

The Effects of Various Animation-Based Multimedia Learning in e-Learning Course

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ABSTRACT

As many as seventy-six undergraduate students in Indonesia were involved in this quasi-experimental study investigating the modality effects of animation-based multimedia learning in e-learning courses. They were divided into three experimental groups (narrated animation, on-screen text animation, animation only) and one control group (printed materials). All groups learned the same materials during four-week sessions. The findings showed that narrated animation achieved bigger effect compared to their counterparts. Detailed results are as follows. 1) Students in the narrated animation group obtained higher scores than those in the on-screen text animation group, (2) Students in the narrated animation group achieved higher scores than those in the animation only group, (3) Students in the narrated animation group gained higher scores than those in the printed materials group, (4) Students in the text animation group had higher scores than those in the printed materials group.

CCS Concepts

• Applied computing → E-learning.

Keywords

Animation; e-Learning; Modality; Multimedia learning.

1. INTRODUCTION

Information and communication technology (ICT) advances have brought tremendous impact on various sectors of our lives such as business, entertainment, and education. Utilizing of ICT in education is used to improve access, effectivity, efficiency, and quality of learning and teaching. Moreover, lecturer creativity can maximize the ICT potential by creating animation for abstract, dynamic, and difficult materials. Learning with dynamic presentations like animations has become popular trends in the last decade [1,2].

Animation is a multimedia component that has an important role in helping learners to understand and digest complex and abstract topics. Animation can contain a process of the motion illusion with explanatory text and narration. Animation can simplify a

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long and complex process by presenting it step by step and making it easy to learn. Furthermore, animation gives a real learning experience for learners when abstract (disassociated) learning topics are simply visualized. In the education field, animations have several purposes including to attract student attention, to demonstrate concrete or abstract procedures and to help students understand dynamic systems. Recent meta-analysis showed that studying with animations had positive effect compared to static graphics [3]. However, some studies reported mixed results regarding the excellence of animation in learning [4,5,6,7]. It is necessary, therefore, to investigate more thoroughly in what situation the animation based multimedia learning provides best results [8].

Meaningful learning using texts and pictures is explained in Mayer's Cognitive Theory of Multimedia Learning (CTML) [9]. It is based on the assumptions that students' working memory have the limited capacity [10], included an auditory and a visual channel [11], and the active learning assumption [12]. The students have to select and organize incoming auditory/verbal and visual/pictorial information in working memory. Finally, they have to integrate existing knowledge to form the mental model [8] (see Figure 1).

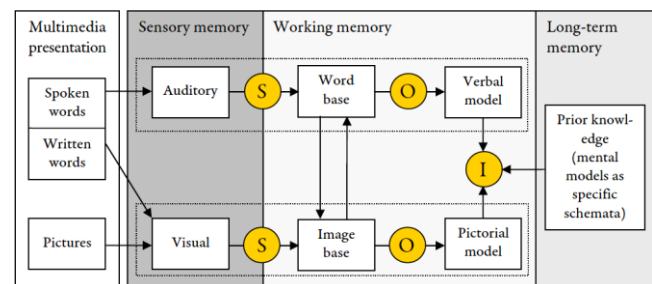


Figure 1. Framework for the CTML [9,12].

In multimedia learning environment, modality principle cites that students receive the information better using animation along with narration than using animation with on-screen text [9]. The CTML theory mentioned that the visual channel becomes overloaded when animation and on-screen text are together presented visually. On the other hand, the auditory channel is not used because there is no information coming. In order to optimize both channels, the texts accompanying animation should be narrated [13].

A narration is verbal information which is presented orally. The auditory information is used to explain and highlight what actually being seen on the screen [14]. This kind of information is processed by the auditory channel. Otherwise, the on-screen text is written information which is presented simultaneously while students are watching animation [15]. This information is processed through the visual channel.

The difference between learning in one modality (watching animation and reading on-screen texts) and learning in two modalities (watching animation and listening to narration) is reported in many empirical studies [16]. According to a meta-analysis, most of these studies indicate that learning by animation and listening to the corresponding narration simultaneously is more effective than by visual information (animation and on-screen text) [17]. Other studies reported similar results [18,19].

In a system-paced instructional material such as animation students cannot control the animation path and interrupt the animation movement, while in simulation students may interrupt the process or change the way the simulation moves. An animation accompanied by related narration is proven to give positive effect on student learning outcomes. However, this does not apply to the simulations. In student-controlled instructional materials such as the simulation, the effect of modalities may have the opposite effect [3,20].

The advantage of visual presentation does not apply to all subject areas. Natural sciences such as biology, chemistry, physics are easy to learn in visual presentation as they require a complex conceptual understanding and contain many interrelated components [3]. The modality effects may have little impact or even do not have the positive impact on social sciences [17]. A meta-analysis [21] found that more studies about the modality effects were conducted in physics than another field. However, it has great impacts in the military and chemistry fields.

Types of information that are delivered by animations also determined the impact level of the modality effects. Information about cause-and-effect explanation is the most widely included in multimedia learning. Only a few non-explanatory related information is accommodated in the animation [3]. Animations that contain procedural knowledge give a higher modality effects than those containing conceptual knowledge [21].

Students learn better using animation which is accompanied with related narration than using animation with on-screen text. When identical written texts are added to the narrated animation, there could be redundant information. In receiving information, overloaded information and missed information could be happened if they are processed using visual channel as well [22]. However, adding summarized texts to the narrated animation can improve learning [23,25]. These studies agreed that few on-screen texts summarizing the narration which are added to the narrated animation can foster learning better than identical on-screen texts. The partially redundant on-screen information which is called on-screen labels plays important role in multimedia learning.

This current study is to investigate the modality effects of animation-based multimedia learning in e-learning courses. Four types of learning materials were developed, i.e. animation with narration, animation with on-screen text, animation and printed materials. The materials cover step-by-step tutoring on e-learning course development. Proposed hypotheses were as follows; students' achievement in narrated animation group is better than those in on-screen text group, students' achievement in narrated animation group is better than those in animation group, students' achievement in narrated animation group is better than those in printed materials group, and students' achievement in on-screen text group is better than those in printed materials group.

2. METHOD

2.1 Design of Study

In this study, three experiment groups and a control group of the quasi-experimental design was used. Students in all groups learned an e-learning course with animation-based multimedia learning materials. Four topics covered in the study include LMS installation, Administrative tasks, Course creation, and Quiz development. The topics were implemented in three types of animations and one printed material. Those would be independent variables and a dependent variable was students' achievement. Post-test was used to measuring the students' achievement after the experimentation. The pre-test was not used because of an assumption that at the beginning of the study they have the same pre-requisite knowledge.

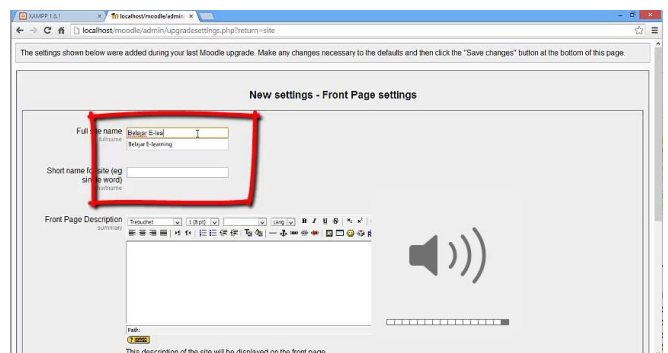
2.2 Participants

The participants were 76 sophomore undergraduate students enrolled in "e-Learning" course from Department of Information Technology Education at the College of Engineering, Yogyakarta State University – Indonesia (age between 19 and 21; 45 males and 31 females). They participated voluntarily in the study. They were divided into four classes including 19 students in each class. The classes were randomly assigned to experimental group 1, 2, 3 and a control group. Prior to group assignments and experimentations, participants were informed about the purpose of the study, the experimental groups, the learning materials, the lecture, and their study requirements.

2.3 Learning Materials

For the experiment purpose, this study has been provided three sets of animation-based multimedia learning materials for the experimental groups and one set of printed learning material for the control group. Each set consists of four tutorial topics in e-learning course i.e. LMS installation, Administrative tasks, Course creation, and Quiz development.

The learning materials for group 1 were developed in formats of narrated animations, which contain procedural tutorials conveyed by related narrations (NA). For group 2, learning materials are in animations without narration, but on-screen texts are added (TA). A sample of captured animations (with narration and with on-screen text) can be seen in Figure 2. For group 3, learning materials are in animations only without narration or on-screen texts (OA). In the control group, students learned the same topics through printed materials (PM).



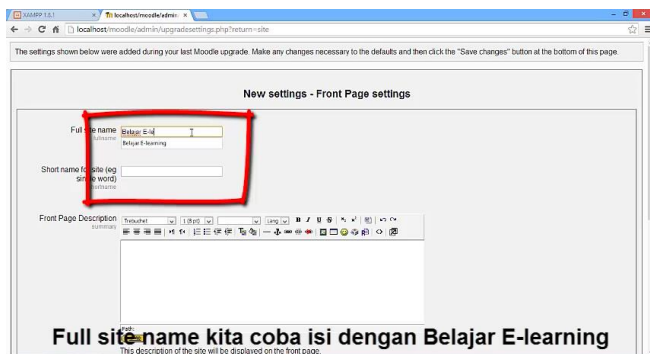


Figure 2. Narrated animation and on-screen text animation.

All materials are available in Moodle-based e-learning portal at <http://besmart.uny.ac.id/v2>. Besides the main learning materials, the portal also provides supporting materials including course description, course schedule, instructor profile, supporting materials (handouts, textbooks, papers, slides, videos, links), announcements, discussion forums, quizzes, and assignments.

2.4 Data Collection and Analysis

To measure the student's achievement, a post-test was provided at the end of the experimentation for the control and the experimental groups. During the experimentation, students in all groups took quizzes to evaluate their knowledge level of each topic. There are four sets of test instruments, each of which consists of 10 multiple choice questions. Each set of instruments was structured according to the range of material topics provided every week. The content validity of the research instrument was done through expert judgments. The test questions were prepared based on the learning frameworks that has been made before referring to the material topics. Moreover, it had been developed according to the syllabus of e-learning course.

To test the four proposed hypotheses, this study used either one-way ANOVA or similar non-parametric Kruskal-Wallis depending on the data obtained. The data were checked to see whether it met the required conditions for the statistical tests. In place of the data did not meet normality requirements based on Shapiro-Wilk test, the data analysis was replaced with the Kruskal-Wallis test and continued with Mann-Whitney test. For the statistical tests, a α -level of .05 was used.

3. RESULTS AND DISCUSSIONS

3.1 Results

Summary of descriptive results (Mean, Standard Deviation, Minimum, and Maximum Scores) from a four-week experimentation is reported in Table 1; while its boxplot diagram is illustrated in Figure 3. The mean score was obtained from achievement test scores conducted every week.

Table 1. Descriptive result summary

Group	N	Mean	SD	Min	Max
PM (0)	19	3.85	0.92	1.80	5.40
NA (1)	19	7.30	0.46	6.20	8.00
TA (2)	19	6.22	1.11	4.00	7.40
OA (3)	19	4.74	0.71	3.60	6.40

PM group: printed materials

NA group: narrated animations

TA group: animations with on-screen text

OA group: animations only (without narration and on-screen text)

There were four hypotheses to be tested in this study where each hypothesis compares students' achievement between the two groups. The data were analyzed by using Kruskal-Wallis test which is the non-parametric version of ANOVA because this research design involved four groups. It is used to test whether there were differences between the four groups. The results showed that there were significant differences between the four groups ($p=0.000$).

The first hypothesis was tested by conducting Mann-Whitney with group (NA and TA) as the between-subject factor and achievement score as dependent measure. From the data obtained, it was concluded that students who learned from narrated animations (NA group) gained better achievement significantly ($p=0.007$) than those who learned from animations with on-screen text added (TA group). NA group mean = 7.30, and TA group mean = 6.22.

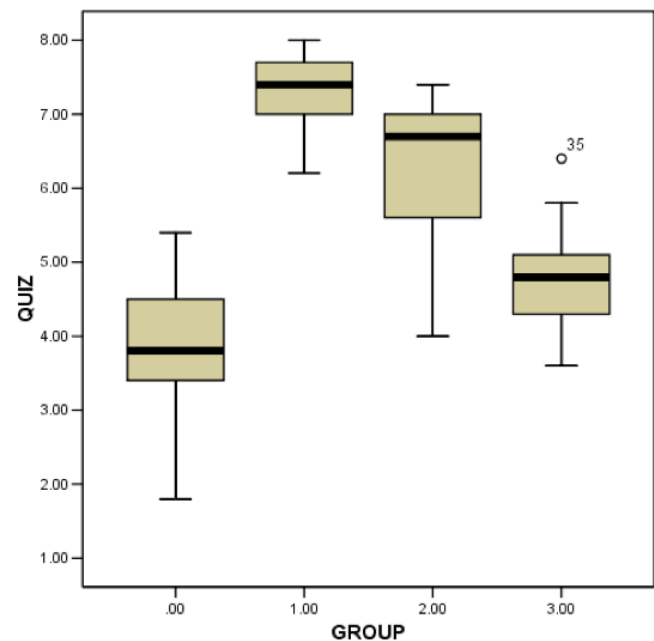


Figure 3. Boxplot diagram of experimental group's scores.

The second hypothesis was also tested with the same tool by comparing NA and OA groups. From the data collected there is a strong evidence to suggest that the student's achievement in NA group where students learned from narrated animations was better significantly than in OA group where students learned from animations only without narration and on-screen text added ($p=0.000$). NA group mean = 7.30, and OA group mean = 4.74.

Using the same statistical test, the third hypothesis was tested by comparing NA and PM groups. it was found that students who learned from narrated animations (NA group) gained better achievement significantly ($p=0.000$) than those who learned from printed materials (PM group). NA group mean = 7.30, and PM group mean = 3.85

Finally, the fourth hypothesis was also tested by comparing TA and PM groups. It was concluded that students who learned from animations with on-screen text added (TA group) gained better achievement significantly ($p=0.000$) than those who learned from printed materials (PM group). TA group mean = 6.22, and PM group mean = 3.85.

3.2 Discussion

Previous studies regarding the advantages of animation in learning showed mixed results [4,5,6,7]. In the current study, we investigated the influence of modalities in a new situation where students learned animations from online courses. The boxplot diagram illustrates characteristic and distribution of data from each experimentation group. The NA group has the narrowest range and the smallest standard deviation among the other groups. It showed that based on the four topics studied, namely; Moodle installation, admin task, course creation and assignment, the narrated animation media can provide students with the most focus understanding among other media.

In addition, the highest mean score was obtained by students in NA group who learned the procedural topics from animations with relevant narrations. The result showed some positive impacts by using narrated animations in learning activity. This result is in line with Mayer's modality principle [9] and has similarity with another study [3, 24].

The first and second hypotheses are the preference of narrated animations role and they were also supported by the findings from many studies. They showed that an appropriate narrated animation is more effective than through on-screen texts [16, 18, 19]. The results of this study have similarity with other studies relating the advantages of short text roles integrated with the animation in improving students' understanding [22].

A meta-analysis [17] suggested that students who learned from graphics with spoken texts performed better than those who learned from graphics with printed texts. To sum up, the second and third hypotheses confirmed that students who learned by using narrated animation (NA group) and on-screen text animation (TA group) achieved higher scores than students who learned by using printed materials.

4. CONCLUSIONS

This study showed that the effect of modalities which combined narration and animation can significantly improve students' understanding in e-learning courses. Narrated animations provide better learning results than shorten text animations. In addition, learning materials presented through text-added animation and narrated animations are more beneficial for students than printed materials. This research suggested to the teachers that the narrated animations can be used in teaching procedural step-by-step knowledge. Further research may investigate on how animations can be used for other learning materials and research fields.

5. ACKNOWLEDGMENTS

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