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Application of Multimedia Animation Engineering Drawing (MMAED) for Vocational High School Students

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Abstract. The use of animated multimedia in vocational schools in Indonesia is still not optimal, this is due to the lack of innovative teaching materials, especially multimedia-based instructional materials. This study aims to apply the results of the development of innovative teaching materials based on engineering animated image Multimedia for Vocational High Schools especially in the competence of Mechanical Engineering expertise. Meanwhile, the specific objectives to be achieved in this study are: (1) applying innovative teaching materials in the form of Multimedia Animation Engineering Drawing (MMAED) to improve vocational students' competence. (2) Measuring the level of vocational students' competence in engineering image material, especially orthogonal projection material. The method used in this application is using the Experimental method, namely by directly testing the product of Multimedia Animation Engineering Drawing (MMAED) to schools that have mechanical engineering competencies in Indonesia. From the application of Multimedia Animation Engineering Drawing (MMAED), students can increase their competencies in engineering material, especially orthogonal projection material.

1. Introduction

Traditional teaching methods are currently largely abandoned by many teachers because they make the learning process ineffective and inefficient for students [1]. The society development and technology advances make multimedia widely used in the world of education, so it plays an important role in human life today [2, 3]. The use of multimedia in teaching, especially through text, images, animation, sound, video, and interactive networks can stimulate student enthusiasm in learning effectively and efficiently and help with learning difficulties [4]. In modern economic and socio-cultural situations, the quality of education is a strategic factor in innovative developments in Russia. Higher education innovation in vocational schools is very important to do to answer the challenges of modernization and development based on the needs of modern reality [5]. Unlike the curriculum in Turkey, secondary schools use a

learning style consisting of visual, auditory and kinesthetic. The active role of students is important in applying this curriculum.

In some machine drawing engineering vocational schools in Indonesia that were met by researchers, in general, the teaching system was still conventional. This means that the learning process is still teacher-centered, so that if the teacher does not enter to carry out learning then students only do the assignments given. Teachers who still have a lot of time to explain the assignments given will be discussed at the next meeting. However, from observations made by researchers, many teachers did not discuss the assignments given so that many students complained of not understanding the assigned material. Therefore, teaching media is needed in the form of innovative teaching materials to facilitate the achievement of learning objectives.

The results of Baukal's research, Charles E., Ausburn J., & Lynna show that workers who continue the higher education state that they really like multimedia animation in delivering material [6].. This is supported by the results of Rhodes E. (2013) study in America that the students who study in the fields of science, technology, engineering, and mathematics stated that the use of multimedia animation and narrative greatly benefits students in learning compared to the use of static images and text [7]. The results of the García-Rodicio & Héctor study show that 97 undergraduate students learning about tectonic plates that use multimedia animation trigger students to think critically so students ask questions about the material delivered through multimedia animation [8].

Multimedia animation offers new insights into learning machine learning analysis techniques about student learning trajectories in the learning environment so students have more complex and open thinking [9]. This is supported by the results of the study of Katsioloudis, Dickerson, Jovanovic, & Jones that the use of multimedia animation in learning and teaching results in differences in the ability of better spatial visualization in mechanical engineering students [10].

Chiou, Tien, & Lee's research results state that animated multimedia teaching materials improve learning achievement, retention, and learning satisfaction better [11]. While the results of other studies conducted on electrical employees, training methods based on multimedia animation technology and equipped with computer software and database technology increased the efficiency of learning electricity employees and greatly reduced training costs [12]. In addition, the results of research by Fratandha, Suherman, & Komaro, showed that the use of multimedia animation was able to improve critical thinking skills in learning metal reinforcement materials in engineering material courses [13]. The results of the study by Hadibin, Purnama, & Kristianto, show that the use of learning media applications in network computer techniques makes the delivery of lessons more varied so that students are easier to understand the material, interesting, and not boring [14]. The difficulty of engineering students in engineering courses related to abstract learning material requires the instructor to make interactive learning media in the form of multimedia animation so that the learning material is easily understood by students [15]

From several results of the research mentioned above that the use of multimedia animation has many advantages over conventional learning. These advantages include increasing student learning achievement, student learning satisfaction increases, students can learn independently.

2. Methods

The research method used is quasi-experimental research method (*quasi-experiment*). The design of the quasi-experimental study used was the research design of *Nonequivalent Control Group Design*. This is because the subject used is complex human and it is difficult to control internal and external factors that can affect variables. For this reason, this method is considered to have the stability to provide accurate information obtained and approach real experiment research whose conditions are difficult to fulfill in educational research. Experiments carried out in two classes, namely the experimental class using multimedia animation and control classes using media images. In the design of this study, there were two groups consisting of the experimental group and the control group. Both groups were given pre-test

to find out the initial state, whether there is the difference between the experimental group and the control group. The design pattern in this study can be seen in the table 1.

.

Table1. Nonequivalent Control Group Discussion

Group	Prates	*Treatment*	post-test
Experiment	T_{E1}	X	T_{E2}
Control	T_{K1}	Y	T_{K2}

Description:
$T_{E1\,/\,K1}$= Initial tests were given to students
X = Learning using MMAED
Y = Learning using pictures and handouts
$T_{E2\,/\,K2}$= final Test given to students

The two-mean difference test of the two samples was conducted to determine whether between the experimental group and the control group there were differences in N-Gain [16], namely:

$$N - Gain = \frac{\%\ actual\ gain}{\%\ potential\ gain} = \frac{\%\ skor\ pascates - \%\ skor\ prates}{100 - \%\ skor\ prates}$$

In this study also conducted descriptive N-Gain analysis using the N-Gain criteria according to Hake [16], namely: 1) Increase with "high gain", if > 0.7; 2) Increase with "moderate gain", if $0.7 > n > 0.3$; 3) Increase with "low gain", if < 0.3.

3. Results and Discussion

Multimedia animation was applied to determine the students increase in mastering engineering drawing concept, especially the mastery of orthogonal projection concept in vocational high school students, especially mechanical engineering, as shown in figure 1.

Figure 1. Engineering Ani9mated Image Multimedia is applied to students

From the results of the study, it obtained the data of engineering drawing concept mastery especially orthogonal projection material in the control and experimental classes as shown in table 2. The data is used to calculate the N-Gain value which is a parameter to determine the improvement of student abilities.

Table 2. Pre-test calculation results, post-test, and *N-Gain* mastery of orthogonal projection concepts

Data	Score	Class	
		Control	Experimental
Pre Test	Highest	50.00	65.00
	Lowest	10.00	10.00
	Average	25.28	33.16
Post-Test	High	70, 00	100.00
	Lowest	30.00	75.00
	Average	45.83	86.05
N-Gain (%)	Highest	42.86	100.00
	Lowest	7.69	61.54
	Average	27.64	80.68

The value of mastery of concepts towards orthogonal projections (American projections and European projections) is displayed in the form of a diagram as shown in figure 2.

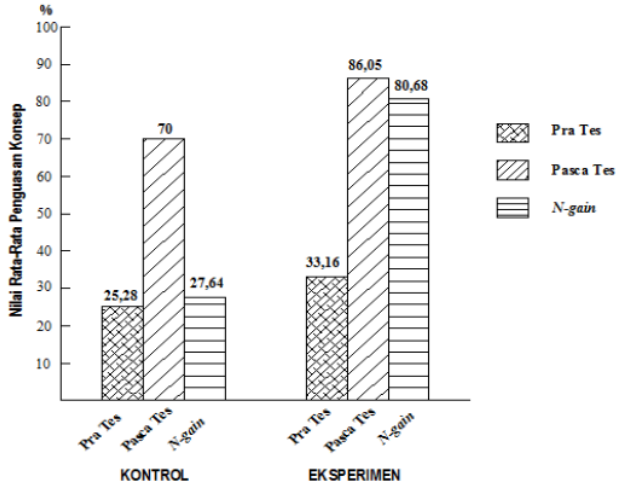

Figure 2. Value of concepts mastery

The discussion relates to mastery of concepts which are part of learning outcomes which are representations of increasing student competence by using Multimedia Animation Engineering Drawing (MMAED). The use of MMAED in engineering subjects can improve concepts mastery. If it reaches 100, it is in the high category. Meanwhile, if it reaches 61.54, it is in the medium category. The average of concept mastery enhancement in orthogonal projection material is 80.68 in the high category.

The use of Multimedia Animation Engineering Drawing (MMAED) can increase the value so that it reaches a high category because generally, animation can improve understanding or learning outcomes. Learning by using animation not only reads, but also sees (the text, still images, and moving images),

and hears which cause increased mastery of the material several times [17]. , besides what is learned tends to be remembered longer [18]. Learning outcomes of what is learned with animation will be mastered deeper because it involves long-term memory (*Long-term Memory)* [19][20].

Real images in learning will have far better results. "An image is worth more from a thousand words ", refers to the impression that complex concepts can be conveyed with only one image [21]. The impact of the learning experience above has been shown to improve mastery of the concept to a high category. This is in accordance with the high relationship between learning media and learning objectives that state media in form of animation has a high relationship to learning concepts. More specifically, the use of multimedia animations in this study can improve engineering concept mastery, and this is consistent with what Falvo stated that Animation from the structure and process can help teachers convey the important scientific concepts [22].

The main outcome of education is learning concepts because concepts are foundation stones or builders thinking. Concepts are the basis for higher mental processes to formulate principles and generalizations. To solve a problem, a student must know the relevant rules, and these rules are based on the concepts he gets [23]. The concept itself as an abstraction that represents a class of objects, events, activities, or relationships that have the same attributes [23]. Mastery of concepts is characterized by following indicators: 1) on attributes, characterized by the existence of relevant attributes, including irrelevant attributes, 2) on relevance, characterized by the existence of links between existing attributes, 3) on clarity, concepts can be seen and concrete- concepts, or the concepts consist of other concepts such as abstract concepts, 4) on coverage, shown in a number of examples involved in the concept, 5) on grouping, concepts can differ in superordinate position and subordinate, 6) on accuracy, a concept concerning whether there is a set of rules to distinguish examples from other than examples from a concept, 7) on strength, a concept is determined by the extent to which people agree that the concept is important [23].

4. Conclusions

Mastery of engineering drawing concepts, especially mastery of orthogonal projection concepts, each increases to reach a high category, using Multimedia Animation Engineering Drawing (MMAED). This enhancement is higher than using images media or handouts that reach the low category. Thus, Multimedia Animation Engineering Drawing (MMAED) has been proven to increase mastery of engineering drawing concept, especially orthogonal projection material up to high category.

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