Effectiveness of animation using pictorial riddle approach toward physics concept understanding at senior high school

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Abstract. The purpose of this study is to determine the effectiveness of animation using pictorial riddle approach toward physics concept understanding at Abul Faidl Senior High School, Wonodadi Blitar. The study applied experimental research with pretest-posttest control group design. The result of the study indicate that the average pretest score for the experimental class is 67.4 while the posttest score is 83.04. The average score for the control class, for the pretest is 65.4 while for the posttest 72.38. The t-independent test result show that the value of sig (2-tailed) 0.000 < α (0.05), then H₀ is rejected and H₁ is accepted. Thus it can be concluded that there is a significant effect of the application of animation using Pictorial Riddle approach toward physics concept understanding in 2018/2019 Academic Year at Abul Faidl Senior High School, Wonodadi Blitar

1. Introduction

There are several provisions in creating a learning process, including education must run actively and interactively that goes both ways between teacher and student and vice versa, inspire, learning that gives the impression of “happy”, able to motivate students to actively give appreciation, provide a forum for a creativity in developing students’ imagination. This is detailed in national education standards. Referring to this standard, of course, a teacher as an educator and the teacher must strive in such a way as to create a learning process that is in accordance with established benchmarks. Thus, teaching skills, both in terms of the use of approaches, strategies, methods, and learning models and abilities in preparing learning media, should be well mastered. However, the facts show that there are still many learning processes that have not focused on the standards set by the government. Still tends to be conventional. As a result, the results achieved are not optimal. Especially for physics subjects which seems quite frightening for most students. According to [1] a teacher is expected to be able to bridge in the process of knowledge transfer. This implies that the teacher must be able to understand students with a variety of methods, strategies, approaches, or through a variety of media that makes students able to think independently, creatively, and systematically. [2] states that along with the development of technology, it is necessary to make use of these technology products as an effort to improve learning outcomes. For example the use of videos and animations that do package material becomes more interesting. It is expected to be able to provide a significant increase in student motivation [3-4].

How to package a learning process becomes interesting, fun, and imprinted on students' memories, can be done including through the use of learning media. According to [5] there are two kinds of media based on technological developments. The first is traditional media, and the second is the latest
technology media. Seeing the development of the ICT sector which shows a significant increase, the learning media by utilizing technology dominates more. One of the ICT products is animation, where the design of the design uses certain software.

Animation is one form of ICT products that displays interesting visualizations for students. The presence of animation is able to open limitations in providing learning experiences for students. The material in the book, can be visualized and can also be given an audio touch. Certain events can also be simulated, which of course this directly or indirectly provides new learning experiences for students [6]. Thus the use of animation in physics learning can be used as an alternative learning media.

According to [7], the process of learning science strongly emphasizes scientific activities, where the activity consists of a series of scientific processes. Through computer-based learning and animation, these processes can be described fairly well, and this has a positive impact on student learning processes [8-10] and also impacts on thinking skills [11]. Thus it can be said that animation is one of the interactive and effective learning media in the learning process.

Physics learning is a subject that not only contains theories and formulas to memorize, but physics requires the understanding and mastery of concepts emphasized in the process of forming knowledge through the discovery and presentation of data. From a series of processes it is expected that strong conceptualization will be formed. Understanding concepts is an indicator of the extent to which students can understand concepts after the learning process. So if a student is able to understand meaning that includes scientific meaning, theoretical meaning, and application in real life, then it is said that the student already has an understanding of the concept. One indicator of a student has an understanding of a good physics concept, namely being able to convey with his own sentence the concepts that have been learned.

Low physics learning achievement at Abul Faidl High School in Wonodadi Blitar, shows that understanding physics concepts is also low. This needs to be corrected in the classroom learning process, which can be done through methods and approaches to learning. [12] states that in the learning process and must be known and understood well by the teacher, there are several models, methods, strategies, or approaches, which are adapted to the material or knowledge that will be given to students. Science, for example, is essentially science is natural science. So hopefully students will get an authentic learning experience. The approach that is appropriate with this knowledge and gives positive results is inquiry, which is the principle of inquiry based on the process of finding [13]. The learning process needs to be packaged in attractive designs, so that it is not boring for students. Given the nature of physics is the process of finding, the learning approach that can be used is inquiry with Pictorial Riddle, as development of inquiry approach. Pictorial Riddle gives students the opportunity to practice their own physics concepts through illustrations in the form of pictures displayed [14]. Illustration of these images is a puzzle that contains problems, which must be solved by students. The problems taken will lead to the concept to be achieved.

According to [15] the approach of inquiry-based science issues is expected to help students grow their practical skills since they conduct investigations through practicum activities. Practical skills in science learning are related to the skills possessed by the students to be able to discover the concept of science through observation, experiment, or investigation.

According to [16], in the implementation of inquiry learning process, students have a very big role. But in this case, the teacher should also continue to provide assistance, so that learning processes can be monitored, both from the cognitive, affective, and psychomotor aspects [17-19]. [20] states that guided inquiry brings the learners to discover their knowledge through inquiry activities with guidance from the teacher [21]. [20] also added that the role of teachers in the meaning of “guided” can be determined at three checkpoints of the activities; when defining the problems, when determining the steps of activities and procedures of investigation, and when drawing the conclusion or reconstruction of the concepts. [22] claimed that referring to the National Science Education Standards, inquiry is an appropriate learning in science education, as well as the implementation of the science curriculum in Indonesia, as well as the Project Benchmarks for Science Literacy 2016 [23].
2. Methods

This study applies animation media with inquiry-based physics learning approaches, using a pictorial riddle. The effect that is measured is understanding the concept of physics. The subjects were the 11th grade students of Abul Faidl High School in the odd semester of 2018/2019 Academic Year, where sampling used random sampling techniques.

| Subject | Pretest | Treatment | Posttest |
|---------|---------|-----------|----------|
| A       | O₁      | X         | O₂       |
| A       | O₁      |           | O₂       |

Note:
A : subjects randomly selected based on class
O₁ : pretest in the controlled and experiment class
O₂ : posttest in the controlled and experiment class
X : the class that received animation learning with the pictorial riddle approach

The subject divided into control class and experimental class. To measure the understanding of physics concepts, instruments were used in the form of 40 questions. The research design was in the form of a pretest-posttest-control group, namely the design of the pretest and posttest control group involving two groups. The two groups were the control group and the experimental group. The research design can be seen in table 1.

The results of the research data are then analyzed inferentially, by comparing the understanding of the concept between the experimental class and the control class. Data is analyzed by the following steps: 1)
1. Calculate gain (gain), by comparing the pretest score and posttest score in each group, using the normalized gain formula:

   \[ g = \frac{X - O}{O} \]

   With the following category:

   \[ g \geq 0.7 \] : high
   \[ 0.3 \leq g < 0.7 \] : medium
   \[ g < 0.3 \] : low

2. Test the normality of N-gain scores for both groups of data
3. Homogeneity test
4. Test the average difference, between experimental and control class

3. Results and Discussion

The data obtained during the study were data on physics concepts understanding in material and energy, in the form of pretest data, posttest data, and N-gain. Data analysis is carried out as a whole, namely before, during, and after the implementation of learning. The results of the analysis showed that in the experimental class, the average pretest of understanding the concept was 67.4, while the posttest results were 83.06. In the control class, the mean value of the understanding of the concept is 65.4, while the posttest results are 72.38, lower than experiment. The average gain in the experimental class is 0.7 which is in the high category. While in the control class the average gain is 0.5, which is in the medium category.
Figure 1. Comparison of the results of pretest, posttest, N-gain between the experimental class and the control class

This condition shows that there was an increase in physics concept understanding in the experimental class after getting physics learning through animation with the Pictorial Riddle approach, compared to the control class. The comparison of the pretest average score, posttest average score, and average gain understanding of students' physics concepts can be seen in Figure 1.

Then, the research data will be analyzed inferentially. Where the data analyzed includes the average value of the pretest, posttest, and n gain, both the experimental class and the control class. Data analysis on the understanding of physical concepts used normality test, homogeneity test, and average difference test. Normality and homogeneity test as prerequisite test before the average test is carried out using the independent sample t-test.

The results of the N-gain score normality test concept understanding for the experimental class, showed a probability value of $0.142 > 0.05$. Then gain understanding of physics concepts students are normally distributed in the experimental class. Whereas in the control class, after a normality test, the probability value is $0.197 > 0.05$. Thus the N-gain score concepts physics understanding of students in the control class is normally distributed.

The next test is the homogeneity test, which shows a probability value of $0.089 > 0.05$. So it is said that the understanding of students' physics concepts between the experimental class and the control class includes homogeneity. Because the gain of understanding physics is normally distributed and homogeneous, then to test the difference in averages using the t-test.

The average difference test between the experimental class and the control class was used to see differences in students' concepts physics understanding between the experimental class and the control class, namely by independent t-test. If the probability value based on the test results is greater than 0.05 then $H_0$ is accepted, consequently $H_1$ is rejected. Conversely, if based on the results of the t-test smaller than 0.05 then $H_0$ is rejected, and consequently $H_1$ is accepted.

Table 2. Independent Sample T-Test

| Variable       | N  | df  | t    | Sig.(2-tailed) |
|----------------|----|-----|------|----------------|
| Experimental Class | 22 | 42  | 3.826| 0.000          |
| Controlled Class     | 22 | 28.811| 3.826| 0.001          |

The results of the N-gain t-test understanding of the physics concepts of the experimental class students and the control class can be seen in table 2. From the results of the t-test statistical analysis...
obtained a significance value of 0.000 in the experimental class. Because the significance value of 0.000 is smaller than 0.05 so $H_0$ is rejected and $H_1$ is accepted. So that it can be said that there are significant differences in increasing understanding of students' physics concepts, between pretest and posttest. This shows that the physics learning process using animation media with the Pictorial Riddle approach influences the understanding of students' physics concepts. Understanding of students' initial concepts of physics material can be known through the results of the pretest.

Understanding of students' initial concepts of physics material can be known through the results of the pretest. The average result of the pretest from the experimental class and the control class has a difference that is not far adrift. This shows that the initial knowledge possessed by students tends to be the same. Understanding of students' final concepts of physics material can be known from the posttest scores given after the two classes get treatment, where the experimental class gets learning through animation with the Pictorial Riddle approach.

The approach taken by the teacher in the control class is a conceptual approach, where the teacher tends to ask just to understand what is conveyed to students. Whereas in the experimental class, physics learning is given by utilizing animation media, which is done with the Pictorial Riddle inquiry approach. Through this approach students are invited to think critically in a delivery through interesting animation. The enthusiasm and curiosity of students during the learning process becomes increased. The ability to remember the concept of physics is also better. The informal way of presentation makes students feel more free to explore their abilities.

Using cartoons as assessment tool is effective in many aspects as it is relevant to students' interests, it promotes students' skills of observation and inductive thinking, and it enhances students' abilities to apply scientific knowledge to their real world. But the most essentially benefit is that cartoons offer an opportunity for teachers to assess student’s understanding in an authentic way [24]. As a complementary learning approach, animation always stimulates students’ interest in learning. In line with [25]. The key point is to integrate the animation content into the teaching activities in the classroom. Realistic feeling, immersiveness, and interactivity ara always regarded as the criteria of choosing animation content in teaching activities [25]. Pictorial riddle is inquiry methods, where Inquiry learning is designed to encourage students to inquire, develop critical thinking, increase their skills and carry out the implementation. This means that the principle of science learning is an active process. Active process has implications for mental and physical activity. It means that, hands-on activities only are not enough, but the mind-on activities [26], in line with this research. Animated educational lessons are easy to understand for the children. They capture images in their minds and as a result it is much easier for them to recall these images rather than plain text from a book. They find it fun to learn as learning becomes part of their recreational activities. It benefits them a lot [27]. The animation in multimedia interactive learning gave a positive effect in improving students’ learning outcomes [28].

Inquiry-based science education is becoming increasingly popular and has proved to be a suitable educational method for the development of necessary knowledge and skills, motivating students significantly. Inquiry-based science education holds out the promise of engaging students more productively, of giving them opportunity to enjoy science and find it rewarding [29]. [30] stated that learning with authentic inquiry learning approach could improve students’ problem solving and scientific attitude, and also create meaningful science learning process. It shows that there is an active involvement of the learners/students in whatever is being taught.

4. Conclusion

Based on the results of research and discussion, it can be concluded that there is an increase in the understanding of students' physics concepts after implementing learning using animation with the pictorial riddle approach. The result also show that there is the influence of the application of learning using animation with a pictorial riddle approach to learning material physics and energy.
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