EVALUATING THE USE OF ANIMATION IN PRESENTING MECHANICAL ENGINES' OPERATION

BY

HANA JAMAL BADI

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International Islamic University Malaysia

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ABSTRACT

Educational technology nowadays is becoming increasingly involved in many learning areas for the sake of supporting and enhancing the learning experience. Therefore, universities who use technology think of producing graduates who not only have up to date information but also good working experience and creativity. Mechanical engineering is one important area of engineering. Students of mechanical engineering require practice and live experiments on complex machines and tools. Unfortunately, certain machines are hard to purchase or to make available for learning purposes. In addition, difficult and detailed topics need advanced explanations and well prepared introductions in order to assist students in better understanding the topic. Such situations require technology and multimedia to support its delivery of information. Two methods will be applied in this research in the progress of collecting the necessary information, preparing the animation design and finally analyzing the findings. The first method is the empirical research and the second method is the heuristic evaluation. Both the regression and factor analysis methods are adopted. The final results show that the majority of level four mechanical engineering students agreed and preferred using animation technology in their studies. In this study, the researcher discusses the multimedia technology in education and mechanical engineering education. Practically, the researcher designs a short animated presenting of a mechanical engine which is provided in the questionnaire to assist students in the evaluation. Following this, the collected data is analyzed using the two aforementioned methods. In conclusion, it is believed that the animated presentation of each individual part of a machine, no matter how complex it may be, will enhance student learning capabilities compared to traditional methods of learning.

خلاصة البحث

التكنولوجيا التعليمية في الوقت الحاضر على نحو متزايد تشارك في العديد من المناطق التعليمية من أجل دعم وتعزيز تجربة التعلم. ولذلك، الجامعات الذين يستخدمون التكنولوجيا التفكير في إنتاج الخريجين الذين لا نملك سوى معلومات محدثة ولكن أيضا تجربة عمل جيدة والإبداع. الهندسة الميكانيكية هو أحد المجالات الهامة للهندسة. طلاب الهندسة الميكانيكية تتطلب الممارسة والتجارب الحية على الآلات والأدوات المعقدة. للأسف، بعض الأجهزة من الصعب لشراء أو لجعل المتاحة لأغراض التعلم. وبالإضافة إلى ذلك، الموضوعات الصعبة ومفصلة تحتاج تفسيرات المتقدمة ومقدمات إعدادا جيدا من أجل مساعدة الطلاب في فهم أفضل للموضوع. تتطلب مثل هذه الحالات التكنولوجيا والوسائط المتعددة لدعم قدرته على تقديم المعلومات. سيتم تطبيق طريقتين في هذا البحث في التقدم من جمع المعلومات اللازمة، وإعداد وتصميم الرسوم المتحركة وأخيرا تحليل النتائج. الأسلوب الأول هو البحث التجريبي والأسلوب الثاني هو تقييم ارشادي. واعتمدت كل من الانحدار ومعامل أساليب التحليل. وأظهرت النتائج النهائية أن غالبية مستوى أربعة طلاب الهندسة الميكانيكية المتفق عليها ويفضل استخدام تقنية الرسوم المتحركة في دراستهم. في هذه الدراسة، قام الباحث مناقشة تكنولوجيا الوسائط المتعددة في التعليم والتعليم والهندسة الميكانيكية. عمليا، الباحثة بتصميم رسوم متحركة قصير كان العرض من محرك ميكانيكي والتي يتم توفيرها في الاستبيان لمساعدة الطلاب في عملية التقييم. وفي أعقاب ذلك، ويتم تحليل البيانات التي تم جمعها باستخدام طريقتين المذكورة آنفا. وفي الختام، يعتقد أن عرض الرسوم المتحركة من كل جزء فردي من آلة، مهما كانت معقدة قد يكون من شأنه أن يعزز الطالب قدرات التعلم مقارنة مع الطرق التقليدية في التعلم. التكنولوجيا التعليمية في الوقت الحاضر على نحو متزايد تشارك في العديد من المناطق التعليمية من أجل دعم وتعزيز تجربة التعلم. ولذلك، الجامعات الذين يستخدمون التكنولوجيا التفكير في إنتاج الخريجين الذين لا نملك سوى معلومات محدثة ولكن أيضا تجربة عمل جيدة والإبداع. الهندسة الميكانيكية هو أحد المجالات الهامة للهندسة. طلاب الهندسة الميكانيكية تتطلب الممارسة والتجارب الحية على الآلات والأدوات المعقدة. للأسف، بعض الأجهزة من الصعب لشراء أو لجعل المتاحة لأغراض التعلم. وبالإضافة إلى ذلك، الموضوعات الصعبة ومفصلة تحتاج تفسيرات المتقدمة ومقدمات إعدادا جيدا من أجل مساعدة الطلاب في فهم أفضل للموضوع. تتطلب مثل هذه الحالات التكنولوجيا والوسائط المتعددة لدعم قدرته على تقديم المعلومات. سيتم تطبيق طريقتين في هذا البحث في التقدم من جمع المعلومات اللازمة، وإعداد وتصميم الرسوم المتحركة وأخيرا تحليل النتائج. الأسلوب الأول هو البحث التجريبي والأسلوب الثاني هو تقييم ارشادي. واعتمدت كل من الانحدار ومعامل أساليب التحليل. وأظهرت النتائج النهائية أن غالبية مستوى أربعة طلاب الهندسة الميكانيكية المتفق عليها ويفضل استخدام تقنية الرسوم المتحركة في دراستهم. في هذه الدراسة، قام الباحث مناقشة تكنولوجيا الوسائط المتعددة في التعليم والتعليم والهندسة الميكانيكية. عمليا، الباحثة بتصميم رسوم متحركة قصير كان العرض من محرك ميكانيكي والتي يتم توفيرها في الاستبيان لمساعدة الطلاب في عملية التقييم. وفي أعقاب ذلك، ويتم تحليل البيانات التي تم جمعها باستخدام طريقتين المذكورة آنفا. وفي الختام، يعتقد أن عرض الرسوم المتحركة من كل جزء فردي من آلة، مهما كانت معقدة قد يكون من شأنه أن يعزز الطالب قدرات التعلم مقارنة مع الطرق التقليدية في التعلم.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion; it conforms to acceptable standards of scholarly presentation and its fully adequate, in scope and quality, as a dissertation for the degree of Master of Information Technology.

.....
Akram M. Zeki
Supervisor

I certify that I have read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the Master of Information Technology.

.....
Asadullah Shah
Examiner

This dissertation was submitted to the Department of Information System and is accepted as fulfillment of the requirement for the Master of Information Technology.

.....
Mior Nasir Mior Nazri
Head, Department of
Information System

This dissertation was submitted to the Kulliyyah of Information and Communication Technology and is accepted as a fulfilment of the requirement for the Master of Information Technology.

.....
Abdul Wahab Abdul Rahman
Dean, Kulliyyah of
Information Technology

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Hana Jamal Badi

Signature..... Date.....

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THE IMPACT OF ANIMATION TECHNOLOGY IN MECHANICAL ENGINEERING EDUCATION

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ACKNOWLEDGEMENTS

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Technology provides access to a larger set of resources and allows users to concentrate on core activities that involve contribution, study, and creativity (Cennamo et al., 2009). Moreover, multimedia as a dynamic technology provides the opportunity to present things similar to reality because of its powerful dynamic features that allow the designer to be creative. Holzinger et al. (2008) agreed that in today's education, dynamic media is well known, widespread, and is almost universal in a media society. Although animation is effective and useful in learning, great care is required in order to implement it properly without distracting the targeted users, because according to Tversky et al. (2002), animations can sometimes be confusing and not clearly understood.

Using educational technology in mechanical engineering topics may prove effective because mechanical engineering is a practical subject consisting of many live experiments. Darbyshire (2012) found "the design, manufacture and servicing of engineered products are important to the nation's economy and well-being". In addition, students come from dissimilar backgrounds and have different personalities and understanding abilities. Chang (2007) found "the sources of student motivation may differ, even though students may be equally motivated to carry out the task in the beginning". Moreover, some mechanical machines are costly and hard to make available for learning and experiment purposes. In addition, difficult and detailed topics require further explanation. The perfect approach to test a new technology is to

use it in the location where it will be actually utilized for the best results and understanding, and in order to determine whether this technology is useful or not (Brooks-Young and ISTE, 2007).

Animation can be most effective when used in complex areas of education that are of a practical nature, such as mechanical engineering and medicine. Garcia et al. (2007) found "the case of Descriptive Geometry (DG) is particularly special, since the main purpose of this subject is not only to provide students with theoretical knowledge of Geometry and Drawing, but also to enhance their spatial perception". This example used Macromedia Flash software as an implementing tool to design the animation. This particular software gives the designer the chance to create animations that may assist in better understanding and visualizing the machine's operations and inner components. Moreover, the group also found that animation technologies were able to authorize the learners' interactive observation in most significant subjects in Descriptive Geometry.

Brooks-Young and ISTE (2007) found that current education requires teachers to comprehend that achieving knowledge using old teaching styles may not be sufficient for delivering information to students. This is because in real life, students use a variety of technologies to do similar tasks in a way that feels more logical to them. As a result, there is an increased need for using multimedia in education, particularly when the subject is complicated. Holzinger et al. (2008) found that using dynamic media in learning is more effective than static media especially when the subject is complicated and contents are rich. Holzinger et al. (2008) showed that when the subject matter was somewhat difficult, learning ability by using dynamic media was considerably advanced compared to when using static textbook lessons. Tan and Zhou (2011) (Li and Cui) found that the educating procedure must be well thought-

out from the very first stages of learning. Excellent scores are achieved by monitoring and managing the entire teaching progress, and not from the final testing. As such, teachers must continue to supervise the learning procedure and help and direct students who face difficulties.

Another critical area of education that can benefit from animation technologies is medicine. Choaa et al. (2009) researched 'Animation-assisted CPRII program as a reminder tool in achieving effective one-person-CPR performance', which aimed towards using animation in Cardiopulmonary Resuscitation (CPR) training. The researchers conducted their study on two groups of trainees, namely an intervention group who used animation in their training, and a control group who relied on their previous usual training. The results of the study were highly significant and identified effective uses of animation in medicine. The analysis results of the group's study that used a 30-point scoring checklist showed that the AA-CPRII group performed and scored better in comparison with the control group ($p < 0.001$). Psychomotor skills tested with the AA-CPRII group gave positive results compared to the control group in hand positioning with a score of ($p = 0.025$), compression depth with a score of ($p = 0.035$) and compression rate with a score of ($p < 0.001$). In conclusion, animation-supported CPR could be a useful tool in accomplishing successful one-person-CPR operations.

1.2 PROBLEM STATEMENT

Certain topics in mechanical engineering are difficult to understand if presented in the traditional method of teaching. In addition, some machines such as automobiles, air conditioning equipment, a spacecraft, and all types of engines might not be available for the students in the laboratories due to their sophistication and high cost. Such

machines require explanations of each and every part, plus the mechanism for which they work. The detailed nature of engineering requires lecturers to give an introduction about the machine before experimenting with it in the laboratory. Using normal white boards and textbooks may not be sufficient for the students to properly comprehend the topic. Therefore, this research aims to design animation program that would allow lecturers to effectively teach difficult subjects through animation presentation in the classroom.

1.3 RESEARCH QUESTIONS

This research has three questions in total:

1: is there is any way to enhance the current learning or teaching styles of mechanical engineering contents to students?

2: what are the impacts of animation technology on mechanical engineering teaching or learning style?

3: does current teaching pedagogy rely on animation technology?

1.4 RESEARCH OBJECTIVES

The objectives of this research are:

1. To design animation technology that presents mechanical engineering content to students with converging learning styles.
2. To analyze the impacts of the animation technology in the presentation of mechanical engineering contents to students with converging learning styles.
3. To assess animation technology as a teaching pedagogy.

1.5 SIGNIFICANCE OF THE STUDY

Nowadays, lecturers in many universities are using advanced technological tools in the classroom to support their teaching and to help students better understand the subject. Moreover, we are living in an environment that is fully integrated with technology and computers. Students are not just addicted to this technology but are also highly self-educated in its use. As such,

1. Students require a well-developed learning environment in order to better understand and manage the technologies related to their field of study.
2. Using such updated technology in learning will enrich their experience, formulate better academic performance, and raise the learning levels of problem solving abilities.
3. As observed by the researcher, tools that are used in the classroom such as, whiteboards and projectors; are not in a good condition besides, they are of a very old version that does not even support good quality presentations. Such tools must be upgraded to the latest versions to help both lecturers and students to butter understand and interact in the class which eventually will give a positive impact on the industry.

1.6 SCOPE OF THE STUDY

While there are many areas of discuss in education particularly regarding applications of current technological advancement such as the use of multimedia, educational technology, etc. This research would evaluate the current programs of teaching engineering courses in IIUM and develop an animation program which is hoped would enhance the teaching styles and understandings of the students particularly the courses that are more difficult relating related to engines, aircraft, etc. Those, the

researcher will select a sample engine that is the Four-Stroke Petrol engine. The engine is animated in such a way that illustrates its internal components and how it works.

1.7 THESIS ORGANIZATION

There are great researches and findings on engineering issues. However, based on this research questions and objectives the overall research contents are organized as follows:

- **Chapter one:** includes explanations for the research background and problem statement, as well as the objectives, research questions, significance of the study and the scope of the study.
- **Chapter two:** scholar and reliable authorized resources are used to write the literature review. The contents of this chapter focuses on educational technology, multimedia in education, the implementation of animation technology in different learning areas, learning styles, human computer interaction and the use of dynamic media in mechanical engineering education.
- **Chapter three:** development of animation educational aid technology. In this chapter the researcher discusses the detail function of the software Adobe Flash CS3 that the researcher used to design the sample animation for the questionnaire. The chapter also discusses the animation methodology and design besides, the questionnaire and evaluation structure.
- **Chapter four:** explains the research method, research design, study population, questionnaire preparations and data analysis technique.

- **Chapter five:** discusses the data analysis, overview of data, rate of response, demographic profile of respondents, the impact of animation on responses' learning, factor analysis and hypothesis test summary.
- **Chapter six:** includes discussion on major findings, conclusions, recommendations and limitations of the study.

1.8 SUMMARY

This chapter contains a clear explanation of the overall nature and purpose of the study. It consists of a detailed explanation of the research background and the problem statement, which discussed the current obstacles that the industry and mechanical engineering education face. The research objectives that contain a list of points that the researcher aims to achieve were described. The significance of the study illustrates the importance of applying animation in teaching approaches to mechanical engineering. The scope of the study showed the important fields and areas that the researcher will focus on during this study and highlighted the things that will be taken specifically into consideration. Commonly used terms in the research were defined, and the thesis organization was outlined.

Universities with specialties that require practice in most of its curriculum such as engineering are encouraged to produce graduates not only with fresh and upgraded information but also with a variety of problem solving skills, creativity in their work, technological knowledge and good working experience. This research focuses on the use of multimedia technologies in mechanical engineering subjects to improve student understanding of the subject. In general, the main objective is to find a solution for the practical lessons in mechanical engineering in cases wherein those machines are unavailable.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In contemporary education, the concept of the classroom teacher has changed from the "sage on the stage" to the contributing member and director of learning that takes place in the classroom (Tileston, 2010). Tileston (2010) found that multimedia technology must be a fundamental component that is available in all classrooms since it is the tool of twenty-first-century education. Using technology in learning is a practical solution to ensure better understanding. McGrath and Brown (2005) found that visual learning plays an essential role in utilizing students' visual senses to improve learning and employ their attention. Therefore, the idea is to create a new learning environment for mechanical engineering students to enhance their understanding, practical skills, and performance by using one of the dynamic multimedia technologies, namely animation.

"For over three decades the term 'learning styles' has appeared in academic literature, often discredited, misinterpreted and dismissed as a concept that is either dangerous or doesn't really exist" (Prashnig, 2006). Hundreds of educators used this concept in learning and achieved positive reactions from students and great results. Its utility is testified to by its wide presence in almost all educational organizations. Sonbuchner (2009) found "the channels a person learns through and the materials used can make the difference between success and failure".

2.2 BACKGROUND INFORMATION

Animation as a multimedia element contains and describes all the other elements by forming a combination that is rich in presentation and delivering information. Miller (2010) found that popularity of animations comes from its unique features. It has a lasting impression on the memory of the user, and it is the single most important reason for its efficiency. In addition, animation makes learning environments more instructive, engaging, and works well for students. Miller (2010) continued by asserting that all of those practical elements actually provide a vast platform for students when learning essential and valuable lessons. In the following, the researcher will discuss the definition of keywords and terms that are related to the study directly, educational technology and how it is merged in education to support students' understanding, the perceptive theory of multimedia learning and the use of animation in different education areas, animation as a problem solving technique in engineering education giving some examples of multimedia used in engineering education, different learning styles, human computer interaction, usability engineering and a comparison between the static media and the dynamic media showing the advantages and drawbacks of each.

2.3 DEFINITION OF TERMS

The key terms used in this research, besides 'Animation' are:

- **Educational Technology:** "Educational technology is an innovative way to design, deliver, facilitate, and manage instruction for learners of all ages, whether it is face-to-face in a classroom, online, or a combination of methods" (Department of Educational Technology in Boise State, 2011).

- **Mechanical Engineering:** "Mechanics is a field of science that studies motion and what causes it. Engineering combines science and math to design, build, and run structures, machines, and systems" (Herweck and Weir, 2008).
- **Multimedia Technology:** "Its scope is transversal (any final client) and strategic (always fits in) while being built on the top of imagination, creativity, aesthetics criterion, analysis capability, communication, compromise and technical and physiological abilities, among others" (Cheng et al., 2010).
- **Animation:** "Computer animation, as used here, refers to any computer-based computation used in producing images intended to create the perception of motion…In general, any value that can be changed can be animated. An object's position and orientation are obvious candidates for animation, but all of the following can be animated as well: the object's shape, its shading parameters, its texture coordinates, the light source parameters, and the camera parameters" (Parent, 2012). "When used appropriately in your application's user interface, animation can enhance the user experience while providing a more dynamic look and feel. Moving user interface elements smoothly around the screen, gradually fading them in and out, and creating new custom controls with special visual effects can combine to create a cinematic computing experience for your users" (Mac OS X Developer Library, 2008).

2.4 EDUCATIONAL TECHNOLOGY

Hefzallah (2004) defined educational technology as "a learning environment that is structured with precision using conventional and new technologies of instruction to achieve clearly stated goals and objectives". In addition, Hefzallah (2004) found that

an educational technology (ET) atmosphere is a surrounding that can encourage learning correspondence for two reasons:

1. ET environment can be organized to be helpful and full of materials. Such an environment provides ease of learning and enjoyment for all types of students whether disabled, slow learners, or fast learners based on their preferences and learning styles.
2. By using upgraded technologies, students around the world will be able to interactively access the educational resources and benefit from them easily.

Higher education is a sensitive level of learning that requires useful materials to support its delivery of information for the practice, problem-solving skills, and overall knowledge that it required from both students and teachers. "In this modern and advancing age, technology is a powerful complement to traditional teaching methods in higher education. Professors can help maintain students' interest and excitement by using technologies to provide a variety of instructional techniques and presentations in the class" (Inoue and Bell, 2006).

Some people think that educational technology might render the teacher as an educator redundant. Such thoughts are false because ET involves three main phases that are linked together and work as one full system (Singh, 2006):

a) Input: contains the university, classroom, teacher, resources, and materials.

b) Process: pertains to teaching styles, practices, learning approaches and the teaching and testing through the use of audio-visual support utilities.

c) Output: is formed in the students' understanding, capability and recognition.

Educational technology has a variety of characteristics capable of supporting alternative assessment approaches, containing different methods of presenting information, maintenance of various communication advances, assessment of group work, and multiple data collection approaches. Performance assessment and project assessment can also be improved by educational technology (Kovalchick and Dawson, 2004).

2.5 COGNITIVE THEORY OF MULTIMEDIA LEARNING

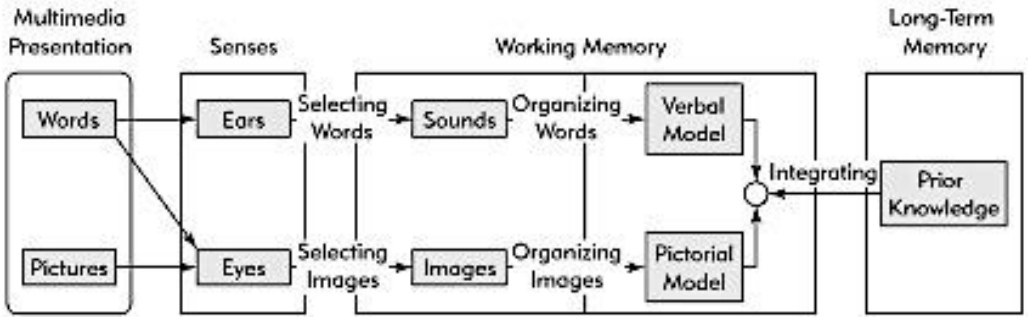

Figure 2.1 Cognitive theory of multimedia learning by Clark and Mayer (2011); adapted from Mayer (2005)

In Figure 2.1, Clark and Mayer (2011) present a model that shows the learning progress with multimedia lessons. They explain that the two processing rows, which are words and pictures, illustrate the dual channel principles that every individual has which contains processing visual/pictorial material and auditory/verbal material. The limited capacity principle where a person can concentrate on a limited number of instructions in each channel at one time is illustrated by the large Working Memory box placed in the middle of the figure. The active processing principle where learning takes place when the appropriate material is presented in the right way is illustrated in the figure by five arrows which are; selecting words, selecting images, organizing words, organizing images, and integrating. However, no matter what type of