



Development of learning video on sub materials interaction in the ecosystem based on functional feeding group of macrobenthos

Sisi Marda Lorensa, Andi Besse Tenriawaru, Wolly Candramila*

Biology Education, Faculty of Teacher Training and Education, Universitas Tanjungpura, Indonesia

*Corresponding author: wolly.candramila@fkip.untan.ac.id

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ABSTRACT

Each organism has a different role as an integral part of an ecosystem. Nevertheless, this concept tends to be random and inaccurate in building a complete understanding of ecosystem interaction pattern. This research aims to develop learning video on ecosystem interaction, specifically on functional feeding group of macrobenthos. The feasibility of video as a learning medium was seen from five aspects of simplicity, audio, integration, balance, and effectiveness. The development of learning video is divided into two stages of the preliminary and the formative evaluation stage. In the preliminary stage, a field survey was conducted in the examples of interaction forms presented in 3 commonly used Biology textbooks. The formative evaluation stage was conducted to test the effectiveness of the learning product through self-evaluation and expert review. 5 validators of 2 lecturers and 3 high school biology teachers were assign. Data analysis was done with Lawshe method. An ICC (Interclass Correlation Coefficient) reliability test was carried out to determine the reliability of the validation instrument. The results of the reliability test using the ICC yielded an ICC value of 0.758 which puts it in the excellent category. All criteria from the aspects of the learning video media validation sheet are declared valid with CVR and CVI values of 1. Therefore, this learning video can be considered valid to be tested in limited trials.

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INTRODUCTION

Communication between teachers and students is a very important factor to create effective learning in providing various understandings related to the topics discussed in learning. These factors can be achieved by using the right strategies, including the type of learning media used (Rosyid et al., 2019). Learning media can facilitate teachers in delivering material during teaching and learning process. Therefore, teachers need to continue to adjust so as not to lag the development of science and technology, comprehend, and master the media used to convey material well and make it easier for students to comprehend learning materials (Musfiqon, 2012).

Teaching and learning activities are a system that has certain components that must be met. Incomplete components create less interesting learning process (Andriani, 2015). On the other hand, appropriate learning materials content, in accordance with the demands of the expected basic competencies, and provides a better understanding of concepts also needs to be taken seriously when packaging it for the students. The use of tools that are familiar to teachers will be beneficial for the creation of more creative alternative learning media. A good teacher's understanding of their students daily will of course be advantageous during the media development process.

Learning media are tools used in learning both graphically, photographically, and electronically that function to capture, process, and rearrange information, both visually and verbally (Arsyad, 2013). Learning media means as an intermediary or introduction message from the source to the recipient in order to stimulate thoughts, feelings, attention, and will to stimulate the existence of desire to be involved in the learning process (Hamid et al., 2020). Video as a learning medium is one of the most effective media in supporting the process of teaching and learning in schools since it can be applied individually or in groups. The benefits of video media are the flexibility and adjustability of the display (Rosyid et al., 2019). Learning videos are also interesting since they involve the senses of sight and hearing so that the material presented can be received optimally. Learning videos can also describe a process accurately and shorten or extend the display time. In addition, videos can be uploaded to the internet so that students can download them to be used as learning media at home because they can display clearer illustrations (Asyhar, 2012).

The development of learning video media can be done by optimizing applications that have been mastered by many teachers, such as Microsoft Office PowerPoint. In this research, in addition to the use of applications that have been mastered by the teacher, better packaging of material is also carried out to adapt the demands in basic competencies and improve understanding of better concepts. The study of the material in the textbook can be a reference in developing media content that is more in line with the expected basic competencies while at the same time providing variations and a clearer emphasis on the concept of the material being delivered. The use of learning media in the form of videos is very useful in biology learning activities, especially learning activities that require visualization media that can help students to understand a process mechanism that cannot be observed directly in everyday life (Sanaky, 2013).

In this study, the aquatic environment is the location where the subject to be studied is taken. The river water environment consists of abiotic and biotic components that interact each other through energy flows and nutrient cycles. When interaction between the two is disturbed, there will be changes that will cause the aquatic ecosystem to become unbalanced and the diversity of species and activities of organisms will decrease. One group of organisms found in freshwater ecosystems is macrobenthos. Macrobenthic animals are animals that part or all of their life cycles spend at the bottom of the waters, whether they are sessile, crawl or dig holes (Ardi, 2002). These animals play an important role in waters such as in the process of decomposition and mineralization of organic matter that enters the waters and occupies several trophic levels in the food chain (Odum, 1994).

The results of the study on functional feeding groups in Sungai Berembang were visualized through a learning video, using images from the research results as an important component of the video. In addition to displaying images of research results, the video media developed also provides information in the form of understanding, type, and composition of ecosystems as well as interactions that occur in an ecosystem, especially river ecosystems and the functional feeding group of the macrobenthos itself. This development concept was chosen to anticipate the shortcomings found in textbooks commonly used in several schools. The results of this study are expected to provide an interesting, clear, and informative alternative learning media for high school student.



METHODS

Research Procedure

This study used the development research method according to Akker (1999) with two stages, namely the preliminary and formative evaluation stages. The description of the two stages is describe as follows:

Preliminary Step

At this stage, a field survey was conducted in the form of a study of examples of interaction forms presented in 3 commonly used Biology Class X textbooks. Information about the types of textbooks used was carried out using a survey method to Biology teachers in SMA and MA in Pontianak City and its surroundings. The results of the study examples of the forms and types of organisms involved in each interaction are packaged in a table for analysis regarding the need for addition by utilizing information about the functional feeding group. Information about the functional feeding group was taken from the results of research by Lorensa (2021) about the diversity of macrobenthos in the Berembang River. Learning video development was carried out using programs that have been mastered by many teachers, namely MS Office PowerPoint by utilizing presentation slides that were exported into video format. On each slide, transition effects and animations are added to increase students' interest in the video made. Furthermore, each .ppt file is exported as a video in MP4 format, and in the Photos application, effects and musical instruments or narration are added.

Formative Evaluation

At this stage, the effectiveness of the learning video design product was tested through self-evaluation and expert review. The self-evaluation stage includes consultation activities with supervisors to evaluate the initial results of the learning video media. Next, at the expert review stage, the feasibility of the video was tested by 5 media and 5 material validators, each consisting of lecturers (n=2) and a biology teachers (n=3). The validated media aspects include simplicity, audio, cohesiveness, balance, and effectiveness, while the validated material aspects include format, content, and language.

Research Instrument

The instrument used in this study was a learning video media validation sheet consisting of 5 aspects with 10 criteria. The assessment of each criterion uses a Likert scale, which are: 4 (very good category); 3 (good category); 2 (less good category); 1 (not good category).

Data Analysis

The validation data were analyzed by calculating the Content Validity Ratio (CVR) and Content Validity Index (CVI) according to Lawshe (1975), with the following formula:

$$CVR = (n_e - N/2) / (N/2)$$

$$CVI = \frac{\sum CVR}{total\ item\ of\ all\ aspects}$$

in which:

CVR = content validity ratio

n_e = the number of panelists indicating "essential" (when fewer than half say "essential," the CVR is negative —when half say "essential" and half do not, the CVR is zero)

N = the total number of panelists

The minimum value of CVR and CVI for 5 validators is 0.99. If in the final calculation the CVR and CVI scores meet the minimum value of Lawshe (1975), then the learning video is declared content-worthy according to the criteria assessed.

After calculating the CVR and CVI, a reliability test was also carried out to determine the level of effectiveness of a research instrument (Arikunto, 2010). Reliability is calculated using the ICC (Interclass Correlation Coefficients) approach developed by Pearson (1901) with the following formula.



$$ICC = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_o^2 + \sigma_e^2}$$

ICC values are calculated in the SPSS Version 20 program and range from zero to one ($0 < ICC < 1$). The ICC value close to one indicates that the instrument's reliability is close to perfect and the data variance is more due to inter-object variance rather than inter-instrumental variance. ICC values close to zero or low can occur due to instrument inconsistency, instability of the object being measured, and unsupportive measurement situations.

RESULTS AND DISCUSSION

Preliminary Step

Examples of interaction forms and types of organisms found in 3 Biology books commonly used in Pontianak City can be seen in Table 1. All types of interactions shown come from various ecosystems. For example, in Book A, the intraspecific interaction shows examples of goats from the grassland ecosystem, while the commensalism interaction shows ferns and orchids from the forest ecosystem. In addition, several types of organisms have experienced domestication so the ecosystem reference for these organisms is blurred. For example, in book B, goats and sheep have experienced domestication and tend to be found in the farming areas, so the concept of interspecific interaction which originally referred to the location of the grassland ecosystem becomes less clear. Some of the animals that are used as examples are also likely to only be found in captivity, such as lions and zebras in zoos. Thus, the concept of predation that you want to explain through the example of the two organisms may not be accepted by students because in captivity the predation activities of the two animals no longer occur.

Departing from the findings of the exposure to interaction material in the ecosystem in the three Biology books commonly used in Pontianak City, a learning media was designed which is expected to be able to answer these deficiencies. The concept of an ecosystem that can contain various interactions needs to be emphasized to students because it relates to ecosystem components consisting of various populations of organisms and the ecological niches owned by each organism. The type of interaction is closely related to the ecological niche possessed by each organism, especially with the utilization of the resources available in the ecosystem. Utilization of these resources can be related to eating and eating activities or the need for space to grow and develop.

Table 1

The results of a survey on examples of forms of interaction presented in three Biology textbooks which are commonly used in high schools in Pontianak City

Type of Interactions	Names of Organisms Described in		
	Book A	Book B	Book C
Intraspecific Interaction	-	Honey Bee (<i>Aphis</i> sp.), Termite	-
Interspecific Interaction:	Not categorized into interspecific interaction	Categorized into interspecific interaction	Not categorized into interspecific interaction
Neutralism	Cow, cat	Worm, Grasshopper	Chicken, cat
Intraspecific Competition	Goats		
Interspecific Competition	Corn and grass	Goats, lambs*	Goat, cow, grass, corn*
Commensalism	Vern and orchids	Shark and remora	Shark and remora
Ammensalism as Allelopathy	Oleandrin toxin produced by <i>Nerium oleander</i> kills humans when eaten; Algae <i>Hydrodictyon</i> and <i>Scenedesmus</i> produce antibiotics to kill bacteria		Walnut tree and fungi <i>Penicillium</i> sp.



Type of Interactions	Names of Organisms Described in		
	Book A	Book B	Book C
Parasitism			
• Endo-parasitism	<i>Ancylostoma caninum</i> <i>Cuscuta filiformis</i> sp.	Epiphyte plants, tapeworm, liver worm, and the host **	<i>Cuscuta filiformis</i> sp.**
• Ecto-parasitism			
Predation	Snake, rats	Tiger, deer, cat, rat	Lion, zebra
Proto-cooperation	Buffalo, starling	-	-
Mutualism	Fungi, blue-green algae	Bacteria <i>Rhizobium</i> , Leguminosae root	Bee, flowers
Allelopathy	-	-	-

*Undifferentiated between intraspecific and interspecific competition

**Undifferentiated between endoparasite and ectoparasite

Concerning eating activities in an ecosystem, the concept of functional feeding groups in an aquatic ecosystem is the solution in this research. The forms of interaction and examples of organisms offered through the presentation of functional feeding groups are obtained from the same ecosystem. Then, the types of organisms displayed are the results of direct observations in the related ecosystem so that there is no element of ecosystem displacements such as due to domestication or captive activities. Making a learning video showing interactions in the ecosystem packaged in the concept of a functional feeding group was made with direct observations of macrobenthos in the Berembang River. The types of interactions and examples of macrobenthic organisms that represent them can be seen in [Table 1](#).

Table 2

Types of interactions and examples of organisms offered through the presentation of the functional feeding group of macrobenthos in the Berembang River

Types of Interactions	Examples	Description
Neutralism	<i>Gammarus</i> and <i>Pila</i>	The neutralism relationship is seen in <i>Gammarus</i> macrobenthos which act as shredders that utilize litter that falls into the waters with <i>Pila</i> as scrapers that utilize organic material found in rocks at the bottom of the river. Both species are not directly involved in feeding or are neutral.
Mutualism	<i>Gammarus</i> and water hyacinth	Mutualism interaction is seen in the <i>Gammarus</i> macrobenthos group where the waste fecal pellets of metabolism become nutrients for aquatic plants, one of which is water hyacinth. Meanwhile, the water hyacinth plant litter becomes <i>Gammarus</i> ' food.
Commensalism	<i>Corbicula</i> and algae	Commensalism interactions in which <i>Corbicula</i> as filtering collectors become the species that benefit from getting food by filtering organic particulate matter in the water, while algae growth is not affected by the presence of filtering collectors.
Parasitism	<i>Pila</i> and algae	Parasitism occurs when one organism takes food from another organism. For example, the interaction between <i>Pila</i> , a scraper, erodes rocks where algae grow, making it difficult for algae to get food because it has been eroded by scrapers.
Predation	Fish, <i>shredders</i> , <i>collectors</i> , <i>predators</i> , <i>scrapers</i>	Predation is the interaction between predator and prey organisms. For example, fish that eat FFG shredders, collectors, and predators. Another example is FFG predators that eat scrapers and collectors.

The types of interactions and examples of organisms with the concept of a functional feeding group of macrobenthos in the Berembang River were successfully developed into learning videos ([Figure 1](#)). The development is carried out in MS PowerPoint and Photos programs which are relatively



easy to be mastered and used by teachers. The learning video that was successfully developed in this study has a duration of 15 minutes and 3 seconds with a total of 67 slides. Based on the number of slides made, if presented in the form of conventional learning, it can take longer than 15 minutes and 3 seconds.



Interaction Neutralism



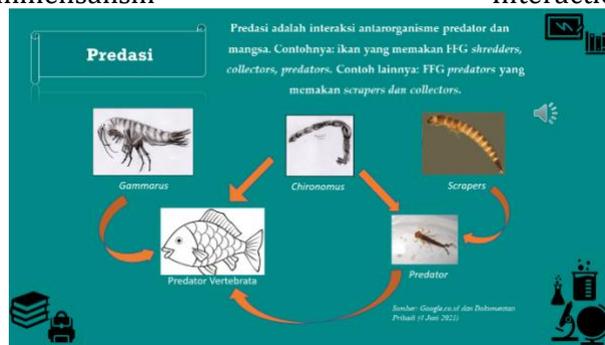
Interaction Mutualism



Interaction Commensalism



Interaction Parasitism



Interaction Predation

Figure 1. Example of Learning video display on Interaction in Ecosystems and Functional Feeding Groups from Macroinvertebrates in the Berembang River

Formative Evaluation

The results of the validation of the video as a learning media which were divided into 5 aspects of simplicity, audio, integration, balance, and effectiveness, resulted in CVR and CVI values equal to 1 for all criteria. The result of material validation of the learning video which is divided into 3 aspects, namely format, content, and language, also produces CVR and CVI values equal to 1 (Figure 2). The CVR and CVI values for both types of validation have met the minimum value specified by Lawshe (1975) for 5 validators, which is 0.99. These results indicate that the learning video media on the Sub Material of Interaction in the Ecosystem and functional feeding groups of macroinvertebrates in the Berembang River are suitable to be tested as learning media in the next step of development.

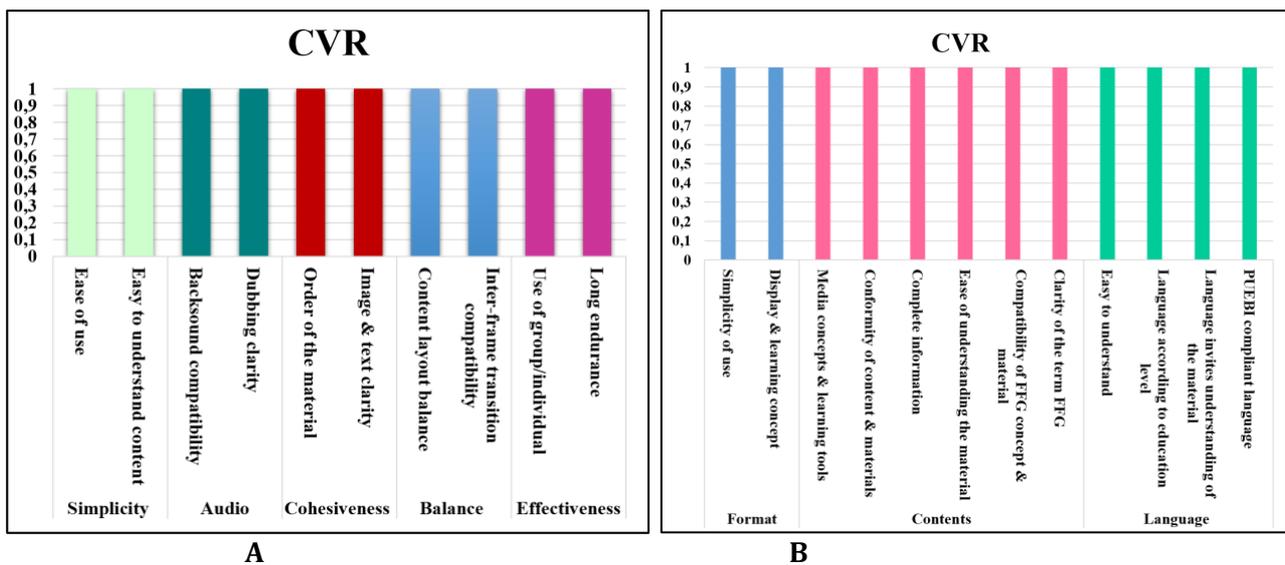


Figure 2. Graphs of CVR values for each criterion of 5 aspects of media validation (A) and 3 aspects of material validation (B) from the learning video developed in this study

Learning media in digital form should fulfill aspects of simplicity such as ease to used, content and display that is easy to understand and not excessive. Learning video media is a non-printed media that can have a lot of information that is displayed through Liquid Crystal Display (LCD) which is commonly used today. In its application, video media allows teachers to display videos with various format options such as being converted into CD (Compact Disk) or DVD (Digital Versatile Disk) (Rosyid et al., 2019). The instructional videos developed in this study are saved in MP4 format which can also be played during lessons along with other digital learning tools such as presentation slides in PowerPoint or e-Modules. These learning videos can also be uploaded to various social media platforms such as YouTube, Instagram, or Facebook so that students can access learning videos outside of classroom learning activities. To further facilitate understanding, the content and display of learning videos should also not be excessive to support the independent learning process outside the classroom. According to Niswa (2012), instructional video media that contains practical guidance and is presented through audiovisuals and is equipped with a narrator's voice makes it easier to understand and use because it is packaged in an auto-run program.

Just like a movie, the power of the background music can increase the audience's interest and reduce boredom rather than displaying only images and the narrator's voice. The narrator's voice must also be heard, have an interesting intonation, and have the right tempo so that it is not boring and makes it easier to understand the material. According to Guswiani, Darmawan, Hamdani, & Noordyana (2018), the back-sound instrument used in this video is considered not prominent, so it will not interfere students' concentration. In addition, the narrator's voice has the right tempo with clear pronunciation accompanied by word stress in the appropriate sentence.

The integration of instructional video media content also supports the successful use of media in learning. The order of displaying the contents of the learning video media is neatly arranged, systematic, and follows the learning activities as described by Praheto, Andayani, Rohmadi, & Wardani (2017). In addition, the size of the images and text in the learning video media is also appropriate, contrasts with the video background color, and is visible. The suitability of the components in the learning video media greatly helps the effectiveness of the learning process and the delivery of learning content messages. In addition to generating student motivation and interest, appropriate learning media can also help students improve understanding, and present interesting and reliable data (Tarigan & Siagian, 2015).

The balance of the layout of the text and images used in the learning video media is also considered good because it is clear and easy to read or understand. The suitability of the transition between frames used in this learning video media also produces a video that will look smooth when played. Balanced transfers and the right duration will accommodate students' understanding of the content of learning video media. Balance is influenced by various factors, including the position of an element, the combination of elements, the size of the elements, and the presence of elements in the breadth of the

field. The balance will occur when the elements are placed and arranged in a harmonious and commensurate sense (Wibawanto, 2017).

From several aspects that have been discussed above, the effectiveness of a learning media will determine its use of a media. When viewed from its flexibility, the developed learning video media is considered to have a flexible nature, which can be used by individuals, groups, or whole classes. This is in line with Arsyad (2013), that one of the factors that must be considered in the selection of media is target grouping, meaning that learning media can be used for large groups, medium groups, small groups, and individuals. In addition, the main value of the effectiveness of a learning media is the durability of long use or not limited by time. This shows that this learning video media can be used all the time because it is packaged in digital form and can be uploaded to various types of platforms, both physical and non-physical, such as computer hard disks, portable hard disks, flash drives, iCloud, Google Drive, One Drive, Dropbox and others (Manzilina, Listiawati, & Wijayanti, 2020).

In addition to the media aspect, learning videos are also assessed based on material aspects. The first criterion in material validation is the simplicity of using instructional video media in the classroom related to the delivery of material, such as presenting concrete learning objects or realistic learning messages, which can reduce boredom during learning and increase memory endurance or retention of the learning objects being studied (Sanaky, 2003). 2013). In terms of appearance, the suitability of the background color, images, and writing with the learning concept shows the results are quite appropriate. An eye-catching media display is deemed necessary to attract the attention of students so that they can listen to the content of the video that is displayed during the learning process in class (Guswiani et al., 2018).

Content is also an important aspect of learning video media. The first criterion that is seen in the content aspect is the suitability of the concept presented in the video with the basic competencies, indicators, and learning objectives that refer to the 2013 Curriculum syllabus. The basic competencies expected in the Sub Material of Interaction in Ecosystems are KD 3.10, namely being able to analyze information or data from various sources. About ecosystems and all the interactions that take place in them. The suitability of the description of the material with the basic competencies is the suitability of the description/exposure of the material contained in the textbook with the basic competencies in the curriculum (Hartono, 2016). The special component of this research is based on basic competence 3.10, namely analyzing, so in the analysis process carried out by students, a more compact media is needed that can present visual and audio simultaneously to facilitate the analysis process of the material presented. The learning objectives to be achieved are that students can explain the meaning, types, and components of the ecosystem and can explain the various interactions that occur in the ecosystem correctly through this learning video media. Good learning is when the learning objectives that have been prepared can be achieved. Practical and innovative learning media is one of the main factors in achieving the success of learning objectives. In addition, the use of media in learning can facilitate understanding and strengthen memory. Aside from that, it can foster interest and motivation to learn in students (Riyana, 2007).

Furthermore, the conceptual suitability of the text content and the ease of understanding it is also considered good. The use of learning media is intended to help achieve learning objectives so that they can explain the concept of learning materials in a systematic order and assist in presenting interesting material to improve the quality of learning (Baidlowi, Sunarmi, & Sulisetijono, 2019). The completeness of the information presented in the learning video media as one of the important components of the content of the instructional video media can also be measured by looking at the ease of understanding the description of the material presented in the instructional video media. One of the requirements for selecting learning media must be followed by the level of students' thinking so that the meaning contained can be understood by students (Sadiman, Rahardjo, Haryono, 2014). Although the material on the functional feeding group of macrobenthos in the Sub Material of Interaction in Ecosystem includes new terminology for students, the delivery of material in simple language and terms allows students to understand the description of the material presented in the instructional video media. For example, simplification of some terms in the functional feeding group of macrobenthos, such as shredders, scrapers, collectors, and filtering collectors. Several literacy studies were also carried out to obtain the concept of a functional feeding group of macrobenthos under the Sub Material of Interaction in the Ecosystem. The concept of a functional feeding group of macrobenthos and interactions in the ecosystem can be accepted after some improvements and additions of materials have been made. The



material clarity of each component of the functional feeding group has also been presented briefly and concisely.

The material in Biology lessons cannot be separated from scientific terms, so it must be translated into Indonesian so that it is easier for students to remember the characteristics and classifications of the species being studied. Therefore, the language used is easier for students to understand especially the language used in learning video media must be easy to understand, not too standard (semiformal), and communicative to students. The clarity of the material from the media is also supported by the language used. A learning media used in education must use proper and correct language so that the meaning conveyed by the media itself is more easily understood by students. The language used in the learning video media must be easy to understand, not too standard (semiformal), and communicative. In addition, the language used is following the educational level of students, namely for high school students and the equivalent. Another criterion is that the language used contains persuasive elements, informative, interesting, and memorable so that it asks students to understand the material presented. Some of the language criteria mentioned above are also inseparable from the guidelines for using appropriate language, namely the language used by the General Guidelines for Indonesian Spelling (in Indonesia, Pedoman Umum Bahasa Indonesia or PUEBI) such as using capital letters at the beginning of sentences, using italics to indicate foreign words or scientific names and the use of the standard word which is following the Indonesian Language Dictionary (in Indonesian, Kamus Besar Bahasa Indonesia or KBBI).

Good media and material assessment can also be seen in the results of the reliability test using the ICC (Interclass Correlation Coefficient) of 0.758 (Table 5). This value indicates that the validation instrument has a good level of consistency in each of its assessment criteria and is included in the excellent category according to Zaki (2017). This also indicates that a good assessment by each validator has a high level of confidence and supports the feasibility of the media to be continued at the next development stage, namely limited trials and wider trials.

Tabel 5.

ICC reliability test results learning video media validation sheet

	Intraclass Correlation Coefficient					
	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single Measures	.385 ^a	.117	.731	4.136	9	36
Average Measures	.758 ^c	.397	.931	4.136	9	36

Overall, the development of video as a learning medium can be declared successful and has a high chance to be continued at the next stage of development. Judging from the media aspect, the use of the PowerPoint application which is already quite familiar among teachers can support the development of alternative media that are fresher in content. In this case, the teacher can conduct a broader literature study during the packaging of materials for teaching materials. Thus, students will always obtain up-to-date information and are not limited to only those listed in the textbooks.

CONCLUSION

The development of a video as a learning media in the Sub Material of Ecosystem Interaction added by information on the functional groups of macrobenthos in the Berembang River was completed and can be declared suitable for use in terms of media content and material. The learning video displays material that is different from the material in textbooks that are generally delivered by the teacher and deserve to be continued at this stage. The development of learning media needs to be accompanied by the search of more appropriate scientific concepts while increasing students' knowledge.

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REFERENCES

- Akker, J. van den. (1999). Principles and methods of development research. In *Design approaches and tools in education and training* (p. 14). Dordrecht: Kluwer Academic Publishers.
- Andriani, T. (2015). Sistem Pembelajaran Berbasis Teknologi Informasi dan Komunikasi. *Sosial Budaya: Media Komunikasi Ilmu-Ilmu Sosial dan Budaya*, 12 (127–150). <https://ejournal.uin-suska.ac.id/index.php/SosialBudaya/article/view/1930>
- Ardi. (2002). *Pemanfaatan Makrobentos Sebagai Indikator Kualitas Perairan Pesisir*. Bogor: Institut Pertanian Bogor.
- Arikunto, S. (2010). *Prosedur Penelitian Suatu Praktik*. Jakarta: Rineka Cipta.
- Arsyad, A. (2013). *Media Pembelajaran*. Jakarta: PT. Raja Grafindo Persada.
- Asyhar, R. (2012). *Kreatif Mengembangkan Media Pembelajaran*. Jakarta: Gaung Persada (GP) Press.
- Baidlowi, M. H., Sunarmi, & Sulisetijono. (2019). Biosfer : Jurnal Pendidikan Biologi. *Biosfer: Jurnal Pendidikan Biologi*, 10(2), 57–65.
- Guswiani, W., Darmawan, D., Hamdani, N. A., & Noordiyana, M. A. (2018). Efektivitas Penggunaan Video Pembelajaran Dalam Pembelajaran Front Office Di Kelas XI Akomodasi. *JTEP-Jurnal Teknologi Pendidikan Dan Pembelajaran*, 3(September), 688–698. <https://journal.institutpendidikan.ac.id/index.php/tekp/article/view/416>
- Hamid, M. A. Ramadhani, R., Juliana, M., Safitri, M., Munsarif, M., Jamaludin, Simarmata, J. (2020). *Media Pembelajaran*. Medan: Yayasan Kita Menulis.
- Hartono, B. (2016). *Dasar-dasar Kajian Buku Teks: Konsep Dasar, Pemilihan, Pemanfaatan, Penilaian, dan Pengembangan Materi Ajarnya*. Semarang: UNNES PRESS.
- Lawshe, C. H. (1975). A Quantitative Approach to Content Validity. *Journal of Personnel Psychology*, 563–575. <https://doi.org/10.1111/j.1744-6570.1975.tb01393.x>
- Lorensa, S. M. (2021). *Functional Feeding Group dari Makrobentos di Sungai Berembang dan Implementasinya pada Submateri Interaksi dalam Ekosistem Kelas X SMA Melalui Video Pembelajaran*. (Skripsi tidak dipublikasikan). Universitas Tanjungpura, Indonesia.
- Manzilina, F., Listiawati, E., & Wijayanti, R. (2020). Pengembangan Media Videoscribe Pada Materi Sistem Persamaan Linier Dua Variabel (Spldv). *JIPMat*, 5(2), 185–199. <https://doi.org/10.26877/jipmat.v5i2.6624>
- Musfiqon, H. M. (2012). *Pengembangan Media dan Sumber Pembelajaran*. Jakarta: Prestasi Jakarta Publisher.
- Niswa, A. (2012). Pengembangan Bahan Ajar Mendengarkan Berbasis Video Interaktif Bermedia Flash Kelas VII D SMP Negeri 1 Kedamean. *Jurnal Bahasa Dan Sastra Indonesia*, 01(01). <https://ejournal.unesa.ac.id/index.php/bapala/article/view/2019>
- Odum. (1994). *Dasar-dasar Ekologi* (Ketiga). Yogyakarta: Universitas Gajah Mada Press.
- Pearson K. (1901). On lines and planes of closest fit to systems of points in space. *Philosophical Magazine*, 2, 559–572. <https://doi.org/10.1080/14786440109462720>
- Praheto, B. E., Andayani, Rohmadi, M., & Wardani, N. E. (2017). Peran Multimedia Interaktif Dalam Pembelajaran Keterampilan Berbahasa Indonesia Di PGSD. *The 1st Education and Language*



International Conference Proceedings Center for International Language Development of Unissula (ELIC 2017), 173–177. Retrieved from <http://jurnal.unissula.ac.id/index.php/ELIC/article/view/1224>

- Riyana, C. (2007). *Pedoman Pengembangan Media Video*. Jakarta: P3AI, UPI.
- Rosyid, M. Z., Sa'diyah, H., & Septiana, N. (2019). *Ragam Media Pembelajaran* (I; M. P. Taufikurrahman, ed.). Malang: CV. Literasi Nusantara Abadi.
- Sadiman, A., Rahardjo, R., Haryono, A., & H. (2014). *Media Pendidikan*. Jakarta: PT Rajagrafindo Persada.
- Sanaky, A. H. (2013). *Media Pembelajaran Interaktif-Inovatif*. Yogyakarta: Kaukaban Dipantara.
- Tarigan, D., & Siagian, S. (2015). Pengembangan Media Pembelajaran Interaktif Pada Pembelajaran Ekonomi. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, 2(2), 187–200. <https://doi.org/10.24114/jtikp.v2i2.3295>
- Wibawanto, W. (2017). *Desain dan Pemrograman Multimedia Pembelajaran Interaktif* (1st ed.; D. Febiharsa, ed.). Jember: Penerbit Cerdas Ulet Kreatif. Retrieved from http://lib.unsub.ac.id/index.php?p=show_detail&id=4740
- Zaki, R. (2017). Validation of Instrument Measuring Continuous Variable in Medicine. In *Advances in Statistical Methodologies and Their Application to Real Problems*. <https://doi.org/10.5772/66151>