The Impact of Computer Animation Learning
On Students’ Academic Performance

by
Mohd Khairezan Rahmat
Universiti Teknologi MARA (UiTM)
Email: khairezan@yahoo.com

Abstract: This study intends to observe the impact of computer animation towards student’s academic performance with different level of achievement and learning styles. A topic on ‘Batik’ (Malaysian Traditional Craft) based on Form Four and Five Visual Art Education subject was developed and has been selected as an instructional materials and research instrument. This study utilizes a quasi experimental design of two independent groups of students based on a factorial design 2 x 2 x 2 on students with different learning styles through a computer animation learning courseware towards students with different achievement level and learning styles. Data collected were later analyzed using inferential statistical methods, through Two-Sample T-Test and One-way ANOVA. The findings from this study shown that, the computer animation learning courseware had given a positive effect on student's academic performance. The findings from this study also showed that learning through computer animation will bring a significant effect on students’ achievement (high and low prior knowledge) and their learning styles. These results indicated that learning through computer animation, utilizing systematic theory and development design able to bring positive effects on students, irrespective of the different learning style and degree of achievement.

Keywords: computer animation, impact, students’ academic performance

Introduction
Multimedia offers an alternative medium of instruction to the current learning process. The nature of interactivity and discovery in multimedia learning bears a beneficial boost to the monotony of passive learning (Mayer, 2000). Both teacher and students may control their own paced of lesson according to his or her own ability. Multimedia can give low ability students extensive learning time before moving forward. Alternatively, high ability students can branch out to random sequencing through the module and not be confined by linearity or a much slower pace (Mayer, 2001; Mayer & Moreno, 2003). This aspect of multimedia learning supports student-centred strategy whereby learners take responsibility in their own learning process (Clark & Mayer, 2003). The liberty to proceed or recede allows self-pacing, an important facet to enable learners to learn according to their individual pace and that will insure both group of students may perceive information equally (Morena & Mayer, 2000).

Mayer (2000) defines multimedia as the presentation of the learning material using both pictorial form and verbal form such as spoken and printed text. Through it, instruction may include motion, voice, text, graphics and still images (Moore, Burton & Myers, 1996). One important combination of media is animation, that been define as an images in motion (Dwyer & Dwyer, 2003). Animation capable features are innovations which can enliven the learning experience. The flexibility of learning through animation will allows a wider range of stimuli thus increase the student engagement in learning. Kearsley (2002) studies show that students who learn from animation have greater self-esteem and motivation. His studies also show that students may retain information and sustain the learning process increases. According to Reeves (1998), animation learning can stimulate more than one sense
at a time and that may be more attention-getting and attention-holding. This study attempted to examine the effects of animation on student performance with different level of achievement (high and low ability) and learning styles (linear and non-linear) in Visual Art Education subject.

**Related Literature**

**Information Processing & Dual Coding**

Information processing theories described human brain as similar to a computer and human learning as similar to how computer processes information (Chandler & Sweeler, 1991). There are three main storage structures in the memory system (1) sensory register, which registers stimuli in the memory system; (2) short-term memory (STM), which serves as temporary storage; and (3) long-term memory (LTM) where information is permanently stored.

Pavio’s (1986) dual coding theory further stated there are two separate information processing systems which is a visual system which processes visual knowledge and a verbal system for processing verbal knowledge. According to Riber (1994) animation that combines visual and verbal knowledge may store information into long-term memory thus facilitates encoding and retrieval process. Dual coding theory also suggests there are three distinctive levels of processing that can occur between the verbal and visual system: representational, associative and referential (Rieber, 1996). Representational processing connects the incoming stimuli from the environment to either the verbal or visual system. Associative processing constructs
connections within either of the verbal or visual systems, and referential processing builds connections between the verbal and visual systems (Rieber, 1994).

**Animation as an Aid to Information Processing**

Animation helped decrease the time to retrieve information from long-term memory and then subsequently reconstruct it in short-term memory. Reiber (1990) explained that animations facilitate the reconstructing process during retrieval by encouraging organization. Mayer (1994) in his study show that computer based animations can be used to promote scientific understanding. Finding also found that students performed better on recall and problem solving test when both the verbal and visual systems were utilized. Chuang (1999) in his study found that student with different of gender and learning styles (field dependence/ field independence) perform on the ability to solve learning problems.

Animation with a support of text had reduced cognitive load of a student’s (Mayer, 1996). His research found that animation complemented with a textual explanation enabled students to take greater advantage of their capability to process information on two levels by stimulating the visual system and by reducing the load placed on the verbal processing system. This re-shuffling of information in working memory increased their ability to make meaning out of the information in preparation for storage in long-term memory. The placement of the supporting textual explanation next to the animation further reduced cognitive load and enhanced performance (Lai, 2000). Students will be guided to learn by sifting the relevant from the irrelevant
information and can relate new information to real world situations (Stoney & Oliver, 1999).

**A Model of Animation, Dual Coding and Information Processing**

Gagne and Driscoll (1988) created a basic model of learning and memory underlying modern information processing theories. It shows how animation works as an aid to dual-coding and information processing (Figure 1). According to Mayer (2001) this theory integrates theories that focus on presenting information in dual mode without increasing the cognitive load. This theory claiming that human process two separate but interdependent systems for processing verbal and pictorial materials. Each channel is limited in the amount of material that can be processed by the learners at one time (Chandler & Sweeler, 1991). The active connections between verbal and pictorial representations will ensure active learning and cognitive process happened. Learners will engage in selecting, organizing and integrating knowledge.

Animation is processed as a part of the visual information. Animation as an attention gaining strategy helps to gain attention and reduce the processing demands in STM, while animation as an elaboration strategy not only helps reduce the processing demands in STM, but also facilitates encoding and retrieval processes by connecting information and providing alternative retrieval pathways (Gagne, 1985).
Learning and Thinking Styles

The term learning and thinking style refer to the characteristic ways in which individuals conceptually organize their environment. This will influence how students learn, how teachers teach and how teachers and students interact in the classroom (Witkin et. al, 1977). According to Raven, Cano, Garton & Shelhamer (1993) given students learn in different ways, instruction should be designed in such way that can accommodate different learning styles. Several classifications of learning and cognitive styles have been purpose by Dunn and Dunn (1978), Felder (2000), Gardner (1993) and Kolb (1984).

Figure 1: A Model of Animation, Dual-coding and Information Processing
Witkin and Goodenough (1979) had developed the concept of field dependence (FD) and field independent (FI) cognitive styles that were defined as the extent to which a person perceives part of a field as discrete from the surrounding field. According to Summerville (1999) FD and FI is a global versus an articulated styles that reflected to the degree to which an individual’s processing of information is affected by the contextual field. FI learners have been referred to analytical, individualistic, task oriented, internally referential, self structuring, linear, detail oriented, interaction, passive learners that prefer external information structures (Hall, 2006).

**Student Prior Knowledge**

Prior knowledge has been considered the most important factor that influences learning (Bloom, 1994). Jonassen and Grabowski (1993) defined prior knowledge and achievement as the knowledge, skills or abilities that the learners bring to the learning environment before the instruction. Dwyer (1994) further classified students’ prior knowledge into high and low level. Hannafin (1997) suggested that compared to individuals who have lower prior knowledge, individuals who have higher prior knowledge can quickly determine their own learning needs, generate their own learning strategies and assimilate new information to their existing knowledge structure.

Mayer and Anderson (1992) found that learning significantly improved for students who possess low prior knowledge when verbal and visual information are presented simultaneously. They suggested that experienced students might be able to build
referential connections between verbal and visual information and their existing knowledge on their own. The computer-based instruction utilized in this study presented verbal (the text) and visual (the graphic illustration or animation) information simultaneously. One of the purposes of this study is to investigate if varied animation strategies will improve the performance of the students identified as possessing low levels of prior knowledge.

**Visual Art Education**

Art teachers have been firm to defend the necessity of art programs in education that claim to improve higher-order thinking skills (Gullatt, 2007). Hamblen (1997) stated that arts are a means by which students become involved, active learners rather than passive, bored students. Passivity leads to boredom and a sense of uselessness and that will become serious obstacles to their academic success (Greene, 1991). Another identified benefit of art was that students are enabling to construct their own meaning because they are actively involved in learning (Catterall, 1998). According to Burton, Horowitz & Abeles (2000), art promote the following outcomes in students’ creativity, originality, focused perception, imagination, risk taking, task persistence and ownership in learning.

The correlation between exposure to the art and student learning styles and achievement has been a subject of much debate (Winner & Hetland, 2000). According to Gardner (1999) art are integral to the education of the whole child. He had proposed that all students have intelligence which registers in eight categories, through with varying degrees of proficiency: (i) linguistic, (ii) logical-mathematical, (iii)
spatial, (iv) bodily-kinaesthetic, (v) musical, (vi) interpersonal, (vii) intrapersonal and (viii) naturalist (Gardner, 1999). He also stated that educators are not meeting the learning needs of their students and school are judging students’ performance largely on standardized test scores. Identification of students’ intellectual strength can be used to foster the introduction of a concept. Gardner (1999) believes that if students were taught in ways that would strengthen all intelligences, they would have more success in academic.

Research Purpose and Questions

The purpose of this research was to investigate the impact of animation towards student’s academic performance with different level of achievement (high and low levels of prior knowledge) and learning styles (linear and non-linear). Two research questions were explored.

1. Does animation improve the performance of the students with different level of achievement?
2. Were there significant differences in the performance of the students with different level of prior knowledge and performance of the students with different learning styles through computer animation based-learning?

Instructional Design

Gagne’s Events of Instruction
Gagne’s theoretical framework was based on the cognitive perspective of learning and emphasized largely on the effectiveness of the instructional design. This theory has correlated the nine events as elements of a good lesson to promote effective learning (Gagne, Briggs & Wager, 1992). The development and creation of the computer animation based learning incorporated with Gagne’s Nine Events of Instruction to be considered a good lesson design (Ellington & Earl, 1999).

Event (1): Gain Attention

Learning is a process which requires attention. In order for learning to take place, capturing the attention of the students is therefore critical; Gagne purposed that learning material should provoke learners to be inquisitive and motivated. In the computer animation based learning courseware, images, textual information, sound and contrasting colors as background were used to attract learner’s attention. Animation was added as part and parcel of the course as well as to stimulate learners’ attention.

![Figure 2: Screen of Main Menu](image)

Event (2): Inform Learners of the Objectives
Learning objectives should be made clear to the students at the start or early of each given lesson. Objectives would initiate a conscious responsibility towards the learning process; this will help assist students to complete the learning programme. The students were informed of the objectives prior to given the module. The module contained a page stating and explaining the objectives of the module. The title of the lesson was also stated and provided input to the content that is to be studied. A pre-test was also given to the students prior to using the module.

![Figure 3: Screen of Learning Objectives](image-url)
Event (3): Stimulate Recall of Prerequisite Learning

Within this context, prior knowledge and understanding of previously learned concepts are associated to the overall learning experience. The ability to make connections of previous knowledge to newly learned information can facilitate learning development. In order to understand the topics, students had to have prior knowledge in the multimedia and animation in general.

*Figure 4: Screen that Recall Student Prior Learning*
Event (4): Presenting the Content

Due to the different learning styles, learners have selective perceptions of content based on each individual needs and cognitive awareness. In order to elicit a response from the learner, stimulus in this aspect refers to the presentation or display of the content. Therefore, clear, simple and direct to the point language was used to explain concepts. Images, sound, video and animation elements were used to illustrate ideas, demonstrate and present content. Also contained were navigational tools for the students to explore.

Figure 5: Screen of Presenting the Contents

Event (5): Providing Learning Guidance

Providing examples, guided instructions and graphical representations, in the learning program offers additional guidance to assist learning. Within ‘Batik’ computer animation learning courseware, learner’s activities were built into the module for the students to interact with images, video, sound, and animation for the students to use and understand the content being presented. The ‘Batik’ process was demonstrated and sound was made available to the students to further understand the content presented.
Event (6): Eliciting the Performance

Post-test were given to the students to assess their understanding towards learning on computer animation based learning methods. Also, through the repetitive exploration of the learner’s activity built into the modules, the students will be required to demonstrate their understanding.
Event (7): Providing Feedback

Providing informative feedback on learner’s performance is an important reinforcement process. Students in this learning environment had access to the teacher via email. Instant messaging feature was added to the module to allow the students to ask the teacher for help or clarification and for teacher to provide feedback to the students. Instructions on how to use the modules were also included to provide feedback.

![Figure 7: Screen that Show a Feedback from Student Answer](image)

Event (8): Assessing Performance

In order to determine the effectiveness of the learning process, assessment was required to evaluate students’ comprehension and knowledge of the learned content. They were also given post-test to see if they understood the content that was presented to them. Projects required critique sessions to demonstrate students understanding of the animation principles by creating an animation movie reflecting the principles learnt.
Event (9): Enhancing Retention and Transfer

Learning is complete when knowledge can be transferred into a new situation. The need to have varied practice tools and aids can facilitate transfer and enhance retention process. The students have to apply what they have learnt in the module in doing a final independent project.
Methodology

Research Design
The research conducted was a quasi-experiment based on the factorial 2x2x2 design, administrated onto two independent groups. Through this method, the research is able to manipulate or exercise control on the variables. Gay (1992) advocates that this design will involve at least two randomly formed groups on which a pre-test functioning as dependent variables is administrated.

The design of this research involves the random segregation of students based on strata sampling. Through this method, the samples were divided into two groups based on the students’ different cognitive styles: field dependent (FD) and field independent (FI). The students were then further re-grouped into two more subsequent groups: those with high achievement levels and those with low achievement levels. The division of these two groups of students was to investigate if there was an increase in performance for the two groups of students who choose the learning styles (linear and non-linear) before and after using the developed web-based learning materials. The achievements of the students from both groups were measured based on their pre-test and post-test scores. The data obtained were analyzed using Two-Samples T-Test and One way ANOVA.

Research Samples
One hundred and sixty form four students from thirty secondary schools in Gombak district, Selangor participated in the study. They are taken Visual Art Education subject as their elective subject. According to Schmeck (1983) at this level, students
learning process were start to develop and it able to influence their academic performance. Dunn (1983) added that student in upper secondary may tend to have their preferable learning styles.

**Research Instruments**

This research involved three main instruments: the Group Embedded Figure Test (GEFT), pre-test and post-test as well as Students’ Aptitude Test. The GEFT test was administered to determine the students’ respective cognitive styles group. A pre-test was then administered to the research samples to determine their existing achievement levels. This was followed by the administration of the post test a day after the samples had participated in the specially developed web-based learning session. The Students Aptitude Test was a test designed and administered to ascertain whether the students fell in the high or low achievers’ groups.

**Data Analysis**

All data obtained were analyzed using the statistical methods found in the SPSS software which catered to the research questions and objectives. The data were analyzed using the Two-Sample T-Test and One way ANOVA. The Two-Samples T-Test was used to determine the difference in means for both dependent variables. The One way ANOVA was applied to simultaneously test the difference between means of two or more groups of dependent variables.
Research Findings

Result and Findings

Two-Samples T-Test was used to test the differences in student achievement between those who choose linear learning methods and those who used the non-linear or web-based learning method. The significance level used to test the statistical significance is 0.05. The findings of this test indicate that 91 students choose the linear learning style (m=4.49) as compared to 69 students that choose the non-linear styles (m=4.29). The findings also reveal that there were no significant differences (p=0.559) between the performance of students who chose the linear learning styles as compared to students who choose non linear learning styles.

The research findings also looked at the difference between student performances with differing cognitive styles through linear learning styles as compared to the student performance with differing cognitive styles through non-linear learning styles. Division of the groups through different cognitive styles: Field Dependent (FD) and Field Independent (FI) were also carried out. This was then followed by the division of student group based on their performance levels (high and low achievement) as well as their learning styles (linear or non-linear). After conducting an analysis through One-way ANOVA with a significance level of 0.05, it was revealed that the p value stands at 0.156. This indicates that there is no significant deference between the performance of students with different learning styles (non-linear) and cognitive styles and the performance of students with different learning styles (linear) and cognitive styles.
Conclusion and Discussion

This study attempted to examine the impact of computer animation towards student’s academic performance. The study showed that students with lower prior knowledge performed equally well to those with high prior knowledge. This result was contrary to much previous research that showed high prior knowledge students perform better than low prior knowledge students. Based on dual cording theory, students with low prior knowledge are helped more when verbal and visual information is presented simultaneously since it helps them build referential connections (Mayer & Anderson, 1992). By rearranging the layout of the instructional text and static visuals, the animations were put side by side instead of static graphic on the top and instructional text at the bottom. This layout would encourage the learners to read the instructional text as well as build connections with the static graphic or animations. There was a significant difference between the high and low prior knowledge students in the pre-test, but the differences were obviously reduced to insignificant differences in the achievement tests after they went through the computer animation based-learning.

The result of the interaction between level of prior knowledge and learning styles provides an important contribution of the effectiveness of animation towards student’s academic performance. Insignificant differences were found between students with different level of achievement. The results showed that the linear based learning styles performed equally as well as the non-linear based learning. This overall finding continues the debate about the value of animation in presenting a concept of teaching. Visualization, included in all treatments seemed to be a powerful factor in learning this multimedia teaching material. The results were in a accordance with many previous literature and animation related studies with different
level of prior knowledge. Clark and Mayer (2003) justified the modality effect by states that students learn more deeply from multimedia lessons when words explaining concurrent animation rather than onscreen text using coordination presentation of explanation in visual format. Wilson (1998) found a general tendency of the mean score for the static treatment produce somewhat better result than any dynamic treatment. Owens (2002) found a trend that the students’ performance decreased as animation strategies were added to the instructional screens. Theoretically, the results of the study strengthened the results and conclusions of some of the previous animation related studies. Practically, the results also raised a very important question to the practice of instructional designer, it is it really worth it to design and develop instructions utilizing animation.

References


