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The Effectiveness of Interactive Multimedia-based Learning in Engineering Drawing Courses

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The utilisation of multimedia in the learning process in higher education should be a way to bring students closer to computer-based technology. This study aimed to determine the effect of the utilisation of interactive multimedia on improving students' drawing skills in the Engineering Drawing course. This research was a quasi-experiment with one group pre- and post-test research design. It was conducted at Universitas Pendidikan Ganesha, Bali, Indonesia, which involved 28 students from the Department of Mechanical Engineering Education. Data analysis was performed by paired sample t-test to answer the proposed hypothesis. Data collection was carried out through evaluating students' performances in making engineering drawings. The results of the analysis showed that there were significant differences between the pre-test and post-test scores of students after the utilisation of interactive multimedia, as indicated by the value of sig. (2-tailed) of 0.00 < 0.05. Thus, it can be concluded that the utilisation of interactive multimedia can improve students' drawing skills. The effectiveness of multimedia appears to increase understanding of students' concepts of engineering drawing, drawing skills, and also their positive response in using interactive multimedia. The findings of this study indicate the importance of the utilisation of ICT in supporting the learning process in higher education in Indonesia, especially in the development of interactive multimedia.

Keywords: *Effectiveness, learning media, interactive multimedia, drawing skill*

Introduction

Learning is a process that involves mental actively, where an individual integrates it with his prior knowledge relevant (Mayer, 2014). Most of today's learning processes use the constructivist approach (Juanda, 2011), which views that learning is the result of construction done by the students themselves after their interaction with the learning environment. In the learning process, students' memory performance is forced to work harder. A task exceeding the memory capacity will affect the process of learning.

Engineering Drawing is a compulsory course for mechanical engineering students in Indonesia. It aims to equip them with the basic ability to read and make a complete picture of a component unit. The main topics in this course include an introduction to engineering drawings, types of lines, writing of numbers and letters, geometric constructions, 3D-object presentation, various kinds of projections, drawing, image-cutting, dimensions-giving, and tolerance (Reddy, 2008). Thus, in learning engineering drawing, the cognitive and psychomotor abilities of students will be prioritised.

A learning process that is more dominated by lecture or discussion methods can cause students to lack the maximum learning experience (Suyitno, 2016). For this reason, learning media that can accommodate many ways of students' learning process and provide a more learning experience are needed (Febdia & Aziza, 2019; Imansari et al., 2020). According to Rohman et al. (2019), the utilisation of appropriate learning media following the characteristics of students can improve the efficiency of teaching and learning activities so that learning objectives can be achieved. Sulistianingsih (2020) also stated several benefits of learning media, including 1) assisting educators in delivering material to students; 2) as a communication tool that is able to bridge abstract ideas into more concrete ones; and 3) making the process of communication, interaction, and delivery of material more effective.

Along with the rapid development of computerised technology, learning media has been packaged into more innovative and attractive multimedia for use in learning. Simply put, multimedia can be defined as a learning medium that can combine several elements such as texts, images, and audio-visual objects in one media (Rachmadtullah et al., 2018; Heo & Toomey, 2019; Imansari et al., 2020). That is, multimedia do not only contain static text or images, but also are equipped with audio effects, graphics, animation, or video that can support the delivery of material to be more easily catches. Some research results showed that the utilisation of interactive learning media could arouse motivation and enthusiasm and provide psychological influences that can encourage students to learn independently (Sulistianingsih & Carina, 2019; Nasrifan & Rahim, 2019; Rohman, 2020).

Learning in the current technological era has encouraged students to have digital literacy skills as part of their modern culture (Ahmed & Nasser, 2015; Thota & Negreiros, 2015). Internet and computer technology have been able to change the appearance of learning media into interactive multimedia by combining texts with graphic animations, as well as audio and video in it. According to Pranata (2004), multimedia-based learning leads to presentations by combining visual (such as images, animations, videos, and colours) with verbal (such as language elements like narration, text, and labels) elements. Audio and video elements in multimedia can support the process of delivering material to students to be more easily understood (Mishra & Sharma, 2004; Miner et al., 2018; Ahmad & Yin, 2019). Thus, the use of interactive multimedia can have a significant influence on the learning process of students in the classroom.

The lack of students' mastery of concepts and skills in drawing occurs because, among others, they are not much involved in the process of constructing a concept in their mind. Based on this, the utilisation of multimedia is a strategic thing to realise an optimal learning process. This study aimed to determine the effectiveness or effect of multimedia-based learning in improving student drawing skills in Engineering Drawing courses.

Research Method

This study used a quantitative approach with experimental research design with one group pretest-posttest design. Experimental research is a type of research used to determine the effect of specific treatments on a measured variable under controlled conditions (Pandey & Pandey, 2015). This study aimed to assess the effectiveness of the utilisation of interactive multimedia in Engineering Drawing courses.

This research took place at Ganesha University of Education, Bali, Indonesia. The research subjects were 28 students of the Department of Mechanical Engineering Education who took Engineering Drawing courses. To find out the effectiveness of the use of interactive multimedia, in this study conducted a comparative test of test results. This test is carried out to compare the results of engineering drawing learning designs, before and after the application of interactive multimedia-based learning models with one group pretest-posttest design.

This study design was chosen because the conditions in the field did not allow for the holding of a control class as a comparison group. Therefore, one group pretest-posttest research design was used to determine the effect of the treatment carried out through interactive multimedia-based learning models on the drawing skills of students in the Engineering Drawing course.

The subjects in this study were 28 students of Mechanical Engineering who took the Engineering Drawing course. The research instrument used was a performance test that was developed following the subject matter and learning outcomes of the course. Data obtained from the results of the pre- and post-test were then analysed using descriptive and inferential analysis. Descriptive analysis was used to describe pre- and post-test data, while inferential analysis was to test hypotheses submitted through the *t*-test. One sample *t*-test is an analysis technique that aims to test a specific value significantly different from the average of a sample. Data analysis was done using SPSS 24 software for windows with a significance level of 5% or 0.05.

Results and Discussion

The results of this study would be presented through descriptive analysis and inferential analysis. Descriptive analysis is the presentation of data about the results of student performance tests before and after being given interactive multimedia-based learning treatment. Meanwhile, inferential analysis is used to test the research hypotheses. The data in this study were quantitative data obtained from the pre-test and post-test scores to measure student learning outcomes, especially in the Engineering Drawing course.

Descriptive Analysis

Figure 1 below shows graphs showing the results of student performance tests before and after the implementation of learning using interactive multimedia in Engineering Drawing courses.

Figure 1. Students' pre-test and post-test results

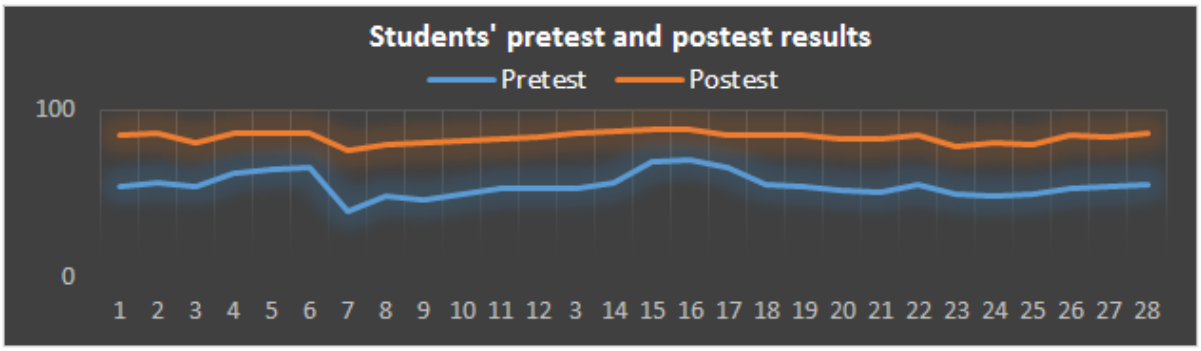

Figure 1 above shows the results of students' pre-test scores before applying interactive multimedia-based learning, as shown in blue graphs. Whereas, students' post-test scores after the implementation of interactive multimedia-based learning is shown with a red graphic. The results of the descriptive analysis with SPSS data can be seen in the following Table 2.

Table 2: Results of descriptive analysis of pre- and post-test data

	N	**Range**	**Min.**	**Max.**	**Mean**	**Std. Dev**	**Variance**
Pre-test	28	30	40	70	54.54	6.9	48.25
Post-test	28	12	76	88	82.75	3.1	9.75

Table 2 above shows the results of the descriptive analysis of students' pre-test and post-test scores in the Engineering Drawing course. It can be seen that the pre-test scores have a minimum value of 40, a maximum of 70, and an average of 54.54. Meanwhile, the post-test scores show a minimum of 70, a maximum value of 88, and an average of 82.75. Based on the results of the descriptive analysis, it appears that the post-test average score of students increased (higher) than the average pre-test one, namely from 54.54 to 82.75.

Before proceeding to hypothesis testing, there were prerequisite tests that must be met, namely data normality test, which in this study was in the form of the Shapiro-Wilk test. The data normality testing criteria were based on the sig. of 0.05. The results can be seen in Table 3 and Table 4 below:

Table 3: Results of the normality test

	Pre-test	**Postest**
N	28	28
Shapiro-wilk	0.934	0.938
Asymp. Sig. (2-tailed)	0.077	0.099
Conclusion	Normal	Normal

Based on Table 3 above, each of the pre-test and post-test scores obtained Shapiro-wilk scores of 0.934 and 0.938 with sig. 0.077 and 0.099, respectively. Because both data (pre-test and post-test) got sig. > 0.05, it can be concluded that both student test data were normally distributed.

Hypothesis testing was done using a paired sample *t*-test analysis. The decision of this hypothesis testing was based on the criteria that if the value of sig. < α (0.05), then H_0 is rejected. The results of the paired sample *t*-test analysis can be seen in the following Table 4:

Table 4: Results of the paired sample *t*-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-28.214	4.717	.891	-30.043	-26.385	-31.652	27	.000

Based on Table 4, the value of sig. was 0.00 < 0.05, then H_0 was rejected. Thus, it can be said that there were significant differences between student pre-test and post-test scores. So, it can be concluded that learning with interactive multimedia significantly influences students' drawing skills.

Discussion

Multimedia in this study was used as an alternative learning resource for students to help them practice their drawing skills. All aspects of drawing skills were adapted to practical activities that would be provided to students in the learning process. Interactive multimedia could direct students in understanding engineering drawing material and also practice drawing skills (psychomotor aspects) with the addition of audio-video or interactive animation. Praheto et al. (2018) stated that multimedia is one form of media that plays an essential role in the learning process. This is also following the multimedia principles stated by Mayer (2014) that students have two channels that are used to process the information received, namely auditory and visual. Both channels have a limited capacity to process incoming information (Pranata, 2004). The additional audio and video elements contained in interactive multimedia would help students understand the material they are learning.

Kurniawati and Nita (2018) stated that the use of learning media is one of the essential aspects of the education process. The material in Engineering Drawing courses contains basic knowledge of drawings, such as drawing tools, various lines and their use, and object projection. The delivery of these materials can be supported by the use of learning media that can combine not only text with images, but also additional audio-video content so that students can more easily understand. This corroborates the opinion of Suyanto (2003) and Munir (2013) that explained multimedia is the use of computers to create and combine texts, graphics, audios, and moving images (video and animation) by combining links and tools that allow users to navigate, interact, be creative, and communicate.

The results of this study were consistent with those of several previous studies, which found that the utilisation of interactive multimedia has proven to be effective in improving the learning process and student learning achievement (Putra & Sujarwanto, 2017; Amir et al., 2018). Multimedia learning can make the learning process easier, especially in abstract material, which can be supported with the help of images and videos in it (Adhitama et al., 2018; Rohman et al., 2019). In learning Engineering Drawing courses, in addition to psychomotor skills, students are also required to have cognitive skills related to the basic concept of drawing knowledge. The combination of texts with pictures enhanced with audio-video features enables learning done by students to be more exciting and effective compared to that with texts or images only.

Conclusion

Based on the results of this research and discussion above, it can be concluded that the utilisation of interactive multimedia in the Engineering Drawing course proved effective in improving the drawing skills of Mechanical Engineering students at Universitas Pendidikan Ganesha, Bali, Indonesia. This learning media was chosen by considering the situation, conditions, material characteristics, and characteristics of students as research subjects. In its implementation, interactive multimedia could be used by students by using PC/laptop devices they had. Additional audio and video contents made the multimedia design looked more attractive, thus increasing students' motivation and independence of learning.

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