

# *Analysis of Multimedia Animation (MMA) Application on Material Science and Engineering (MSE) Learning in Higher Education*

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**Abstract**— The research has been conducted to analyze the impact of Multimedia Animation (MMA) application on student achievement of Material Science and Engineering (MSE) subject learning in higher education. In this research, an e-learning media called Multimedia Animation (MMA) was developed. MMA provides learning materials in form of combination between textual explanation and interactive visual animation concept. The research method was experimental with pre-test and post-test that included a control group and experimental group. The study was conducted with 26 undergraduate students in the MSE course subject. It was found that the application of MMA can help students to understand learning materials easily. In addition, the use of MMA helped students to improve their learning outcome in MSE course subject. In comparison to control group students, experimental group students were more successful in Material Science courses due to high N-Gain value. This result shows that MMA application in learning activity can increase the learning outcome effectively.

**Keywords**—*multimedia animation; learning achievements; material science; e-learning*

## I. INTRODUCTION

One of the most challenging aspect in materials science learning is the dimension of the object. The object like an atom, molecule, the bonds between them, crystal structure and other microstructures and macrostructures are invisible by naked eye. It makes the material science have an abstract concept, complexity and need a specific thinking ability to understand the subject.

Materials Science is a basic science and engineering subject in high school and university. This course subject considered as a difficult course. Based on preliminary research conducted in Department of Mechanical Engineering Education, Indonesia University of Education, only 68.6% of students could solve problems related to MSE subject. There are still many students who experience difficulties in studying MSE subject due to its abstract concept, complexity and invisible object.

In order to make the educator easier to teach this subject and improving student achievement in MSE subject, one of the effort that can be implemented is using instructional media or

learning media that can facilitate students to help understand the subject by visualize the abstraction of MSE course subject. In this era, the use of ICT became popular to help learning process more effective, not only in primary and secondary education, but also in higher education. This technology can provide visualization of abstract and complex object to help student in learning process.

Several research had been conducted in application of ICT like interactive multimedia (MMI) on learning process focusing in science and engineering education. The use of MMI on learning process had several advantages comparing to traditional-hands out learning, MMI application can improve the ability to read the image projection of vocational school students [1], and learning achievement of assembly and brake system assembly for vocational school students [2]. Specific to MSE subject, Callister have developed the multimedia animation for MSE subject [3]. But it is still limited in conceptual knowledge such as: 1) the crystal structure in the form of unit cell which does not contain the characteristics of each unit cell determining the mechanical properties of the material; 2) the field and the direction of the crystal which do not yet contain the Phase Diagram determining the ease of the material being formed, or determining the softness and hardness of the material.

Based on the background, the purpose of this study is to analyze the effect of MMA application on MSE learning process and to measure how the MMA technology can improve student achievement in MSE subject.

## II. METHOD

The research used experimental method with pre-test and post-test design. There are two group (Experimental and Control) of student that given a treatment of MMA application in the learning process, with pre-test (O1) and post-test (O2) observation in the beginning and the end of treatment, respectively.

TABLE I. RESEARCH METHOD

Group	Pre-test	Treatment	Post-test
Experiment	O1	X	O2
Control	O1	Y	O2

Notes:  
 O1 : Pre-test  
 O2 : Post-test  
 X : Group with MMA treatment (MMA as learning media)  
 Y : Group without MMA treatment (Hands-out as learning media)

The data analysis used for the observation results from post-test is by descriptive statistics. Descriptive statistics is a statistic used to analyze data by describing of data collected [4]. The descriptions are done by presenting lists, tables, graphs and then generating statistical values such as the highest value, the lowest value, the average value and the N-Gain score of both group. The N-gain score criteria will be divided to three categories, Low Criteria, Middle Criteria and High Criteria [5].

III. RESULT AND DISCUSSION

The learning process in this research conducted in two groups, one group used MMA media for learning process (Experiment Group) and other group used traditional learning using hands-out as learning media (Control Group). Before the learning was carried out, the pre-test (O1) was given as the initial observation for the study and would be compared with the post-test (O2) results of both groups. In this research, the MMA technology that focus on MSE subject was developed before, the technology will be used as instructional media to explain the concept of a system clearly that provides the students to get experience during learning process [6]. The MMA technology that used in this research can be seen in Figure 1 below.

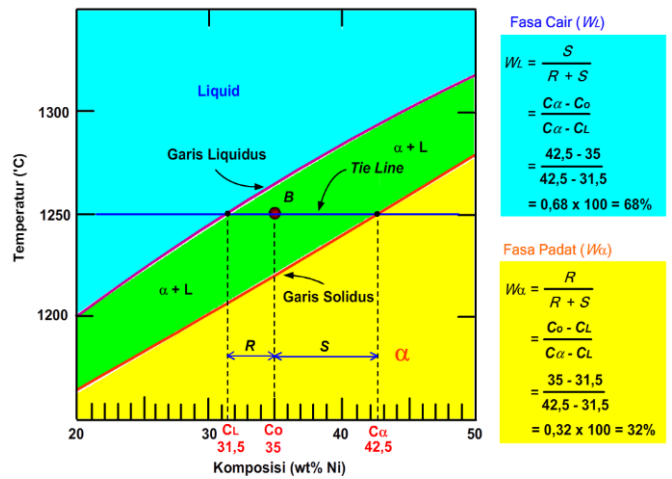


Fig. 1. Multimedia Animation (MMA) of Materials Science and Engineering subject.

Learning outcomes are the results of the pre-test and post-test of students in this study. Learning outcomes of both groups are shown in table 2 below.

TABLE II. LEARNING OUTCOMES OF CONTROL AND EXPERIMENT GROUP

Criteria	Control Group		Experiment Group	
	Pretest	Posttest	Pretest	Posttest
Average Score	7.89	64.27	10.32	83.20
Maximum Score	17.11	90.79	23.68	98.68
Minimum Score	2.63	39.47	2.63	63.16
Average N-Gain	0.61		0.81	

During pre-test, the average score of Control group and Experiment group is 7.89 and 10.32, respectively. The gap between Control and Experiment group is not too far, it does mean the student capability and knowledge about MSE course subject is relatively in same level before pre-test conducted.

After given the different treatment, Control Group and Experiment Group had a different learning outcomes. The average post-test score in Control group is 64.27, with maximum score 90.79 and minimum score 39.47. It is contrast with learning outcomes of Experiment group, the average post-test score is 83.20 with maximum score 98.68 and minimum score 63.16.

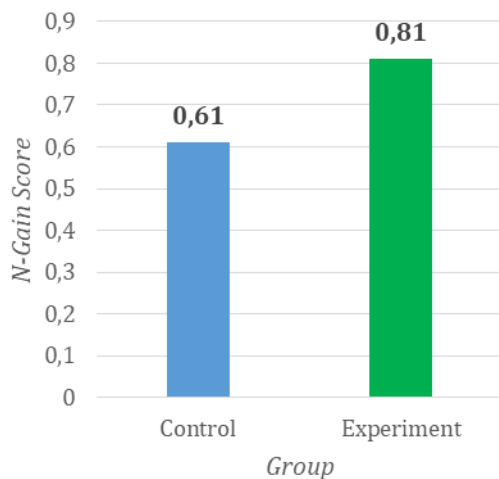


Fig. 2. N-Gain Score Comparison of Control Group and Experiment Group.

The average learning improvement from Control and Experiment group can be seen in Figure 2. The average N-gain score of students in Control group is only 0.61 or in Middle Criteria, but the Experiment group reach score 0.81 or in High Criteria. In this study, the Experiment group that using MMA as instructional media has a higher learning improvement than the Control group that use hands-out only for learning media. It shows that the application of MMA that combine the visualization and simulation in learning process of scientific subject can help student to learn the course materials easily [7], and increase the learning outcomes due to student's involvement in simulation of learning materials [8]. There was a relationship between live images media or animation media to the learning outcomes [9].

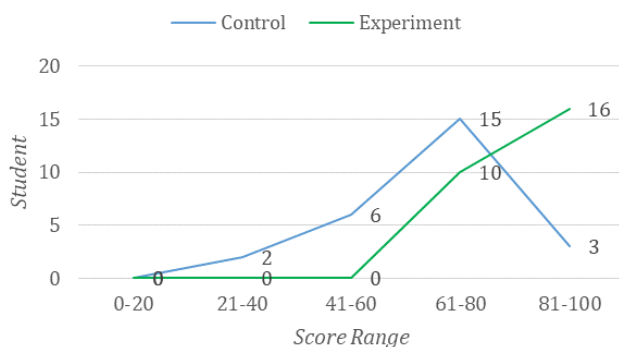


Fig. 3. N-Gain Score Comparison of Control Group and Experiment Group.

Based on Figure 3, it can be seen that the post-test score distribution range of Control and Experiment group is different in curve. The control group is dominated by students who get score between 61-80, while the experimental group is dominated by students who get score between 81-100. In the control group, there were still students who get score between 21-60, while in the experimental group there was no students had score below 61. It can be concluded that the learning process in the experimental group using MMA was more effective and efficient compared to the control group, and

student learning outcome increases with significant. This is proved that this media is not only increasing the performance by, but it is upgraded to 60% with multimedia.

Student learning improvement can be affected by several things. Improvement in learning outcomes can be affected by several factors, the conditions of learning, the learning model used, the learning media, and the attitudes of students itself [10]. In the learning process of experimental group, the learning media used is MMA which implement a combination of visualization, audio, motion and simulation. This advantage makes MMA well received by students and can obtain an in-depth comprehension to the learning materials since they use their long-term memory (Long-term Memory) by visualization [7][11].

#### IV. CONCLUSION

This research shows the effect of MMA implementation as instructional media on Material Science learning in Higher Education. The result shows that Material Science and Engineering learning using MMA as instructional media can improve student's learning achievement with high improvement criteria. MMA is very effective to help student to visualize the abstract and complexity concept in Materials Science learning.

The recommendation of this research include the need of further research to implement the MMA in different course or another education level with different samples. And need for further research on the application of MMA in advanced subject that combine conceptual knowledge and calculation on the learning process.

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