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Multimedia-Based Discovery Learning Approach to Improve Critical Thinking Skills and Student Learning Outcomes

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Abstract

The purpose of this study was conducted to determine the increase in critical thinking skills and student learning outcomes in multimedia-based elasticity learning and discovery learning. The type of research used is action class research with 3 cycles. Each cycle consists of 4 stages, namely planning (action), action (action), observation (observation) and reflection. The sample used was class XI IPA 2 SMA Negeri 2 Pekalongan. The critical thinking skills of students in cycle 1 are still in the low category, but the positive behavior of students has begun to appear. The participation of students in discussions increases. Critical thinking skills in cycle 2 increased with good categories. Students who are usually lazy have started to join the discussion. The increase in critical thinking skills occurred in the third cycle with the very good category, because in this cycle the discussion groups were divided based on the peer tutor principle. The percentage of student learning outcomes also increased to 74%. This increase can be seen in the acquisition of a gain value of 0.55 in the medium category. Multimedia-based learning with discovery learning models can be applied in learning physics so that it can improve student learning skills and outcomes

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INTRODUCTION

Generally learning physics subjects are difficult for students to understand, because most students have not been able to connect the material being studied with the knowledge used. Students receive abstract knowledge because learning is given in the form of lectures. Actually, physics subjects are interrelated between concepts and the environment, so that students can apply them directly (Setyowati, et.al, 2011).

The concept in physics itself is the result of observations and research on various natural phenomena that are studied through experiments in the laboratory, so students need to be taught how to conceptualize physics through experimental activities (Lawson, 1995). However, the facts show that laboratory experiments are still very rarely carried out in schools (Yulianto, 2009). The skills students acquire from direct experience include information and communication technology literacy skills, critical thinking skills, problem solving skills, effective communication skills, and collaboration skills. These skills are characteristic of today's global society (Chaeruman, 2010).

Critical thinking is a process that is directed and clear, such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research, the ability to argue in an organized manner, the ability to evaluate systematically, the ability to say something confidently. An organized process so that students can evaluate the evidence, assumptions, logic, and language underlying other people's statements (Johnson 2002). The ability of students to develop critical thinking skills must be supported by learning media. The development of information technology has influenced the use of various types of media as a tool in the learning process. So that teachers are expected to be able to use these tools or equipment effectively and efficiently in classroom learning (Sanaky, 2009). Learning will be more fun, if the teacher uses multi-media learning media, namely a combination of experiments, videos, computers and physics props (Rosch,1996; (McCormick, 1996; Turban, 2002; (Robin&Linda, 2001). Multimedia learning will provide maximum results if the teacher uses an approach that can build student's critical and creative thinking.

In addition to the use of multimedia, a learning model is needed that is in accordance with the characteristics of the subject, such as the discovery learning model. The use of discovery learning provides direct experience to students, thereby attracting student's attention and forming abstract concepts. Understanding material is easier, motivation increases, and learning is more realistic and meaningful. (Illahi, 2012). Discovery learning is also effective in helping students build their own understanding and knowledge (Balim, 2009).

The data obtained from the results of interviews and daily tests of physics class XI shows that this class is included in the low category. Student activities tend to be passive so that to build an active atmosphere in the class faces many challenges. Student's critical thinking skills that are expected by the teacher are not visible in the learning process. The learning carried out by the teacher through lectures and practicum has not been able to improve student's critical thinking skills. During the practicum the students were very enthusiastic and active, but when the teacher used the lecture technique they became passive again.

This study provides an alternative to learning by using various media to reduce the lecture method. The media used are; videos, practicum, demonstration props and Phet simulations. The teacher hopes that the use of multimedia can create interesting and meaningful learning.

Based on the background description that has been described, the problem in this study is whether there is an increase in critical thinking skills and student learning outcomes in multimedia-based elasticity learning and discovery learning approaches. The purpose of this study, among others, was to determine the improvement of critical thinking skills and student learning outcomes in elasticity-based multimedia learning and discovery learning approaches.

RESEARCH METHODS

This type of research is a classroom action research with 3 cycles. Each cycle consists of 4 phases; planning, action, observation and reflection. The sample used was students in class XI IPA 2 at SMA Negeri 2 Pekalongan in the 2018/2019 academic year.

In the early stages, a preliminary study was carried out to identify problems. The process of problem identification is carried out by class observation and data on previous learning outcomes. The instruments used were formative test questions, student activity sheets, observation sheets and interviews. The learning tools that need to be prepared are the Learning Implementation Plan (RPP) and teaching materials.

The data analysis in this study is qualitative and quantitative. Qualitative data collection is obtained from interviews, observation sheets and observations of attitudes in class. Quantitative data for learning outcomes uses pre-test and post-test, as

well as student activity sheets, while data on critical thinking skills are obtained from interviews and observation sheets.

The stages of the research implementation were giving a pre-test to the sample class, after the pre-test the sample class was given a multimedia-based learning application treatment. The treatment was given in each cycle, and each cycle ended with a posttest.

Data processing were analysed by percentage techniques using equation 1.

$$Percentage\ (P) = \frac{n}{N} \times 100\% \text{ .....(1)}$$

where;
n : score obtained by students
N : maximum score

The results are then compared with the range of student success criteria in Table 1.

Table 1 ranges from student success criteria

Interval	Category
$80\% < P \leq 100\%$	Very good
$66\% < \mathrm{P} \leq 80\%$	Good
$56\% < P \leq 66\%$	Fair
$40\% < P \leq 56\%$	Less good
$P \leq 40\%$	Not good

(Arikunto, 2011)

The increase in student learning outcomes is determined by the normalized gain (N-gain) formula equation 2 (Y Yerimadesi, et. al, 2018).

Gain test

$$N_{gain} = \frac{score\ of\ posstest\ (\%) - score\ of\ pretest\ (\%)}{maximum\ score - score\ off\ pretest\ (\%)} \text{ ..... (2)}$$

The criteria for improving critical thinking skills can be seen in Table 2.

Table 2. Criteria for the gain test

Interval	Criteria
$N_{gain} > 0{,}7$	High
$0{,}3 < N_{gain} < 0{,}7$	Medium
$N_{gain} < 0{,}3$	Low

Multimedia-based learning and discovery learning approaches use indicators of critical thinking skills as seen as Table 3.

Table 3. Indicators of critical thinking skills

No.	Indicators
1	The skills of students in testing data
2	The skills of students in analyzing various opinions
3	The skills of students in appreciating honesty
4	The skills of students in preparing arguments
5	The skills of students in summarizing conclusions from some data
6	The skills of students in detailing the results of experimental observations
7	The skills of students in explaining the problem at hand

RESULTS AND DISCUSSION

In the first cycle the sample class was given video media treatment related to the elastic properties of objects, then students were given activity sheets and discussed with their group friends. During the discussion the teacher made observations related to the indicators of student's critical thinking abilities. In the discussion process, only a few indicators can be observed, several other indicators are observed after students present the results of the discussion. The last activity in cycle 1 is giving posttest.

The results of reflection in cycle 1 indicate that there has not been an increase in student learning outcomes and critical thinking skills, so it is necessary to do cycle 2. The treatment of this cycle uses a series and parallel spring demonstration with Phet simulation. Students work in groups to practice Phet media and discuss filling out worksheets, after which each group makes a presentation in front of the class. The teacher becomes the facilitator and fills in the observation sheet of student's critical thinking abilities. In this cycle students appear more responsive and active. The final activity of students is given a posttest. The results of cycle 2 reflection showed an increase in student learning outcomes and critical thinking skills, even though they had not reached the KKM average. Classroom action research continued with cycle 3. The learning media used in cycle 3 was hooke's law practicum. This practicum activity is carried out with worksheets guidelines which contain work steps and questions that lead students to find the relationship between the increase in force and length and in the end they can find an equation to calculate the spring constant. Reflection from cycle 3 shows an increase in student learning outcomes and critical thinking skills, so there is no need for the next cycle. The learning carried out by the teacher uses the stages of the discovery learning model. The initial stage is giving a stimulus, students listen to a video or Phet simulation about the material to be delivered. The second stage, students are given problems related to the material and phenomena related to these phenomena (problem statement). The third stage, students collect data through activity sheets (collecting data). The fourth stage is data processing. Students answer questions that can guide students so that students can find and understand physics concepts independently.

The fifth stage, students actively discuss with their classmates to understand the concept of physics (data processing). The sixth stage, students are given exercises related to understanding concepts through verification questions. The seventh stage, students are directed to make conclusions about understanding the concept of physics (generalization) (Illahi, 2012). This stage is in accordance with the discovery learning stage, and is carried out in each cycle.

Student's critical thinking skills in cycle 1 are still in the low category, students are less responsive to lessons and passive in discussions. In cycle 2, student's positive activities and attitudes began to appear. Activities and positive attitudes that begin to appear from students have an impact on the emergence of student's critical thinking skills. Student participation in discussions began to increase. Critical thinking skills in cycle 2 have started to increase in the good category. The increase in critical thinking skills in cycle 3 increased, students began to be critical in discussions. They gave each other information and asked the group team. The presentation activity also shows the activities of each group. Student's critical thinking skills in cycle 3 increased to the very good category, it can be seen in Table 4.

Table 4. Results of student's critical thinking skills for each indicator

	testing data	analyzing various opinions	appreciating honesty	preparing arguments	summarizing conclusions from some data	detailing the results of experimental observations	explaining the problem at hand
cycle 1	0,38	0,45	0,41	0,21	0,28	0,38	0,34
percentage	38	45	41	21	28	38	34
category	Not good	Less good	Less good	Not good	Not good	Not good	Not good
cycle 2	0,4	0,5	0,6	0,5	0,5	0,5	0,5
percentage	40	50	60	50	50	50	50
category	Less good	Less good	Fair	Less good	Less good	Less good	Less good
cycle 3	0,76	0,76	0,86	0,83	0,86	0,86	0,90
percentage	76	76	86	83	86	86	90
category	Good	Good	Very good	Very good	Very good	Very good	Very good

Learning activities that are conducive have an impact on the emergence of critical thinking skills. This resulted in the percentage of student learning outcomes also increasing to 74% in the good category. The increase in learning outcomes from cycle 1 to cycle 2 is in the medium category, as evidenced by the acquisition of a gain value of 0.55. The results of the pretest and posttest can be seen in Table 5. The improvement of critical thinking skills and the achievement of student learning outcomes shows that the application of multimedia-based discovery learning provides added value compared to the lecture method commonly used by teachers (Wartono, et.al, 2018).

Table 5. Pretest and posttest outcomes

	cycle 1	cycle 2	cycle 3
The highest score	57	80	87
Lowest score	30	45	53
Average	43	63	74
Percentage	43%	65%	74%
Gain value		0,55	
Category		Medium	

The results of the observation of critical thinking skills in cycle 1 have not shown any improvement. Students are still passive and do not respond to the material provided by the teacher. The critical thinking indicator in cycle 2 has increased from cycle 1, but has not shown a good category. In cycle 3 critical thinking skills have increased in the very good category. Students show a good response to learning. In this cycle students begin to openup in explaining problems in the learning material, as shown in Figure 1.

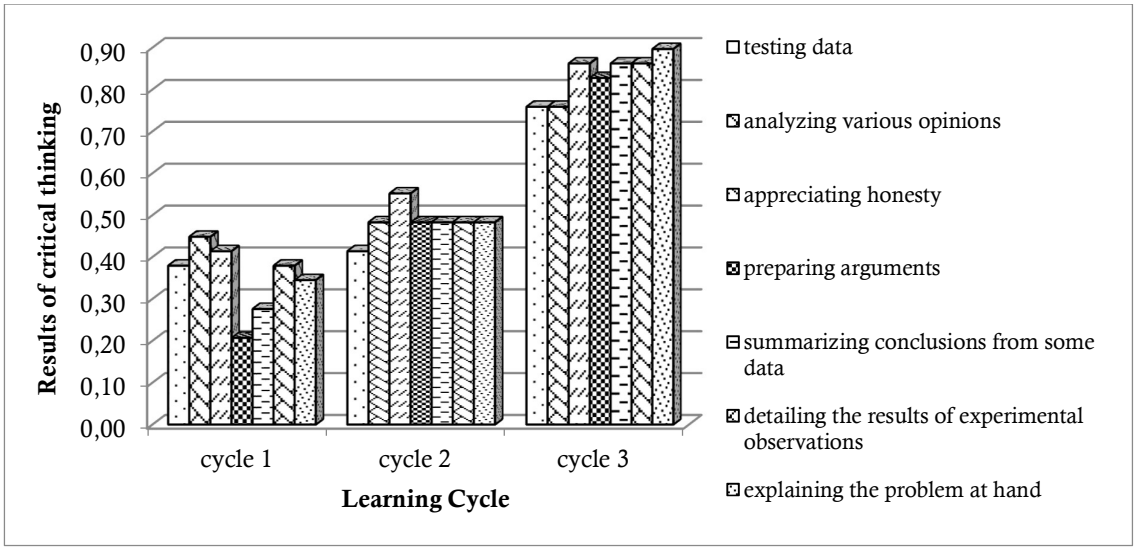

Figure 1. Result of student's thinking skills

Although discovery learning can improve student learning outcomes and critical thinking skills, there are still obstacles that must be overcome, for example the formation of groups and facilities and infrastructure in schools (Jaedun. A, 2009). Solutions for group formation with peer tutors. Peer tutors can help low-ability students to understand material (Abdelkarim, R & Abuiyada, R. 2016).

Sweller et al (2007) states that high academic ability students are able to follow the learning well, compared to the low academic ability students. With discovery learning can improvethe ability of the low academic ability students (Alex & Olubusuyi, 2013). Inquiry - discovery learning facilitates students to learn through active involvement, and teachers encourage students to have the experience and conduct experiments that enable them to discover concepts or principles without requiring the help of a teacher (Saab et al, 2005).

CONCLUSION

Multimedia-based discovery learning approach can be applied in learning physics, so that it can improve critical thinking skills and student learning outcomes. The application of multimedia learning media provides active and conducive learning conditions. Learning outcomes in learning with multimedia-based discovery learning approaches have increased in the medium category, while student's critical thinking skills are very significant in the good category.

Multimedia-based learning media is highly recommended in the physics learning process. Student activities in learning will be seen if the teacher uses approaches and media appropriate learning. Student's critical thinking skills improved significantly due to group division based on the peer speech principle, so it is highly recommended in future studies to divide groups based on peer tutoring principles.

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