Improving Learning Outcomes of Vocational High School Students through Application of Circular Motion Learning Media Using Microcontrollers

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Abstract. The purpose of this study was to determine the effect of application circular motion practicum media using microcontrollers-based toward the learning outcomes of students. The object of this research is the students of State Vocational High School and Private Vocational High Schools in Madiun. The research design was Nonequivalent control group pretest-posttest. Data collection technique used 5 questions of cognitive essays tests. Data analyzed using qualitative descriptive techniques. The findings found out that the application of circular motion learning media using microcontroller has a significant influence on improving the students' cognitive learning outcomes.

1. Introduction

Physic education is an education of natural knowledge that learns the symptoms or natural phenomena. Through physics, a phenomenon can be explained and understood by the human mind and thought. In the process of teaching physics in vocational high schools, should provide more space for activities of exploration, find and draw the conclusion of a phenomenon. According to [7], students must build understanding based on their thinking; the teacher as an instructor must provide a model of good performance criteria and provide guidance and feedback to students.

Indonesia is currently applying the curriculum 2013 which has a concern in empowering all the potential of students aiming to gain competencies through efforts to grow and develop attitudes, knowledge, and skills [6]. In addition, the goal of the K-13 curriculum is solidarity, independence, cooperation, and creativity. So, with self-ability of the students, they are able to process by combining knowledge into new and original knowledge of students.

Learning media is important in a learning process; then it needs to be developed and applied in the class [5]. Based on research conducted by [1] indicated that the use of media in an Adobe Flash is able to increase student learning abilities and ability to be as a source of information, and teachers is easier to convey information to students. This is associated with the ease and effectiveness of learning time management; so it is not limited in boring traditional spaces.
2. Research Method
This research was a Quasi Experimental study. The study aimed to determine the effect of manipulated variables on the results [8]. This research conducted in public and private schools in Madiun at 2017/2018 academic year. The design of this study was a pretest-posttest control group design which is before treatment; the two sample groups were given initial tests to measure the initial condition. Furthermore, the experimental class is given treatment with circular motion learning media using microcontroller-based. [9] The collection technique used 5 questions of essay test instruments. The n-gain test used to analyze categories of improvement in cognitive learning outcomes.

3. Result and Discussion
The result of the average score test of N-Gain from control class and experiment group is presented in table 1.

| Group          | N-gain | Category |
|----------------|--------|----------|
| Control Class  | 0.1    | Low      |
| Experiment Class| 0.3    | Average  |

Based on the results in table 1, the control class gained an average of N-gain score of 0.1 and the experiment class is 0.3. This showed that cognitive learning outcomes from the experimental class are higher than the control class, and is presented in figure 1.

![Learning Outcome Graph](image)

**Figure 1.** Graph on comparison of average score of N-Gain

The differences of average score the N-gain test in Figure 1 between the control class and the experiment class that is applied to circular motion learning media using a microcontroller occurs because using media in the learning process students can develop their potential in trying to find physics concepts and solve problems during the learning process. In addition, the use of new learning media also has a direct impact on students’ learning interest. So, the knowledge gained during the learning process becomes more meaningful for students. The findings of this study are also in line with the research conducted by [4], stated that learning media have a significant
influence on student learning outcomes in SMP 12 Palu. Then, the results of the research conducted by [2] showed that the learning outcomes in the experimental class have a higher score than the control class that does not use projection media.

In general, although the average scores the N-gain in the experimental class using media is higher than the control class without media in learning, but when analyzed more specifically on each indicator of cognitive learning outcomes including memorizing (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5); there are interesting fact from the analysis result of the control class and experiment class where applying circular motion learning media using microcontrollers in learning to provide an influence on cognitive learning outcomes only on indicators C1 to C3. Meanwhile, applying the media in learning has no effect on indicators C4 and C5. Comparison of Analysis result of cognitive learning outcomes on each indicator is presented in Figure 2.

![Chart of Learning Outcomes](image)

**Figure 2.** Chart of N-gain score in each indicator

Based on figure 2, the highest increases in the experimental class are in the indicators of understanding (C2) and applying (C3) with an average N-gain score of 0.4 and the lowest increase is in the indicators of analyzing (C4) and evaluating (C5) with a score of 0.1. Meanwhile, in the control class, 4 indicators of the 5 indicators observed, obtained a score of 0.1, namely the indicators of memorizing (C1), understanding (C2), analyzing (C4) and evaluating (C5). In applying indicator (C3), there is no increase. The results proved that the average increase in cognitive learning outcomes in the experimental class is higher than the control class because applying circular motion learning media using microcontroller-based, students can find knowledge directly. And with this media, students can immediately apply theories to circular motion and prove it directly. It impacts on increase memory of the gained knowledge.

On the indicators of analyzing (C4) and evaluating (C5), the increase in cognitive learning outcomes in the experimental class show the same result as the control class which is in the low category.

On the indicators of understanding (C2) and applying (C3), the increase in cognitive learning outcomes in the experimental class was much higher than the control class because, in the experimental class, students are required to be more active in the learning process, so students gained knowledge based on their own knowledge and experience. This finding is in line with the research conducted by [3].
4. Conclusion
Based on the analysis and discussion, conclude that applying circular motion learning media using microcontroller has a significant effect on students cognitive learning outcome.

5. References

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