Impact of multi-representation-based video on students’ learning outcome

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Abstract. This study aims to determine the effect of using multi-representation based video media on high school students’ learning outcomes. The study used a quantitative approach with a quasi-experimental design. The research sample was 24 students of class X IPA-1 for the control group and 22 students of class X IPA-2 for the experimental group. In the experimental group, the multi-representation based video media were used during instruction, meanwhile in the control group the instruction did not involve any multi-representation based video media. The data were collected from students’ responses on a test for student learning outcomes and the data were analysed using the t-test. Based on the results of the analysis, it is known that student-learning outcomes have increased with the average post-test score of the experimental class 82.73 and the average value obtained in the control class post-test activity is 75.91. Based on the results of hypothesis testing at the significant level of $\alpha = 0.05$ and df = 44, the t-table = 1.68 and the t-count = 3.32. Thus, it can be said that there is an influence from the use of multi-representation based video media on student learning outcomes on the concept of Works and Energy.

1. Introduction

Learning with the Multi-Representation (MR) model is learning by involving various forms of presentation (display) concepts [1] and optimizing the use of the five senses [2]. Various types of tools and media have been developed using a multi-representative learning model. Among them are the development of a multi-representative module in the thermodynamics course [3], the development of a multi-representative practicum module with PhET simulation [4], the development of a multi-representative module on the concept of black body radiation [5], and the development of a multi-representative electronic book [6]. Meanwhile, the development of multi-representative based videos has very few references, one of which was found to be a multi-representative electronic book on the concept of intermolecular forces [7].

Learning outcomes (LO) is a measure of the achievement of student learning outcomes in the cognitive, affective and psychomotor domains and describes the level of success or success of a course [8,9]. The study of efforts to improve student learning outcomes has been widely researched in various ways, including improving learning outcomes in materials science through reverse classroom techniques [10], application of the Dick and Carey model of learning design [11], social learning intelligence [12],
problem-based learning [13], school-based blended learning [14] and digital learning [15]. Learning outcomes are also influenced by latent variables that exist in students, including those related to students’ motivation and metacognitive skills [16], emotions of worry [17], interest and motivation [18] and self-regulation and life expectancy [19].

The results of observations at the research target school at High School 1, Jantho City, Aceh Besar showed that the learning outcomes of physics subjects, especially the concept of business and energy, were still very low, namely 40-55 and had not yet reached the Minimum Completeness Criteria (KKM) (75). The results of the observations show that learning still uses the discussion method, ask and answer questions and is very rarely used learning media. On the other hand, many relevant studies prove that the use of learning media can increase student interest, motivation and learning outcomes [20,21,22,23,24,25].

The media that has been used by previous researchers is only focused on one presentation, this will cause student reasoning to be limited and students only use one of the five senses while participating in learning. As an alternative and refinement of existing media, through this study video media with various presentations or multi-representation were developed, so that students can use the three or four senses optimally. The use of more than two senses will increase the absorption of the concepts being taught [26]. The main objective of this study is to determine the increase in learning outcomes after being taught with a multi-representative model combined with interactive video. Another objective is to find out which cognitive domains are dominant in the use of multi-representative videos in physics learning.

2. Research Method

2.1. Design of Research
This study used a quantitative approach, a quasi-experimental method and a two-group post-test and pre-test design. The form of the quasi-experimental research design used in this study is clearly shown in Table 1. The initial test and the final test are the same in shape and difficulty level given to the control group and the experimental group.

| Groups     | Pretest | Treatment | Posttest |
|------------|---------|-----------|----------|
| Experiment | 01      | X         | 02       |
| Control    | 01      | -         | 02       |

2.2. Population and Sample
The target population of this study were all students of class X IPA at SMA Negeri 1 Kota Jantho Aceh Besar. While the sample in this study were students of class X IPA-1 (24 students) and X IPA-2 (22 students) at SMA Negeri 1 Kota Jantho who were selected by simple random. Class X-IPA-1 with 24 students is assigned as an experimental group, which will be taught using a multi-representative model combined with video. While class X-IPA-2 with a total of 22 students was designated as a control group who would be taught using conventional methods as has been done so far.

2.3. Collection of Data
The data in this study are quantitative data in the form of test scores. The data were collected using a multiple-choice test on the concept of effort and energy developed by the researcher. Indicators for the development of question items refer to the physics syllabus for high school in physics subjects. Based on the indicators in the physics syllabus class X IPA, 15 multiple choice test items on effort and energy were developed. Each question consists of a test body (stimulus) followed by 4 answer choices with 1 correct answer and 3 answers as a distraction. Before the questions are used for data collection at the beginning and at the end of the lesson, they are first tested for validity, reliability, difficulty index,
difference power index, and distractor analysis. All activities of carrying out validation, reliability, differential power indexes, etc. refer to the model used by the previous researcher. [27].

2.4. Data Analysis
The main objective of this study was to examine the impact of using multi-representative based video on student learning outcomes. The data used to achieve the research objectives is the value of student learning outcomes on the topic of effort and energy for the control and experimental groups. Data were collected twice, before and after learning. Both data were analyzed using the t-test formula to see differences in student learning outcomes before and after learning [28].

3. Results and Discussion
There are two main results that need to be reported, namely (i) the impact of using multi-representative based video on student learning outcomes in the effort and energy subtopic, and (ii) the highest cognitive domains affected by the effort and energy subtopic learning with multi-representative based video.

3.1. Average of Learning Outcome
This research was conducted at SMA Negeri 1 Kota Jantho in the academic year 2008/2019 or even year. The selected sample was the students of class X IPA1, totalling 24 students who were assigned to the experimental class with treatment using multi-representation based learning video media and class X IPA2 totalling 22 students who were also designated as control class who were given treatment as usual. The learning outcome data of the two groups is shown in Appendix 1, while the results of the analysis of the relationship between the pre-test and post-test are shown in Figure 1.

\[
y = 0.3164x + 70.172 \\
\text{r}_{xy} = 0.3836; R^2 = 0.1472 \\
\text{Average} = 35.84 (X) \\
\text{Dif.} = 79.36 (Y) \\
\text{Post-test score} = 43.52
\]

**Figure 1.** Relationship between post-test and pre-test for the experimental group

The graph in figure 1 is the association between prostate and pre-test scores for the experimental group. The relationship between the two scores provides an overview of the profile of the test takers and describes the profile of the answers given by students. Students who have high scores on the pre-test will also score high on the post-test after being given treatment or carrying out learning. The results of the analysis between the pre-test and post-test in the graph show that the pre-test score contributed 15% to the post-test score \( (r_{xy} = 0.3836; R^2 = 0.1472) \). In other words, only about 15% of the pre-test score contributed to the post-test score, while the remaining (100-15) 85% were influenced by the treatment factor, in this case learning using multi-representative based video in the experimental group. In other words, the difference or increase in the mean score of 43.52 was only 15% due to the high score on the pre-test, while the 85% increase in the score was influenced by the effect of multi-representative based
video learning. The same analysis can also be performed for the scores in the control group as shown on the graph in figure 2.

The graph in Figure 2 is the association between prostate and pre-test scores for the control group. The relationship between the two scores provides an overview of the profile of the test takers and describes the profile of the answers given by students. Students who have high scores on the pre-test will also score high on the post-test after being given treatment or carrying out learning. The results of the analysis between the pre-test and post-test in the graph show that the pre-test score contributed 42% to the post-test score ($r_{xy} = 0.6472; R^2 = 0.4189$). In other words, about 42% of the pre-test score contributed to the post-test score, while the rest ($100 - 42 = 58\%$) were influenced by the treatment factor, in this case learning using the usual or conventional means in the control group. In other words, the difference or increase in the average score of 38.61 was about 42% due to the high score on the pre-test, while the 58% increase in the score was influenced by the effect of learning in the usual way or conventional methods.

Based on the results of the analysis in Figures 1 and 2, it can be said that the increase in scores after learning, both the experimental and control groups, contributed to the score on the pre-test although the percentages were different. For the experimental group the contribution of the pre-test score to the post-test was around 15%, while in the control group the contribution was 42%. Meanwhile, the post-test score contribution caused by treatment or learning was 85% for the control group and 58% for the control group. Findings like this are in common with some of the findings by previous studies, including the contribution of the PBL model to the post-test score [29], the contribution of the TAI-type model to the post-test score [30], the contribution of TSTS type treatment to the post-test score. [31], the contribution due to problem solving treatment on the post-test score [32] and the contribution to the post-test score due to treatment with the PhET simulation [33].

### 3.2. Learning Outcome per Bloom Cognitive

The test instrument developed to measure the learning outcomes of business and energy concepts is arranged in four cognitive levels by Bloom, namely C1 (remembering), C2 (understanding), C3 (applying), and C4 (analysing). Data analysis was conducted to obtain information about the greatest impact of multi-representative based video learning on Bloom's cognitive level. Therefore, the data analysis includes the calculation of the average pre-test and post-test scores as well as the N-Gain value with reference to Hake [34]. The details of the classification of test items for the 4 Bloom cognitive domains and the results of the analysis are shown in Table 2.
Based on the results of the analysis in table 2 it can be said that the impact of learning with the help of multi-representative based video media is in the medium and low categories. However, this impact is different for different cognitive domains, with the largest impact on cognitive domain C1 (remembering) and the smallest impact on cognitive domain C4 (analysis). Thus, it can be said that learning with the help of multi-representative based videos is effective in order to shape students' memory skills and less effective at improving students' analytical skills. Based on the results of the analysis in table 2, it can also be understood that the increase in the cognitive domain from remembering (C1) to analysis (C4) has actually experienced a decrease in the N-Gain value from 0.44 to 0.24. In other words, multi-representative based video-assisted learning is only effective for the lower cognitive domains. This is in accordance with the characteristics of video media, namely the learning process uses more of the eye senses, so that what can be recorded in students' thoughts is only the impression of remembering.

Table 2. Question grids according to Bloom's cognitive and results

| Cogn. | Verbs   | Items no. | Avrg Pre-test | Avrg Post-test | N-Gain | Categories |
|-------|---------|-----------|---------------|----------------|--------|------------|
| C1    | Remember| 1,4       | 12.50         | 18.00          | 0.44   | Middle     |
| C2    | Understand| 2,5,7   | 16.33         | 19.33          | 0.35   | Middle     |
| C3    | Application| 8,9,12 | 08.00         | 13.67          | 0.33   | Middle     |
| C4    | Analysis| 3,6,10,11,13,14,15 | 09.86 | 14.00 | 0.24 | Low        |

The findings in this study are consistent with some of the results of previous studies, where the learning method used was only effective in the low cognitive domain. Among them are problem-based learning models [35,36], inquiry-based experimental methods [37], problem solving learning models [38], ENT type cooperative learning methods [39], process skills approaches [40], and problem posing learning models [41].

4. Conclusion
Based on the results of research and data analysis, it can be concluded that learning using multi-representative based video is only effective for improving students' abilities in the lowest cognitive level of Bloom (remembering) or less effective for higher cognitive levels. This is in accordance with the characteristics of video media, which is only oriented to the use of the five senses of seeing so that only the ability to remember is trained.

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Attachment 1: Learning Outcomes Data

Table 4.1. Pre-test data and post-test of student learning outcomes

| No | Name | Pre-test | Post-test | Name | Pre-test | Post-test |
|----|------|----------|-----------|------|----------|-----------|
| 1  | AH   | 53       | 73        | AR   | 20       | 79        |
| 2  | AR   | 40       | 79        | AAL  | 26       | 53        |
| 3  | BN   | 26       | 66        | CR   | 33       | 60        |
| 4  | CM   | 33       | 79        | CT   | 13       | 60        |
| 5  | DF   | 40       | 86        | F    | 20       | 73        |
| 6  | DRH  | 40       | 92        | IMO  | 33       | 66        |
| 7  | ES   | 53       | 86        | I    | 40       | 86        |
| 8  | IM   | 40       | 92        | KN   | 46       | 86        |
| 9  | IR   | 33       | 79        | MH   | 26       | 66        |
| 10 | IH   | 33       | 66        | MNZ  | 46       | 86        |
| 11 | MF   | 20       | 99        | MR   | 13       | 53        |
| 12 | MN   | 33       | 79        | MA   | 33       | 73        |
| 13 | MRI  | 46       | 86        | M    | 33       | 66        |
| 14 | MRF  | 53       | 92        | MAR  | 20       | 79        |
| 15 | N    | 33       | 86        | MI   | 46       | 86        |
| 16 | PR   | 53       | 86        | NA   | 53       | 99        |
| 17 | RR   | 20       | 73        | RMS  | 26       | 73        |
| 18 | R    | 46       | 92        | RA   | 40       | 79        |
| 19 | RZ   | 33       | 86        | SM   | 53       | 86        |
| 20 | RZD  | 26       | 79        | SB   | 33       | 73        |
| 21 | RA   | 26       | 66        | SW   | 33       | 79        |
| 22 | RN   | 46       | 86        | WH   | 60       | 73        |
| 23 | RY   | 20       | 73        |      |          |           |
| 24 | SRF  | 26       | 79        |      |          |           |