



Development of Digital Biology Teaching Materials to Revitalize Post Covid-19 Biology Learning

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ABSTRACT

This research carried out the first few stages namely Define, the second stage was Design, the next stage was Develop and the last was Dissemination. From each of these steps, there are several steps that need to be carried out. In the Define step, there are 5 stages that need to be taken. 1) front-end analysis, 2) learner analysis, 3) task analysis, 4) concept analysis, and 5) specifying instructional objectives. These five steps aim to map the needs of students and also the needs of the learning process. The hope is that the product to be developed can truly answer the needs of learning and students appropriately. In the second stage, is Design. There are 4 activities that need to be carried out during the Design stage, namely 1) constructing criterion-referenced tests, 2) media selection, 3) format selection, and 4) initial design. This Design stage is the result of the embodiment of the analysis carried out in the Define stage. Of course, the hope at this design stage is that the resulting product design is a product that is suitable and in accordance with the conditions of the perpetrators of the learning process, especially students as learners. In the Develop stage, the initial product produced from the Design stage is reviewed by experts and professionals, and tested on product users. Input from experts and professionals as well as input from product users, becomes a reference for consideration in revising the product being developed. The goal is that users can actually do learning according to their knowledge. If the product has passed the test at the develop stage and revisions have been carried out, then the next stage is the dissemination of the use of the resulting product. what really needs to be considered at this final stage is the choice of platform or container that will be used as a medium for disseminating the teaching materials that have been prepared.

Keywords: Covid Pandemic, Learning Biology, Digital Learning, Teaching materials, Learning strategies

Introduction

The Covid-19 pandemic which has been going on for the last two years has had a major impact on the world of education, including the biology learning process in schools. Restrictions on interaction between humans cause the biology learning process to be forced/forced to be carried out in virtual classes through online learning, or under the auspices of the internet network (online). This virtual class inevitably causes a reduction in interaction, both social interaction between individual teacher-students and students, and most importantly between students (subjects) and the biology objects and problems they are studying and then replaced with the commodification of teaching materials that are presented online. digitally through an internet network-assisted learning technology platform. This virtual class commodification is not without problems. A study conducted by Wisanti, et.al (2021), for example, shows that the majority of biology teachers face obstacles in managing online learning which are influenced by three main factors, namely: technology, teacher competency, and student attitudes. For the teacher factor, there are indications that teachers experience difficulties in preparing, managing and implementing learning tools, especially teaching materials, by giving more assignments. Furthermore, the difficulty of facilitating student learning processes that reflect the characteristics of science learning through hands-on and minds-on activities is also recognized by teachers globally (eg Aldarayseh, 2020). Even though the pandemic conditions have shown an improving trend and made it possible to implement the policy of returning to face-to-face learning processes in

schools (although on a limited basis), however, the biology learning process after the Covid-19 pandemic still requires adaptation, bearing in mind that there is still uncertainty about public health which has implications for practice. biology learning that still applies e-learning. The need for e-learning adaptation is emphasized by the NSTA (2020), with one of its recommendations: strengthen science teaching and learning through digitally accessible content that has the potential to provide active or constructive learning experiences that enable the learner to gather, analyze, and display data and fully engage in simulated real-world problem contexts. This recommendation explicitly describes the need to develop and provide teaching materials that are representative and easy to access and use by both teachers and students in digital learning situations or environments that enable students to develop skills relevant to the characteristics of science (biology).

As part of the LPTK which has the task of preparing and supporting quality biology teacher education programs, the Biology Education Study Program at the Faculty of Mathematics and Natural Sciences, UNY has been trying to develop academic programs, one of which is in the aspect of biology teaching materials through lecturer research and student final assignments. Apart from teaching materials, currently one of the potential facilities owned by the Biology Education Study Program is an audio-visual laboratory that can be empowered to develop digital teaching materials products to become alternative solutions to the adaptation needs above. However, efforts to develop digital teaching materials certainly cannot be done haphazardly, but need to be pursued through academic activities, especially research. The support of cooperative relations, especially with biology subject teacher deliberation groups or associations (MGMP), is a potential asset for study program research teams to design and conduct research on the development of digital teaching materials that are oriented towards efforts to revitalize post-pandemic biology learning. The purpose of this research is based on research issues including: 1) what aspects of development need to be considered, 2) what are the specific designs of teaching materials, and 3) how are the potential feasibility of applying these teaching materials.

Research Methodology

The research carried out is research and development research. The research design used is a 4D research design (define, design, development, disseminate). The first stage of development is conducting a needs analysis which consists of 5 activities, namely 1) front-end analysis, 2) learner analysis, 3) task analysis, 4) concept analysis, and 5) specifying instructional objectives. At this stage the researcher analyzes the needs for the development of Biology teaching materials needed by teachers in schools. To obtain needs analysis data, it was carried out by conducting FGDs with MGMP biology teachers. This needs analysis stage can be supplemented by carrying out literature and research studies that are relevant to this research. In the second stage, namely design, there are 4 activities, namely 1) constructing criterion-referenced tests, 2) media selection, 3) format selection, and 4) initial design. This stage contains the preparation of teaching materials that will be developed according to the needs of the teacher. This stage also contains the selection of media according to the characteristics of students and the characteristics of the material. At this stage the preparation of the initial design of the product to be compiled or the preparation of prototypes of teaching materials to be compiled is carried out. In short, the define and design stages will be carried out in the first year. The activities in the first year can be described as follows: 1) preparing a research plan, 2) preparing a cooperation agreement with partners, namely the MGMP biology teacher, 3) preparing a needs analysis instrument, 4) determining samples and research locations, 5) preparing data collectors, 6) collect needs analysis data, 7) analyze data, 8) compile and develop applications, 9) compile and send articles, 10) compile and collect reports. After the design stage is complete, the research stage is followed by the development stage. At this stage, products that are still prototypes are developed into final products. Before becoming the final product, the product prototype will be reviewed for suitability by experts. This conformity test stage is called expert appraisal. At this stage, the product will be validated by experts; media and material experts to find out the suitability of the product being developed. After being tested by experts, the product is then tested on users. This stage is called developmental testing. The results of expert validation and trials form the basis for product improvement to become a ready-to-use product. The last stage of this research is disseminate or dissemination of research results. There are three activities in the last stage of this research, namely 1) validation testing, 2) packing, and 3) adoption.

Results and Discussion

The results of digital media development research according to the research stages are as follows:

1. Define stage

At this stage, it is carried out to determine the problems that exist in learning Biology in high school, especially in evolution material in class XII. These problems include conditions in the field as well as conformity with the curriculum and reference books for learning resources (package books) so that the need for learning media that is appropriate to the problems can be provided appropriately. At this stage the researcher will interview the teacher providing evolutionary material in class XII about how the learning process in class is carried out, using

any methods, models and approaches, what concepts are given in evolution material as well as asking for the learning tools used by the teacher in carrying out evolutionary learning in class. After determining the problems of evolutionary learning, it is continued to analyze the characteristics of students in Biology learning, especially in evolutionary material in class XII which includes the background of students' understanding of evolution material and students' cognitive abilities. At this stage the researcher will interview students regarding evolution material in class XII so far with the teacher providing the material regarding how learning is carried out through the student's point of view, what things are expected of students to be taught in evolutionary material, as well as students' understanding of the evolutionary material. Alone.

Researchers analyze the suitability of the assignments and exam questions given to students whether they are in accordance with what is stated in the Basic Competency (KD) of the curriculum used. In this study, the researcher conducted interviews and at the same time asked the teacher for documents related to assignments and also exam questions given to students in class XII high school evolution material to then be analyzed by researchers. The results of the task analysis will be used to adjust the learning videos that will be made later according to the assignments given by the teacher. After that, it was carried out to identify the concept of evolution material for class XII SMA which would be taught from the results of the analysis at the *front-end analysis stage*, then it was detailed and linked to other concepts and then arranged systematically. The concepts given will be related to biological phenomena that can be captured and revealed in the learning videos that will be compiled later. Observation results can be seen in table 1

Table 1. Results of interviews with teachers

Part		Question	Answer
Define	Front End Analysis	1. How many classes do you teach and in which classes?	1. There are 4 classes that I teach, namely class XI MIPA 1 to class XI MIPA 4.
		2. What curriculum is used currently? How is the application of the curriculum during the learning process in class?	2. The curriculum currently used in class XI is the 2013 curriculum. Implementation of the curriculum follows the core competencies and basic competencies according to the 2013 curriculum.
		3. What topics are taught in the material on the digestive system?	3. The first topics are foodstuffs and nutrients, then digestive organs, disorders and technologies related to digestion.
		4. How long will it take to teach the material?	4. 6 meetings. Each meeting is 2x45 minutes. The last meeting is used for evaluation.
		5. What learning models and methods (teacher centered or student centered) have been used to teach digestive system material?	5. The models and methods that I use vary so that I and the students themselves don't get bored. As for digestion material, the method I most often use is observation. I will divide students into small groups to discuss digestive system problems. In addition, I also use the project method with practicum. For example, I provide sweet potatoes, then students will analyze the protein, carbohydrate and fat content in the laboratory. I also sometimes hold quizzes for students across chapters. In the implementation of learning I use more student centered because the students are also more active with this method.

6. What learning models and methods are most effective for use in the digestive system material?	6. The most effective model may be more towards PJBL. Students prefer to be given activities, especially observing themselves with the material provided. The teacher only emphasizes the basic concepts of biology as well as accompanies. This is also intended to support students' research abilities because all class XI in this school are required to make a research which will then be included in a research competition.
7. What media are generally used in the digestive system material?	7. Miscellaneous. The media that I usually use for digestive system material is to bring students closer to the food ingredients. In addition, the digestive organs are planned to use the cow's stomach as the object of observation. I also use PPT media but only to display pictures for discussion.
8. How did the students respond to the model/method/media used? Is it good or bad? active or passive?	8. The response was positive. Very rarely there are students who respond negatively. Students prefer to carry out projects rather than just sit and listen. So that students are usually more active when there is a discussion.
9. How are the learning outcomes obtained? Are students able to understand all the concepts being taught?	9. For concepts, the majority of students understand the material I teach.
10. How are the learning outcomes obtained? Do most of the students pass the KKM?	10. At the first meeting I always make learning contracts with students. My contract is that I see the value in the process, not just in the test scores they get. I judge students also from how they interact in class and practicum, this practicum has the greatest value. I also saw from how they discussed when I gave students a problem which was then analyzed and compared with existing journals and then presented. So far the results of biology learning have been quite good, only when yesterday was online learning I couldn't give a high score because I couldn't observe students directly so I didn't know students' actual understanding of biology learning. However, all students passed the KKM.

	11. If students have fulfilled the KKM, what program will be given to students? Meanwhile, for those who do not meet the KKM, what form will the remedial program take?	11. For those who have not passed the KKM there will be a remedial program, but I will adjust the form according to the wishes of the students. So I will summon these students and invite them to discuss what kind of remedial plan they want and what problems they are facing and what material they have not understood. So not only do the questions come back, but students are also required to re-understand the material they have not understood. For students who have fulfilled the KKM, I rarely give special programs and are more focused on participating in research competitions that are required for all class XI
	12. How and what kind of learning process method was carried out during the pandemic (online) yesterday?	12. In yesterday's online learning I used Google Classroom a lot as a place to give assignments to students and zoom meetings for teaching and learning activities.
	13. Is there an analysis of student test results? If so, may I ask for the results of the analysis?	13. There are results of the analysis but I rarely use them because the exams at this school already use a computer and a separate system.
	14. Can I ask for the learning tools used in the material for me to analyze further, if any?	14. Can I prepare it later? For the previous year, I will look for it later.
Task Analysis	1. What assignments are given while teaching the material on the digestive system ?	1. The assignments that I give in the material on the digestive system are usually in the form of projects, especially practicums. As I explained, I provide food ingredients, then students will analyze the contents in them. For example, cassava contains carbohydrates. What are carbohydrates like, sir? You're confused. That's why we checked in the lab using Lugol, Lugol's function, what color is it. In addition, I also gave discussion assignments about biology problems, then students looked for supporting journals to solve biology problems and presented them.
	2. Is there an analysis of student work results? If so, may I ask for the results of the analysis?	2. There is but I rarely use it.
	3. Is it permissible for us to ask for repeat questions and or assignments given on the material for us to analyze further if any?	3. Yes, I will prepare it later.
Specifying Instructional Objectives	1. Is there a teacher's hope after students learn the material that it can be applied in everyday life? It	1. For me it is more towards application in the daily lives of students. When discussing food, they should at least

	can be in the cognitive, affective, and psychomotor domains	know the concept of healthy food. The concept of 4 healthy 5 perfect has been abandoned a long time ago. I also don't expect students to just eat a lot without paying attention to the nutritional content. Second, I also hope that students understand more about the early symptoms of digestive disorders. Next, I hope students can understand more about the impact of food on their health and growth and development.
Design	1. Is there any input or additions regarding what concepts need to be discussed in the video media that I'm making?	1. For those related to stunting, maybe food and nutrients, then about the concept of healthy food.
	2. Any suggestions on key visuals to show in our videos?	2. Maybe it can be shown about the symptoms of stunting that can be observed by children. Real evidence that occurs in children who experience stunting.

Based on the results of obesityvation with students, the following answers can be found. Data can be seen in Table 2

Table 2. Student Needs Analysis Data

Part		Question	Answer
Define	Learner Analysis	15. Do you like biology lessons?	15. There are 4 classes that I teach, namely class XI MIPA 1 to class XI MIPA 4.
		16. Do you think biology is fun ?	16. The curriculum currently used in class XI is the 2013 curriculum. Implementation of the curriculum follows the core competencies and basic competencies according to the 2013 curriculum.
		17. Have you got material about the digestive system?	17. The first topics are foodstuffs and nutrients, then digestive organs, disorders and technologies related to digestion.
		18. What are the learning methods and models commonly used by teachers to teach biology?	18. 6 meetings. Each meeting is 2x45 minutes. The last meeting is used for evaluation.
		19. media is usually used by the teacher?	19. The models and methods that I use vary so that I and the students themselves don't get bored. As for digestion material, the method I most often use is observation. I will divide students into small groups to discuss digestive system problems. In addition, I also use the project method with practicum. For example, I provide sweet potatoes, then students will analyze the protein, carbohydrate and fat content in the laboratory. I also sometimes hold quizzes for students across chapters. In the

	implementation of learning I use more student centered because the students are also more active with this method.
20. In your opinion, the method/model/media is effective? What is the reason?	20. The most effective model may be more towards PJBL. Students prefer to be given activities, especially observing themselves with the material provided. The teacher only emphasizes the basic concepts of biology as well as accompanies.
21. What information or knowledge do you want to know about the material of the digestive system?	21. Miscellaneous. The media that I usually use for digestive system material is to bring students closer to the food ingredients. In addition, the digestive organs are planned to use the cow's stomach as the object of observation. I also use PPT media but only to display pictures for discussion.
22. What form of learning do you want in the material on the digestive system ?	22. The response was positive. Very rarely there are students who respond negatively. Students prefer to carry out projects rather than just sit and listen. So that students are usually more active when there is a discussion.
23. After studying this digestive system material, what results or understanding do you expect?	23. For concepts, the majority of students understand the material I teach.
24. What do you think if learning this material is done with audio-visual media (video)? Or are there suggestions for other forms of learning media that you think are more interesting?	24. At the first meeting I always make learning contracts with students. My contract is that I see the value in the process, not just in the test scores they get. I judge students also from how they interact in class and practicum, this practicum has the greatest value. I also saw from how they discussed when I gave students a problem which was then analyzed and compared with existing journals and then presented. So far the results of biology learning have been quite good, only when yesterday was online learning I couldn't give a high score because I couldn't observe students directly so I didn't know students' actual understanding of biology learning. However, all students passed the KKM.

2. Design Stage

At this *design* or design stage, the researcher designs a script that contains biological phenomena that can strengthen the conceptuality of biological material, namely evolution in class XII high school which will be included in the video, then arranges and organizes the material into a draft which will later be included in the learning video. . The script is discussed with supervisors and related parties as an illustration of the learning video that will be compiled. The researcher then arranges the video according to the script that has been discussed and

well prepared. Researchers can also prepare content designs in the form of images or videos (self-recording or footage) so that at this stage researchers can produce initial products in the form of video designs for class XII high school evolutionary biology learning.

3. Development Stage

The development or development stage is carried out in two stages, namely expert appraisal and developmental testing:

a. Expert appraisal

This stage was carried out to solicit responses to learning videos that had been made by researchers by experts, in this case the Biology Education Lecturer at the Faculty of Mathematics and Natural Sciences, UNY and education practitioners in schools, namely high school teachers who taught class XII evolutionary biology material. Validation aims to correct conceptual errors in the initial design of learning videos that have been made with data in the form of assessments and comments and suggestions which will later be known as Revision I.

b. Developmental testing

This stage was carried out to try out the initial product design that had been improved (Results of Revision I) by experts and practitioners to the real subject, namely students in limited field trials. Then after being revised, the media will be tested in a large field test to find out if there are differences in the increase in students' scientific literacy in the control class and the experimental class.

A limited field test was conducted to test audio-visual (video) media products as a means of obtaining data regarding the level of difficulty of students in understanding the content of the evolution material for Class XII SMA contained in the video so that it can be used as a reference for future product improvements. At the limited field test stage as many as 30 students in 1 class will be used.

An open field test was conducted to test audio-visual media products (video) which had been revised in a limited field test as a means to find out the differences in the increase in students' scientific literacy in the evolution material for class XII SMA in the control class and the experimental class. In the limited field test phase, as many as 30 students in 1 class will be used as the control class, and as many as 30 students in 1 other class will be used as the experimental class.

Conclusion

The development of digital teaching materials in biology learning is really needed by paying attention to the material content. Based on the results of field observations, teachers can develop digital media for learning biology.

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