains Indonesia*, *12*(1), 95–110. https://doi.org/10.24815/jpsi.v12i1.34407

Astuti, A., Panjaitan, R. G. P., & Titin, T. (2021). Kelayakan media video pembelajaran pada submateri sistem endokrin. *Edukasi: Jurnal Pendidikan*, *19*(2), 290–303. https://doi.org/10.31571/edukasi.v19i2.2919

Bucata, G. (2023). Challenges at the educational level in the teaching and training of generation “Z.” *Land Forces Academy Review*, *28*(4), 265–276. https://doi.org/10.2478/raft-2023-0031

Failasufah, M., & Setyasto, N. (2023). Audio-assisted smartbox learning media in IPAS content of metamorphosis of animals for fourth-grade students. *Jurnal Penelitian Dan Pengembangan*

Pendidikan, *7*(3), 456–464. https://doi.org/10.23887/jppp.v7i3.65677
Fikri, A. A., & Famelia, V. (2023). Pengembangan lesson plan berbasis model Discovery Learning pada materi pembelahan sel di tingkat MA/SMA. *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *7*(1), 56–64. https://doi.org/10.33369/diklabio.7.1.56-64
Ghufron, S., Nafiyah, N., Djuwari, D., Rulyansah, A., & Saputri, T. (2024). Effectiveness of innovative learning media in Elementary Schools during the Covid 19 pandemic. *Pegem Journal of Education and Instruction*, *14*(3), 230–242. https://doi.org/10.47750/pegegog.14.03.22
Giannakos, M. N., Krogstie, J., & Aalberg, T. (2016). Video-based learning ecosystem to support active learning: application to an introductory computer science course. *Smart Learning Environments*, *3*(1), 11. https://doi.org/10.1186/s40561-016-0036-0
Hamidi, H., Sarjan, M., Fauzi, I., Rahmatiah, R., Yamin, M., Sudirman, S., Azizi, A., Muliadi, A., Khery, Y., Muttaqin, M. Z. H., Rasyidi, M., & Ardiansyah, B. (2022). Multidimensional science education: Overview of philosophy foundations (ontology, epistemology, axiology). *Path of Science*, *8*(10), 5001–5006. https://doi.org/10.22178/pos.86-6
Hani, M., Yulistia, A., Anindya, A., Islamiati, A., Alwini, S. N., & Nuryadin, A. (2024). Developing animated video for water cycle topic in fifth grade of elementary school. *PIONIR: JURNAL PENDIDIKAN*, *13*(1). https://doi.org/10.22373/pjp.v13i1.22033
Hidayati, A. (2023). Peningkatan hasil belajar menggunakan media flash card materi pembelahan sel di SMA Negeri 1 Sumber. *Jurnal Pendidikan Dasar: Jurnal Tunas Nusantara*, *5*(1), 568–576. https://ejournal.unisnu.ac.id/jtn/article/view/4944
Hikmah, N., Mustami, M. K., & Syahriani, S. (2023). The influence of active knowledge-sharing learning model with assistance of learning animation videos on student activities and outcomes in cell division material class XII SMAN 5 Barru. *Journal of Islam and Science*, *10*(1), 49–54. https://doi.org/10.24252/jis.v10i1.34314
Huang, Y., Rahman, A. R. A., & Yahaya, M. F. bin. (2024). Applying comics as learning tools: A thematic review. *International Journal of Academic Research in Progressive Education and Development*, *13*(3), 2253–2276. https://doi.org/10.6007/ijarped/v13-i3/22072
Ilesanmi, A. (2023). Teaching and learning with instructional videos: issues and concerns for educational practice. *International Journal of Instructional Technology and Educational Studies*, *4*(1), 1–6. https://doi.org/10.21608/ihites.2022.121271.1110
Jonah, T. M. F., & Tobi, T. (2022). Areas and causes of students' difficulties in learning the concept of cell in Secondary School biology curriculum. *International Journal of Advanced Academic Research*, *8*(3), 16–27. https://www.ijaar.org/articles/v8n3/ahe/ijaar-v8n3-Mar22-p8322.pdf
Kingsley, O. V. (2019). Management of learning facilities. *New Trends and Issues Proceedings on Humanities and Social Sciences*, *6*(7), 82–87. https://doi.org/10.18844/prosoc.v6i7.4516
Kristi, Y., Panjaitan, R. G. P., & Mardiyyaningsih, A. N. (2023). The eligibility of the encyclopedia of circulatory system diseases and disorders based on traditional medicinal plants for hypertension as learning media. *Jurnal IPA & Pembelajaran IPA*, *7*(3), 234–246. https://doi.org/10.24815/jipi.v7i3.32300
Kusumah, S. W. (2024). Development of video-based learning media on SLETV material to improve mathematics learning outcomes. *Contemporary Education and Community Engagement (CECE)*, *1*(1), 8–15. https://doi.org/10.12928/cece.v1i1.820
Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel Psychology*, *28*(4), 563–575. https://doi.org/10.1111/j.1744-6570.1975.tb01393.x
Lorensa, S. M., Tenriawaru, A. B., & Candramila, W. (2022). Development of learning video on sub materials interaction in the ecosystem based on functional feeding group of Macrobenthos. *Biosfer: Jurnal Pendidikan Biologi*, *15*(2), 203–213. https://doi.org/https://doi.org/10.21009/biosferjpb.23832
Mansur, H., & Utama, A. H. (2021). The evaluation of appropriate selection learning media at junior high school. *Indonesian Journal of Instructional Media and Model*, *3*(1), 17. https://doi.org/10.32585/ijimm.v3i1.1401
McKenzie, A. R. (2009). Unique considerations for assessing the learning media of students who are deaf-blind. *Journal of Visual Impairment & Blindness*, *103*(4), 241–245. https://doi.org/10.1177/0145482X0910300408
Mkimbili, S. T. (2019). Meaningful science learning by the use of an additional language: A Tanzanian perspective. *African Journal of Research in Mathematics, Science and Technology Education*, *23*(3), 265–275. https://doi.org/10.1080/18117295.2019.1654212
Mufaqih, S., & Juanengsih, N. (2023). Development of digital comic as a media for biology learning in class Xi High School on cell material. *AIP Conference Proceedings*, 040024. https://doi.org/10.1063/5.0123708
Nehm, R. H. (2019). Biology education research: building integrative frameworks for teaching and learning about living systems. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 15. https://doi.org/10.1186/s43031-019-0017-6
Ningsih, K. (2020). Analysis of prospective biology teacher capabilities in acquiring the learning

concepts and biology science materials in Junior High Schools. *Jurnal Pendidikan Matematika Dan IPA*, *11*(1), 22–33. https://doi.org/dx.doi.org/10.26418/jpmipa.v11i1.31027

Panjaitan, R. G. P., Titin, T., Yuliana, Y. G. S., & Shidiq, G. A. (2020). Students' perceptions on the use of video in learning about reproductive system. *Jurnal Bioedukatika*, *8*(2), 112–121. https://doi.org/doi.org/10.26555/bioedukatika.v8i2.15960

Prasetya, W. A., Suwatra, I. I. W., & Mahadewi, L. P. P. (2021). Pengembangan video animasi pembelajaran pada mata pelajaran matematika. *Jurnal Penelitian Dan Pengembangan Pendidikan*, *5*(1), 60–68. https://doi.org/10.23887/jppp.v5i1.32509

Purba, B. P. W., Afrianti, B., Saragih, F. E., Adlini, M. N., & Rifda, R. (2023). Pengembangan video pembelajaran pada materi sistem pernapasan di Madrasah Aliyah Laboratorium Universitas Islam Negeri Sumatera Utara Medan. *Jurnal Edukasi Biologi*, *9*(2), 90–97. https://doi.org/https://doi.org/10.21831/edubio.v9i2.19893

Purba, K. R., Liliana, L., & Kwarrie, Y. N. P. (2017). Development of interactive learning media for simulating human blood circulatory system. *2017 International Conference on Soft Computing, Intelligent System and Information Technology (ICSIIT)*, 275–278. https://doi.org/10.1109/ICSIIT.2017.68

Rostikawati, R. T., Susanto, L. H., & Rahayu, E. P. (2021). Developing encyclopedia of macrozoobenthic invertebrates learning module ti improve students' learning outcome in biology subject. *Jurnal Pendidikan Matematika Dan IPA*, *12*(2), 159–169. https://doi.org/10.26418/jpmipa.v12i2.45051

Selje-Aßmann, N., Poll, C., Tisler, M. K., Gerstenberg, J., Blum, M., & Fleischer, J. (2019). Inquiry-based learning in the life sciences. In *Inquiry-Based Learning – Undergraduate Research* (pp. 171–180). Springer International Publishing. https://doi.org/10.1007/978-3-030-14223-0_16

Sugihati, Y., Nurwahidin, M., Herlinawati, H., & Firdaus, R. (2024). Development of Powtoon-based learning videos to improve learning outcomes in siroh subjects at Markazur Quraan Baitun Najaah. *Jurnal Teknologi Pendidikan : Jurnal Penelitian Dan Pengembangan Pembelajaran*, *9*(3), 452. https://doi.org/10.33394/jtp.v9i3.11613

Sugiyono, S. (2021). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta. https://inlislite.uin-suska.ac.id/opac/detail-opac?id=26594

Surata, I. K., Sudiana, I. M., & Sudirgayasa, I. G. (2020). Meta-analisis media pembelajaran pada pembelajaran biologi. *Journal of Education Technology*, *4*(1), 22–27. https://doi.org/10.23887/jet.v4i1.24079

Suwastini, N. M. S., Agung, A. A. G., & Sujana, I. W. (2022). LKPD sebagai media pembelajaran interaktif berbasis pendekatan saintifik dalam muatan IPA Sekolah Dasar. *Jurnal Penelitian Dan Pengembangan Pendidikan*, *6*(2), 311–320. https://doi.org/10.23887/jppp.v6i2.48304

Vital-Rumebe, G., Ontiveros-Moreno, I. L., Guerra-Rojas, C. G., & Gutiérrez-Rocha, A. (2021). Video learning: Aprendizaje y educación a través de medios audiovisuales, desde una perspectiva histórica y contemporánea. *Revista Panamericana de Pedagogía*, *32*. https://doi.org/10.21555/rpp.v0i32.2272

Widyaningrum, F. A., Maryani, I., & Vehachart, R. (2022). A literature study on science learning media in Elementary School. *International Journal of Learning Reformation in Elementary Education*, *1*(01), 1–11. https://doi.org/10.56741/ijlree.v1i01.51

Yakob, N., Kaliun, K., Ahmad, A. M., Rashid, R. A. A., & Abdullah, A. (2020). The effect of coupled Inquiry-5E in enhancing the understanding of meiosis concept. *International Journal of Evaluation and Research in Education*, *9*(1), 129–137. https://doi.org/10.11591/ijere.v9i1.20393

Yalcin-Incik, E., & Incik, T. (2022). Generation z students' views on technology in education: what they want what they get. *Malaysian Online Journal of Educational Technology*, *10*(2), 109–124. https://doi.org/10.52380/mojet.2022.10.2.275

Yu, C. J. G., & Sumayao, E. D. (2022). Development and implementation of a contextualized comic book to improve students' conceptions of cell division. *Asia Pacific Journal of Educators and Education*, *37*(2), 301–323. https://doi.org/10.21315/apjee2022.37.2.15

Yulinda, M. F. F., & Saifuddin, M. F. (2022). Digital puzzle: Alternative media for cell learning in Middle School. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, *4*(2), 230–234. https://doi.org/10.20527/bino.v4i2.12600

Zhang, B., & Taranikanti, V. (2024). The roles of video in online learning. In *The Future of Television and Video Industry*. IntechOpen. https://doi.org/10.5772/intechopen.114245