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Light-Board: Simple Media to Learn Photosynthesis Concepts

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ABSTRACT
This research is a research and development that aims to develop learning media for LED-based photosynthesis material. This media is designed with a 4D model consisting of four stages, namely define, design, develop, and disseminate. However, this research was only carried out until the development stage due to time constraints. The instrument in this study is the validation sheet consisting of media validation and material validation. The results obtained after validation by media experts with a total of 3 and material experts with a total of 3.1 included in the criteria are quite suitable used as learning media in the classroom. It can be concluded that after the development of LED based learning media are appropriate use for learning in the classroom.

Key words: Learning media, photosynthesis, LED

1. INTRODUCTION

Learning is a natural, spontaneous, and lifelong process of human nature. Education, on the other hand, is a formal, structured, organized process with specific goals. The ability of informal continuing education and training is important for professionals today. Knowledge is now out of date, so a professional must continue to update his experience and knowledge profile if they want to be competitive [1].

In recent years it has been recognized that digital media can be felt by people around the world, from the social and cultural environment. The environment within the school was created to be comfortable for students to guide knowledge. Therefore, the learning environment based in the school environment, aimed at improving student learning performance, has evolved over time [2]. Scientific reasoning skills can be acquired through assignments in schools with the enhanced investigation by technology media or modeling of instructional media as examples showing how to conduct virtual experiments in classroom [3].

Entering the era of globalization accompanied by the development of science and technology has a big influence on the world of education. Today's education is inseparable from technological advances, so teachers must adapt, especially in developing learning media [4].

Solar energy has great potential as a clean, inexpensive, renewable, and sustainable source of energy, but it must be captured and converted into useful forms of energy such as plants. Very interesting, and the approach is to store solar energy in the form of chemical bonds, as is done in natural photosynthesis [5]. Photosynthesis material involves plant physiological processes that are abstraction and invisible so that visualization is needed [6]. Photosynthesis is the process of forming organic compounds in the form of glucose and oxygen from inorganic compounds in the form of carbon dioxide and water with the help of sunlight by autotrophic organisms [7]. To make it easier to understand the photosynthesis process, innovative technology-based learning media are needed. Photosynthesis depends on the density and quality of light reaching the chloroplast. Shade conditions are characterized by changes in light density and quality [8].

The technology developed is LED lights (Light Emitting Diode). LED is one of the electronic components made of diode semiconductor type material that can emit light [9]. Some of the benefits of LED-based learning media based on Wahyudin & Hadromi's research that LED media can improve student learning outcomes, besides making it easier for students to understand the material and be more motivated in learning [10]. To teach children natural sciences and ecology, it is designed according to pedagogical theories and curricular goals to help children learn about photosynthesis by utilizing the surrounding environment [11]. Therefore we need the development of LED-based learning media on photosynthesis material.

This media also does not complicate the teacher in making it. Because the material used is easy to find around and is an environmentally friendly material, this media is made from used materials, so it is suitable for use in biology subjects to teach students how to use waste. The application of learning biology can use environmental problems. Therefore our research uses used charcoal for media production [17]. Also, teachers who have limitations in the use of technology can use this media to attract the attention of students in understanding the lesson. The actual points of this media vary. This is not ordinary learning, because it aims at a goal, and its purpose is related to shared interests in

school. An educator and students participate in the use of instructional media. Positively related to his interests, both for professional reasons and knowledge [1]. Students in the class interact with each other. They can recognize, interact, socialize, participate in in-class activities, both individuals and groups. In making learning media (content) so that it becomes a place where our imagination is given the freedom to create and arrange materials around the class [13]. This LED-based technology can be used to help the development of student learning.

Based on the description, the problem was formulated: what is the feasibility level of LED-based learning media on photosynthesis concepts?

2. RESEARCH METHOD

This research is a research and development / R&D research that aims to develop LED learning media for photosynthesis material. The instrument developed was a validation sheet consisting of media validation and material validation. The validation of instructional media is used to obtain information about the quality of instructional media based on expert validator evaluations. In contrast, the validation of the material is used to obtain information about the accuracy of the learning material.

The development of instructional media uses the 4D model developed by Thiagarajan, Dorothy S. Semmel, and Melvyn I [14]. The 4D model consists of four stages: the defining stage, the design stage, the development stage, and the deployment stage [15]. The first stage in the 4D model is the stage of defining/defining, namely analyzing the concept to determine the objectives to be developed in media development and determine the material boundaries. The second stage is the design stage, which is designing learning media, which is determined from the results of the defining stage as well as the learning media that have become validated by experts in their fields and then revised. The third stage is the development stage, which is the testing phase to students when learning photosynthesis, which has previously been validated and revised. The last stage is the dissemination stage, which is the stage of using media that has been developed by other educators and in other classes to test the effectiveness of the media when learning in class (Basri et al., 2017). The criteria for determining the instrument's validity level can be seen at Table 1.

Table 1: Validity Level Criteria

Validation Value	Kriteria
1,00 - 1,99	Invalid
2,00 – 2,99	Invalid
3,00 – 3,49	Valid
3,50 – 4,00	Very valid

The formula used in the validity analysis is as follows:

$$V = \frac{\sum s}{n(c-1)}$$

Information:
c: number of categories
r: indicator rating score
n: number of indicators
s: the lowest score for each item

Besides, in order that the assessment data are strong, media feasibility criteria are developed. In this study, the feasibility of the media on a scale of 1 to 4 with category 1 is the lowest score, and 4 is the highest score — determination of the range through the highest value minus the lowest value divided by the highest value. The average eligibility analysis criteria used can be seen in Table 2. The eligibility category is based on the following Arikunto criteria.

Testing the feasibility of the media required experts in the assessment of this media. The experts used in this study are teachers who meet the criteria, as listed in Table 3.

Table 2: Eligibility Criteria for Mean Value Analysis

No	Mean	Eligibility category
1	3.26-4.00	Very decent
2	2,51–3,25	Decent enough
3	1,76–2,50	Inadequate
4	1,00–1,75	Not feasible

Table 3: Subjects of media validators

No	Validator	Criteria
1	Theory	1. Having the ability in the field of material used
		2. Minimum of 5 years of teaching experience
		3. The minimum level of education that has been completed is Master of education
		4. Do not have a kinship with the researcher
2	Media	1. Having the ability in the field of learning media
		2. Having experience in learning
		3. The minimum level of education that has been completed is Master of education
		4. Do not have a kinship with the researcher

3. RESULTS

The design of making media

Media used in the form of a drawing board equipped with LED lights. The function of this LED light is to provide a differentiator between the results of photosynthesis and the photosynthesis process needed. The goal is to make students easy to memorize. LED lights indicate an important part involved in the photosynthesis process from the beginning to the end of the process. Also, on the board, some exciting

pictures and labels can help explain the photosynthetic process. Researchers choose LED lights because they are environmentally friendly. This LED light has low power consumption. In learning Biology, aspects of loving and environmentally friendly need to be considered in order to teach students that the attitude of environmental love can be done anytime and anywhere.

Collection of media design objects

The media is mostly made from used goods. Board, cardboard, and frame are used items that are not used anymore. The use of used goods is to teach students that goods that are not used still have the same use-value even higher than the value of the previous item. Also suitable for use in biology subjects. Then start to make photosynthesis patterns, make running LEDs, and finally, the installation of LED lights.

Media design

This stage is the installation of LED lights into the images that have been provided to clarify the process of photosynthesis and the important aspects involved in photosynthesis. In photosynthesis, six carbon dioxide (CO2) and six water molecules (H2O) will react with sunlight to produce one glucose molecule and six oxygen molecules. From the result, photosynthesis of CO2 is converted into solid glucose for plant needs along with water. While oxygen is released into the air for the needs of human and animal respiration.

Media making

The LED circuit is mounted on the drawing board, then connected to the running LED so that the lamp rotation is as needed. Next, attach the switch and the circuit in the box so that its use is safe and effective. Making media is as attractive as possible so that it can get the attention of students and can motivate students to make other environmentally friendly media and can increase motivation in learning.

Expert Validation

This media must be tested before going through the validation stage first, which is carried out by three media validators and one material validator. The results of the material validation obtained data that shows that this media is included in the criteria quite feasible with the acquisition number 3. The table of the calculation of the feasibility of the material can be seen in Table 4. After the assessment by the material expert, there were a number of inputs for this media, including there was no direct message from the media without explanation from the teacher, and the images were not conceptually appropriate with the material. From this input, a revision was made for improvement so that the media could be tested on students.

Furthermore, the results of the validation to the media experts as many as three people showed that this media included in the criteria was quite feasible to use. Rating scores can be seen in Table 5. There is also input from the results of this media assessment, namely: the size of the media is less to be taught to large groups, LED lights that are not yet by their functions, images that are not appropriate in visualizing the material, and this media is suitable for use in schools with minimal technological facilities so that the school targets for trials must be considered.

Table 4: Assessment of material feasibility by experts

No	Rated aspect	Point	Explanation
1	Compliance with competency standards	4	Worthy
2	Accuracy in explanation of conceptual material	2	Inadequate
3	Clarity of information in the illustrations shown	3	Decent enough
4	Presentation of material includes the scope of content	4	Worthy
5	Learning messages can be conveyed in a complete, concise, and practical manner	2	Inadequate
Mean		3	Decent enough

Table 5: Expert appraisal of media

No	Rated Aspect	Validator			Mean	Explanation
		1	2	3		
1	Selection of material for pictures	3	3	3	3,00	Decent enough
2	Paper used	4	3	4	3,67	worthy
3	Clarity of image printing	4	2	3	3,00	Decent enough
4	Media size	3	4	3	3,33	worthy
5	Writing words on the media	3	3	3	3,00	Decent enough
6	Picture color	3	3	3	3,00	Decent enough
7	Font size	2	3	3	2,67	Inadequate
8	Font type	3	3	3	3,00	Decent enough
9	The suitability of the material with the object image	3	4	3	3,33	worthy
10	Material interest in motivating users	2	2	2	2,00	Decent enough
Mean		3	3	3	3,00	Decent enough

The media is divided into four groups: printed, visual, interactive, audiovisual. Examples of printed material include models, pictures, wall charts, leaflets, brochures, modules, books, handouts, and student's worksheets [18]. For some students or teachers, this media may not be

interesting to see the growth and development of technology and social media. but once again researchers only create alternative media for those who cannot access the internet [19, 20]. The use of learning media does not have to be fixed using digital media such as laptops or smartphones. Media that are 3-dimensional are still quite feasible to use, especially for remote schools with limited facilities. Even schools with complete facilities do not rule out the possibility of utilizing this type of media because every learning requires varied media to avoid burnout.

On the one hand, the need for non-gadget type media is given that teachers with limited gadget capabilities but very good scientific aspects are expected to help in the teaching process. This media can also be modified into one of the games, such as guessing pictures, because the method of learning while playing is considered to reduce the boredom of students in the class [16].

CONCLUSION

Development of learning media. Based on the results of the development of learning media for LED photosynthetic material that has been validated by the media experts and the material experts that the media was quite suitable for learning media in photosynthesis material.

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