



Implementation of Pedagogical Content Knowledge with Multimedia on Rectilinear Motion Topics

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Abstract

Pedagogical content knowledge is a combination of understanding knowledge material (content knowledge) and ways of educating (pedagogical knowledge). The purpose of this study is to improve student learning outcomes and interests through the implementation of multimedia assisted pedagogical content knowledge. The research method used is control group pretest-posttest design. Data collection was done by test and questionnaire. Data analysis using t test and gain test. The results showed that there was an increase in learning outcomes by the implementation of pedagogical content knowledge (PCK) with $t_{\text{count}} > t_{\text{table}}$ and N-gain score of student learning outcomes of 0.60. Questionnaire results show the high interest of students in learning by using multimedia of Rectilinear motion.

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INTRODUCTION

One important factor in achieving national education goals is the quality of the learning process done by a teacher. But this seems not in line with the quality of learning in Indonesia in certain areas. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) survey on the quality of education in developing countries in Asia Pacific, Indonesia ranks 10th out of 14 countries and for the quality of teachers, its quality is at level 14 of 14 developing countries (Gumilar, 2013).

The designed learning should be attention to the characteristics of the topic, students and learning objectives. One way to develop learning that takes into account these three aspects is through Pedagogical Content Knowledge (PCK). Pedagogical Content Knowledge is described as the result of a combination of understanding of teaching material (content knowledge) and understanding of ways of educating (pedagogical knowledge) that blend into one that needs to be possessed by a teacher. Pedagogical Content Knowledge is an understanding of what learning methods are effective to explain certain material, as well as an understanding of what makes certain material easy or difficult to learn (Eggen & Kauchak, 2007). A teacher who can master PCK properly will certainly improve his competence optimally because he is mastering the content and how to teach content (Mahen & Nuryantini, 2018).

Physics is one of the Science subjects that aims to educate students, so that they can think logically, critically, have an objective nature and discipline in solving problems in various fields regarding physical phenomena. The use of physics is not limited to branches of natural science, but also other fields such as technology, electronics, architecture, and so on. Reality on the ground, physics is still considered by students as a lesson that is not interesting and difficult to understand (Purwaningsih, 2015). Media is a useful communication tool to make the learning process more effective and help the students to understand the concept. The benefits of using media are expected to attract the attention of students and facilitate students in understanding the concept. The media can help students more easily understand the presentation of the concept presented by the teacher (Ekawati et al., 2015).

The observations at MA Al Hadi showed that there were still many teachers who did not use technology due to the lack of teachers' knowledge in visualizing the concept. The use of application software, for example Macromedia Flash Player, Video Animation, Video Tracker and others can help teachers in creating enjoyable learning (Putriani & Sarwi, 2014; Sriatun et al., 2018). Another factor that causes low learning outcomes in physics is the small number of teachers who have qualifications and competencies in developing the media (Sukadi et al., 2015).

The implementation of PCK with the right use of media is expected to be a solution to overcome the low learning outcomes and student interest in physics subjects. A lot of research has been done on the application of PCK, from the research it turns out that PCK has a positive impact on learning activities. This has an impact on the close relationship between pedagogical knowledge and teaching material. (Saminan & Zulfira, 2015; Muchsin & Khumaedi, 2017).

Based on the description above, it is clear that the activity of increasing physics learning outcomes cannot be separated from the application of the PCK concept. Rectilinear motion is a basic concept that can help students learn further physics material, especially those that are closely related to mechanics. A good understanding of the rectilinear motion will greatly provide sufficient knowledge when students learn mechanics in class XI. Meanwhile, with the help of multimedia it is expected that PCK implementation can be optimized. This study aims to implement PCK with the help of multimedia in rectilinear motion learning to improve student learning interest which has an impact on improving learning outcomes.

METHOD

The research was conducted at MA Al Hadi, Demak for the 2017/2018 school year. The population used was all students of class X. The sample was determined by purposive sampling, namely class X.1 as a control class and class X.2 as an experimental class. The research design used was an experiment with a control group pretest-posttest design. Research data collection methods use test and questionnaire methods. The research instrument consisted of a description test, and a questionnaire. Test data analysis using homogeneity test, normality test, t test, and gain test. Homogeneity test is used to find out that both samples have the same initial state before being treated. Normality test is used to find out whether the data is normal or not. The gain test is used to determine the improvement of learning outcomes in students and the t test is used to determine the effectiveness in terms of increasing mastery of concepts between classes that use PCK strategies and multimedia with classes that use group discussion and assignments.

RESULT AND DISCUSSION

The results of the multimedia-assisted PCK implementation in the form of increased mastery of concepts that have implications for learning outcomes and student interest in physics subjects.

Concepts Mastery of Rectilinear Motion

Data from processing pretest, posttest, and N-gain scores for mastering the Rectilinear concepts of control class and full experimental class can be seen in Figure 1.

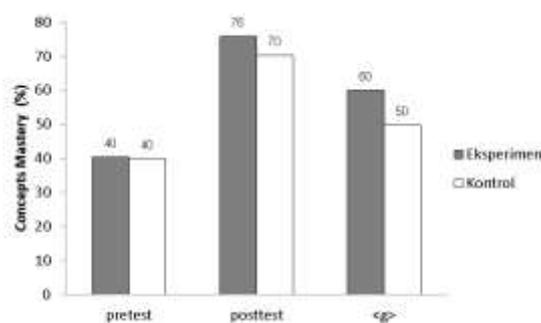


Figure 1. Comparison of percentage of Pretest, Posttest, and N-gain Score on Rectilinear Concept Mastery.

Based on the results of testing the hypothesis of concepts mastery of Rectilinear, the N-gain score of the two classes shows that the gain score of the experimental class is higher than the control class. The high acquisition of experimental class gain scores is due to the implementation of learning by using multimedia, providing opportunities for students to better understand the material, exchange ideas with each other, and help each other in solving each question given by the teacher.

This is in line with the opinion of Waight (2015) that a teacher with good PCK abilities will more easily convey learning with the use of technology. Teachers who have the competence of PCK will combine pedagogical and content aspects with the ability to employ technology that is good for implementing effective learning strategy innovations in the classroom.

The implementation of PCK with the correct use of media will produce a quality learning process. This is reinforced by the results of Chang et al. (2008) study, stating that the use of media with simulation and animation will provide better abstract reasoning to students, so as to improve learning outcomes. The use of media will make it easier for teachers to investigate student difficulties in learning, so as to improve student learning outcomes (Hochberg et al., 2016).

Normality Test, Homogeneity, and Concept Mastery Hypothesis Test

Normality test using Kolmogorov-Smirnov Test with testing criteria at significance > 0.05 then the data is normally distributed, whereas if the significance < 0.05 the data is not normally distributed.

Data normality test is intended to determine the distribution of data scores of students' concept mastery for both classes. The results of the normality test of the average N-gain score from the concept mastery of Rectilinear motion for students from two classes can be seen in Table 1.

Table 1. N-gain Normality Test Results $\langle g \rangle$ of Concepts Mastery in Experiment and Control Class

Data source	Class	Average $\langle g \rangle$	Sig.	Decision
$\langle g \rangle$	Control	0.50	0.200	Normal
	Experiment	0.60	0.200	Normal

Table 1 shows that the results of the normality test for the average gain score normalized students' mastery of concept data for the experimental class and control class obtained a significance > 0.05 . Thus it can be concluded that the N-gain score by mastery of the concept of the two classes is normally distributed.

The data homogeneity test is intended to see whether the two samples have the same variance or not. The homogeneity test of the average N-gain score by both classes is presented in Table 2.

Table 2. N-gain Homogeneity Test Results $\langle g \rangle$ of Concepts Mastery in Experimental and Control Classes

		Levene	df1	df2	Sig.	Decision
		Statistic				
$\langle g \rangle$ mastery of concepts	Based on Mean	2.017	1	60	.161	Homogen

Table 2 shows that the results of the homogeneity test of the average gain score normalized students' concept mastery data of the experimental and the control class obtained a significance > 0.05 . Thus it can be concluded that the average N-gain score data concepts mastery of both classes is homogeneous. The Condet mastery of the data is normally distributed and homogeneous, testing the hypothesis about Condet mastery is done by t-test. This is intended to see the difference in the two average scores of increasing students' concepts mastery between the experimental class and the control class. The test results with the complete t-test can be seen in Table 3.

Table 3. Different Tests of Concept Mastery of Rectilinear Motions In Experiment and Control Classes

Data source	Class	$\langle g \rangle$	Std. Dev	t-tes	Sig.	Decision
$\langle g \rangle$	Control	0.50	0.13	3.23	0.000	Significant
	Experiment	0.60	0.11			

Based on Table 3 it can be seen that the average normalized gain score is obtained t count = $3.23 > t_{table} = 1.69$. Since the significance = $0.002 < 0.05$ means there is a significant difference in the average gain score of the experimental class with the average gain score of the control class, thus it can be said that the increase in Condet master of Rectilinear motions students through the application of PCK is significantly higher than that of mastery the concept of students through group discussion activities and assignments, or in other words the implementation of Rectilinear motions students' learning through the application of PCK with the help of multimedia significantly increased the mastery of students' concepts than through group discussions and assignments.

Student Responses to the Learning Process

A given attitude scale aims to determine students' attitudes towards PCK implementation in learning. The attitude scale which consists of 18 statements is given to students who take part in learning. Student response results were 3.18 from a scale of 4 and 79.49 from a scale of 100. This result confirms that the teacher's ability to use innovative media can improve student interest and learning outcomes.

Based on the results of the study, it was clear that student interest increased after the multimedia-assisted PCK implementation. In general students respond positively to the learning of the Rectilinear motions concepts with multimedia assistance. This is inseparable from the techniques and methods of the teacher in presenting and packaging the subject matter to students. The use of multimedia in the learning process makes students focus their attention on the material delivered by the teacher. This is shown from the interest of students in participating in teaching and learning activities as well as increasing students' motivation in learning because students feel learning is directly related to students' lives. The use of multimedia as a medium also helps teachers become more innovative in designing media that will be used in the learning process in the classroom.

Based on the results of students' answers through questionnaires, it was seen that students had high enthusiasm and enthusiasm for the learning carried out. Students are more diligent in learning and want to work hard on the questions given by the teacher, although there are still students who have not achieved the expected results. The implementation of PCK with the help of multimedia makes students more willing to express opinions and ask questions to obtain or find concepts.

CONCLUSION

The implementation of PCK with the help of multimedia can increase student interest and learning outcomes in physics learning. This can be indicated by the value of the t test, gain test and the results of student response questionnaires which show that the implementation of PCK with the help of multimedia has a positive effect on improving students' learning interest so that the impact on student learning outcomes increases.

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