Effectiveness of Problem Based Learning Model Assisted with Circulation System Display Media to Improve Cognitive Ability and Expressing Opinion Activities of High School Students

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Article Info	Abstract
	The purpose of this study was to analyze the effectiveness of the problem-based learning model assisted by the circulation system visual aid to improve cognitive abilities and the activity of expressing high school students' opinions. This research is an experimental study with a quasi-experimental design with a two group pretest-posttest type with control group design. The population of this study was all students of grade XI MIPA SMA N 1 Purwodadi which consisted of 7 classes. The samples of this research were students of grade XI MIPA 2 and XI MIPA 3. Sampling was done using simple random sampling technique. The research data is in the form of cognitive ability test results and the results of observation of students' opinions expressed activities. Methods of data collection using tests (multiple choice questions pretest and posttest) and observation sheets. The results showed that the cognitive abilities of students in the experimental class had increased based on the N-gain calculation, which was 0.53 which was in the medium category. The activity of expressing students' opinions has also increased. The percentage of activeness in expressing opinions was initially only 2.78%, increasing to 100%. The conclusion of this study is that the PBL model assisted by the circulation system visual media is effective for improving students' cognitive abilities and activities to express opinions.

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INTRODUCTION

The demands of the Ministry of Education and Culture to improve reading literacy skills require students to be actively involved in the learning process. Based on the results of observations at SMA Negeri 1 Purwodadi, information was obtained that students were still not fully actively involved in learning, especially in learning living systems. This is because living systems cannot be sensed directly. One of them is the material of the circulation system. The study of the circulatory system is still limited to using an ordinary torso which does not show a direct simulation of the process. The simulation process is only taught through video, it can only be sensed by the eyes and hearing.

This causes students to be less interested in learning. In fact, many problems in everyday life related to the circulatory system can be used as learning resources through case studies. This causes cognitive abilities and activities to express student opinions are still low. As a result, learning outcomes in the circulation system, students who reach the Minimum Mastery Criteria (MMC) are only 27,78%. Therefore, efforts are needed to improve cognitive abilities and activities to express students' opinions on the material of the circulation system.

Efforts that can be made are by using a Problem Based Learning (PBL) learning model assisted by three-dimensional visual media of the circulation system. PBL models assisted by visual media help students solve problems in learning by applying them to visual media (Bororing, *et al.*, 2020). Learning the circulation system using three-dimensional visual media, makes students pay more attention to each stage in demonstration activities. Student responses become positive towards the learning process with visual media, so that student learning outcomes and activities increase (Casmuri & Lissa, 2019).

Aisyah, *et al.* (2018) stated that the special experiences experienced by students with visual media made material concepts easier to understand. The visual media used in learning make students more enthusiastic in participating in the learning process. Students are enthusiastic in paying attention to the stages of blood circulation demonstrations using visual media (Subkhi, *et al.*, 2019).

Learning using the PBL model as an effort to improve students' cognitive abilities is also considered very effective. Yanti (2017) states that cognitive abilities by PBL model PBL model show good learning outcomes. The PBL model has also been proven to have a significant effect on students' cognitive abilities (Saputri & Febriani, 2017). The PBL model has a positive effect and can facilitate problem solving, communication, group work, and interpersonal skills (Simatupang & Ionita, 2020).

Marasabessy & Djukri (2018) stated that there was an increase in students' cognitive abilities after the PBL model was applied in the learning process. Dyah & Suyanto (2019) stated that PBL in the biology learning process was proven to be effective in improving students' cognitive abilities. The PBL model also has a different effect on good learning outcomes (Azizi, 2019).

PBL model assisted by three-dimensional visual media based on the description above, it is necessary to apply it in learning the circulation system. Students are expected to have cognitive abilities with critical thinking. The activity of expressing student opinions is also expected to increase with the PBL model assisted by the circulation system demonstration media.

RESEARCH METHOD

This research was conducted at SMA N 1 Purwodadi in the odd semester of the 2021/2022 academic year. This research is an experimental study with a quasi-experimental design with a two group pretest-posttest type with control group design. The population of this study were all students of grade XI MIPA SMA N 1 Purwodadi which consisted of 7 classes. The sample of this research is students of class XI MIPA 2 and 3. Sampling using simple random sampling technique, the total sample is 72 students.

Grade XI MIPA 2 as an experimental group learning the circulation system using the PBL model assisted by the circulation system display media, hereinafter referred to as the 3D Light-Emitting Diode Circulatory System (3D LED-CS) media. The media consisted of a circulation process simulation board

that was manipulated using lights and 3D media of the heart structure.

Grade XI MIPA 3 as the control group used the PBL model assisted by the circulation system video media, hereinafter referred to as VS media. The media is in the form of videos that have audio and visuals about the circulation system. Video sourced from platform YouTube which can be downloaded via the link https://youtu.be/N-bwLhQWLgo.

Research data in the form of cognitive ability test results and activity observations express student opinions. Data collection methods used were tests (multiple choice questions pretest and posttest) and observation sheets. Research data were analyzed quantitatively. The results of cognitive abilities were analyzed using the N-gain calculation. The results of the observation of the activity of expressing opinions were analyzed using the calculation of the percentage of classical activity.

RESULTS AND DISCUSSION

The purpose of this study was to analyze the effectiveness of the PBL model with the aid of the circulation system visual aid to improve cognitive abilities and the activity of expressing opinions for high school students. An effective indicator for cognitive abilities that must be met in classes using 3D LED-CS media is the difference in average in the medium/high category through N-Gain calculations. An effective indicator for the activity of expressing opinions that must be met in classes using 3D LED-CS media is the minimum active percentage of 80%.

Cognitive Ability

N-gain is used to analyze the increase in cognitive abilities before and after learning the circulatory system. The N-gain value was obtained by calculating the difference between the pretest and posttest scores. The analysis was carried out in classroom with VS and 3D LED-CS media. The results of the analysis of the average N-gain score in the class with VS media was 0.04 in the low category. While the classroom was carried out by 3D LED-CS media got an average N-gain score of 0.53 in the medium category. The total and average N-gain gains in the medium-high category in the VS and 3D LED-CS media classes are shown in Figure 1.
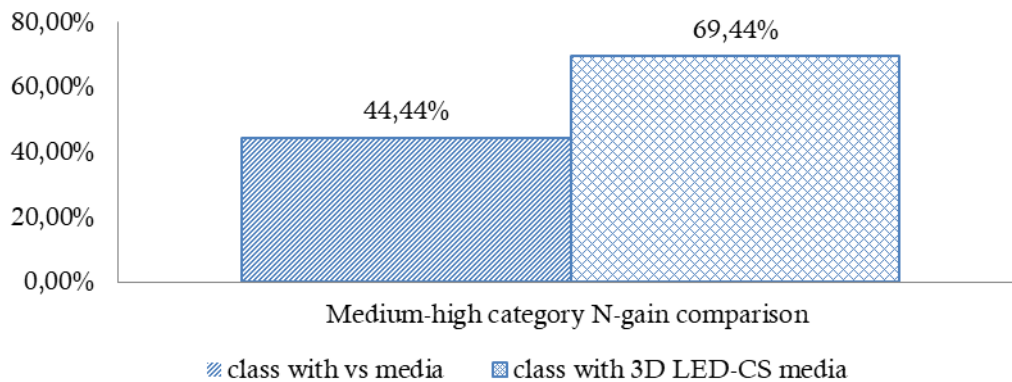

Figure 1. Percentage of N-Gain of Media Group VS and 3D LED-CS Medium-High Category

Based on Figure 1 concluded that the class using 3D LED-CS media obtained more N-gain values in the medium to high category. This means that the PBL model assisted by the circulation system visual media is effective in improving students' problem solving abilities. The difference is natural because the media used is also different. This is related to Edgar Dale's experiential learning theory.

The circulatory system that cannot be sensed directly requires media to help the understanding process. Media that involves more senses can provide concrete experiences for students. Therefore, the group with 3D LED-CS media scored higher.

Jackson (2016) states that visual media provide concrete experiences because students can perform

simulations with the percentage of concepts being remembered by 90%. In contrast to learning that uses a video. Video media only provides a learning experience with the percentage of concepts being remembered is only 30%. Edgar Dale's cone of experience is depicted in Figure 2.

Figure 2. The Cone of Edgar Dale's Experience (Wyatt & Looper, 1999)

Groups of students who study with 3D LED-CS media can maximize their senses such as sight, hearing, and touch. This sense of touch can provide a real experience while learning. In contrast to the group of students who learn to use VS media. Students can only maximize their sense of sight and hearing.

For example students were studying the structure and function of the heart in the Circulatory System. Study groups with 3D LED-CS media can use heart media as a learning resource. Students can feel and observe the structure of the heart clearly. While the VS media study group only saw the structure of the heart through video. Of course it provides a different experience and level of understanding. So the results of the analysis after learning show that the group that learns with 3D LED-CS media gets a higher score.

Expressing Opinion

The data was measured through the observation sheet instrument. The complete results of the analysis of the percentage of activities expressing student opinions are shown in Figure 3.
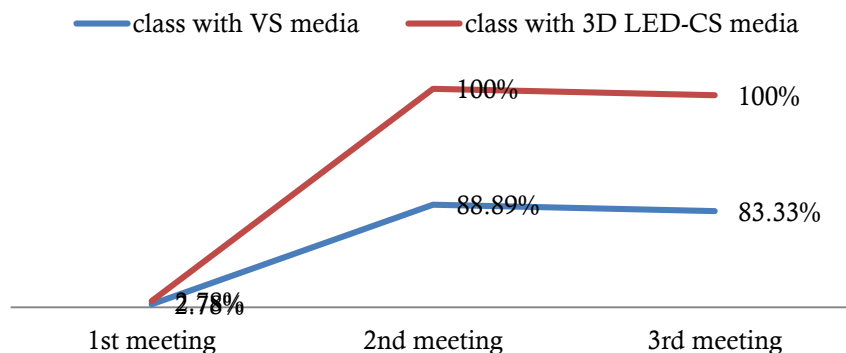

Figure 3 . Comparison of the Results of the Activity of Expressing Opinions in Class with VS and 3D LED-CS Media.

Based on Figure 3, it can be concluded that students in the class where the circulation system learning material uses 3D LED-CS media are more active in expressing their opinions. The first meeting, the group with VS and 3D LED-CS media did not show significant opinion activity. This is because at the

first meeting, learning has not used the media. The first meeting of students is directed to collect cases related to the circulation system in everyday life. The opportunity to express opinions at the first meeting was actually quite a lot, but students just missed it. For example, when asked about the circulatory system disorders they have experienced, many students are silent. This relates to the self-confidence and prior knowledge of each student.

The second and third meetings, groups using VS and 3D LED-CS media experienced increased activity in expressing opinions. Improvement can occur in both classes because the learning process is not much different. Each group is given an student worksheet to work on which is then delivered in turn. This process requires students to be involved in group discussions.

Discussion causes each student to be required to exchange information with each other. This is in line with the research by Yusup & Mas'ud (2019) which states that the use of the group discussion method requires students to exchange information and arguments. Nurhidayah (2018) also states that discussion can help the process of increasing student activity in expressing opinions.

Although both have increased, there are still differences between the two classes. This is due to the difference in the media used. As previously mentioned, Alwi (2017) stated that visual media have the value of giving the experience a real impression for thinking. Therefore, the group with 3D LED-CS media experienced a significant increase in the activity of expressing opinions.

LED-CS 3D media can assist students in conveying the results of each group's student worksheet. For example, when studying material on circulatory system disorders, each group that conveys the results of the student worksheet is supported by conducting a live simulation. Students can perform simulations by pressing the light switch on the circulation system simulation process board. A light switch that is turned off can manipulate an example of a clogged vessel disorder.

Unlike the case with the group with VS media, students cannot do simulations directly. Submission of the results of student worksheet cannot be accompanied by simulations of manipulating disturbances. The result seems that the activities of expressing opinion tend to decrease. This is because the VS media does not provide a real impression for thinking.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the problem-based learning model assisted by the circulation system visual media is effective for improving cognitive abilities and activities to express high school students' opinions.

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