

ADOPTING MAYER'S DESIGN PRINCIPLES IN AN INTERACTIVE MULTIMEDIA WEB-BASED LEARNING MODULE TO PROMOTE STUDENT CENTERED LEARNING

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ABSTRACT

Many educators are aware that multimedia learning applications can bring positive impact to learners. At the same time, many researchers have claimed teachers and students can enjoy various benefits if multimedia learning application is used. However, we have to follow proper design guidelines while designing multimedia applications as not to bring cognitive overload to the students when using them. In this study, Mayer's design principles (Mayer, 2001) are adopted to design the interactive multimedia web-based learning module. On the other hand, we may also notice that teaching and learning environment has shifted to another paradigm where many universities are introducing student centered learning approach with the aim to achieve better learning outcomes. This paper would like to share the positive results obtained from the study where students had undergone an independent learning environment. Pretest and Posttest were given to the students to measure their performance before and after having the lesson using the learning module. After the lesson, students were asked to participate in the survey questionnaires in order to collect the students' perceptions towards the learning environment and feedback about the learning module. The results will be interpreted as per the design guidelines recommended by Mayer. This paper concludes with discussion on the positive impacts brought by this teaching and learning approach. With this study, it intends to share the positive outcomes received and encourages other educators to use this teaching and learning approach.

KEYWORDS

Multimedia, Interactivity, Web-based learning, Mayer's design principles, Student centered learning

INTRODUCTION

The teaching and learning process is believed to have come to a new phase where it should no longer be in the form of chalk-and-talk. Malaysia government introduced smart schools and encouraged the uses of ICT in teaching and learning because it is believed that it can ease teaching, gain attention from the students and also allow students to have better understanding (Abas & Chow, 2010). Every educator has his or her own way of teaching. No matter which teaching method is adopted, the main objective is to deliver the knowledge to students efficiently and effectively. Educators would want to see how students can demonstrate their skills or knowledge through the assessment of coursework and examination. At the end of each course, educators would be convinced from the students' results whether the respective teaching approach is successful. From the outcome, educators would explore more ways for students to learn better.

Information technology is advancing so fast until we have difficulty in catching up with the knowledge on new hardware and software. This change has also affected education institution where learning is no longer limited to the classrooms. Learning through the space of Internet is made possible nowadays. Besides that, it is common to see the usage of multimedia in PowerPoint slides, video clips, flash animation, and flash cards in teaching. New tools are introduced and new environments are engaged for teaching and learning. In Malaysia, many universities had started to use multimedia technology in teaching. Multimedia University has conducted a study where students are exposed to multimedia technology and it received positive results (Neo & Neo, 2001). Nevertheless, the new technology is not meant to replace the conventional teaching, but to serve as another option for teaching and learning.

BACKGROUND STUDY

Multimedia Learning

Multimedia learning is able to increase retention rate and to promote deeper learning. An integrated model was recommended by Hede (2002) which is to illustrate the relationships among various variables that explain the impact of multimedia in different learning situations. It was concluded that there are many factors involved in achieving the effects of multimedia on learning. Hede (2002) proposed an integrated model to illustrate the relationships drawn among various variables that determine the impact of multimedia in different learning situations. The variables identified are the following:

- Multimedia input (three elements: visual input, auditory input, learner control);
- Cognitive processing (two elements: attention, working memory);
- Learner dynamics (three elements: motivation, cognitive engagement, learner style); and
- Knowledge and learning (four elements: intelligence, reflection, long term storage, learning).

Therefore, the design of multimedia application needs to be carefully planned and woven to achieve positive effects towards the learning process.

There are many studies reported on the benefits of adopting multimedia learning in the classroom. Nicholson and Nicholson (2010) wrote a paper sharing the results of using one of the multimedia elements, which is video for teaching information technology. From their study, it showed positive and convincing results of having a multimedia environment for teaching and learning from both teachers and students. It was commented that this teaching method "*provides benefits to students in the form of greater satisfaction with the learning process, a greater understanding of the material.*" (Nicholson & Nicholson, 2010)

Student Centered Learning

In many universities, student centered learning has become a common practice because it encourages students to be more independent and at the same time given the opportunity to explore the learning subject and tailor the learning materials to their own requirements. It is said that student centered learning promote better learning attitude and performance (Armbruster *et al.*, 2009).

Herrington *et al.* (2002) wrote a research paper reporting the positive impact of having student centered learning implemented in an online learning environment because students are given the authority to control their own learning. In such learning setting, students were encouraged to develop their skills in self and independent learning as this would be a critical factor which led to the success of online learning environment (Herrington *et al.*, 2002).

Interactive Multimedia Learning

Interactivity is considered as an important force that would drive students throughout the whole learning process when multimedia learning application is used. When students have the chance to control and interact with the learning applications, they would control how they study and this again will make sure students can learn more effectively (Neo *et al.*, 2008; Vaughan, 2003). According to Sims (1997), "*interaction is intrinsic to successful, effective instructional practice as well as individual discovery.*" (Sims, 1997) On top of the proper design principles applied in any multimedia application, we also need to consider the interactivity components in the learning contents. Incorporating multimedia elements in learning contents can help in stimulating our senses while navigating the learning contents, and at the end we would be able to capture the learners' attention and also to achieve better retention rate (Reeves, 1998). According to Vaughan (2003), "*Studies indicate that if you're stimulated with audio, you will have about a 20 percent retention rate, audiovisual is up to 30 percent, and in interactive multimedia presentations where you are really involved, the retention rate is as high as 60 percent.*" The anticipation from the results of having the interactive multimedia application adopted is to achieve better retention rate. The interactivity design for the multimedia application is also aligned with combination of elements used within the application itself. Proper combination of multimedia elements would then be able to achieve the positive effects. The design will be discussed in the following section.

Mayer's Seven Design Principles

Richard Mayer had proposed seven design principles to be considered while designing a multimedia learning application to ensure the positive impact of multimedia is achieved and not to overload the students' brain processing while perceiving an application which is rich with media. The seven principles are Multimedia Principle, Spatial Contiguity Principle, Temporal Contiguity Principle, Coherence Principle, Modality Principle, Redundancy Principle, and Individual Differences Principle as listed below (Mayer, 2001):

Table 1. Mayer's seven design principles (2001).

1. Multimedia Principle	Students learn better from words and pictures than from words alone. (refer to Figure 1)
2. Spatial Contiguity Principle	Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen. (refer to Figure 1)
3. Temporal Contiguity Principle	Students learn better when corresponding words and pictures are presented simultaneously rather than successively. (refer to Figure 1)
4. Coherence Principle	Students learn better when extraneous words, pictures and sounds are excluded rather than included. (refer to Figure 2)
5. Modality Principle	Students learn better from animation and narration than from animation and on-screen text. (refer to Figure 3)
6. Redundancy Principle	Students learn better from animation and narration than from animation, narration, and on-screen text. (refer to Figure 3)
7. Individual Differences Principle	Design effects are stronger for low-knowledge learners than for high-knowledge learners and for high-spatial learners rather than for low-spatial learners.

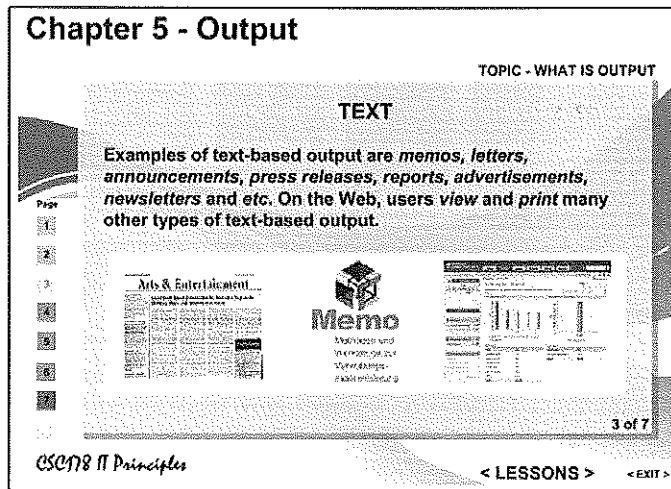


Figure 1. Multimedia Principle/Spatial Contiguity Principle/ Temporal Contiguity Principle.

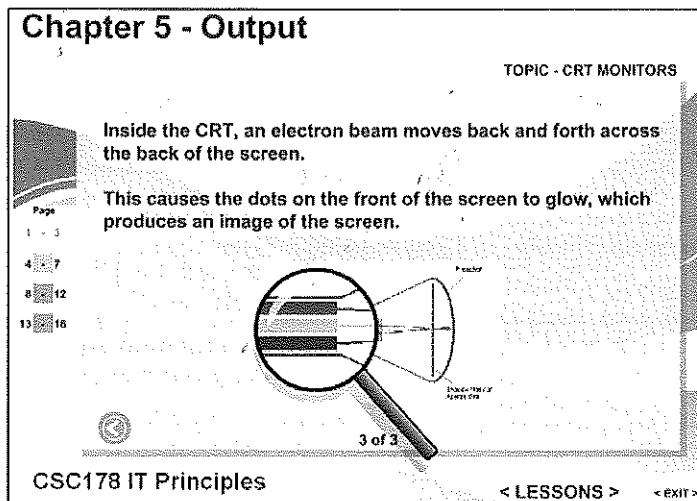


Figure 2. Coherence Principle.

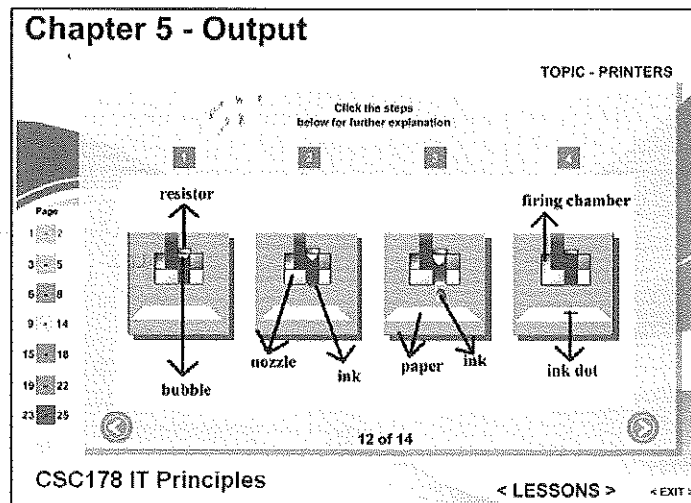


Figure 3. Modality Principle/Redundancy Principle.

METHODOLOGY

A group of 58 students who studied Diploma in Business Administration participated in this study. The students enrolled for their first Information Technology subject. One chapter was selected in this study, which is on Computer Output. A web-based interactive multimedia module was designed based on the contents of this chapter. The students were given Pretest with 20 questions in the previous class before the treatment. The students were asked to have their independent learning in the computer laboratory. An URL was given to them at the beginning, and then students were on their own while browsing through the web-based interactive multimedia module. After two hours, Posttest was given to students in order to find out whether they understood the content after the lesson. The lecturer was present in the computer laboratory throughout the 2 hours. During the learning process, observation was done in order to collect some other findings which were related to the study.

ANALYSIS AND DISCUSSION

Pretest and Posttest

Table 2 shows the results from the One-Sample T Test. It is obvious that the students were able to score better in the posttest. The interactive multimedia module in such independent learning setting environment was able to make the students understand the chapter well.

Table 2. One-sample statistics for TG.

	Test Value = 0							
							95% Confidence Interval of the Difference	
	N	Mean	t	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Pretest	58	8.69	20.190	57	.000	8.690	7.83	9.55
Posttest	58	13.00	27.818	57	.000	13.000	12.06	13.94

Evaluating the Learning Environment

In the following class, the students were given survey questionnaire to collect their feedback towards the new learning environment. It intended to find out if they students prefer such learning environment, whether they were motivated in such setting, and whether the multimedia elements helped them to understand better. The survey was measured in Likert scale where 1 for Strongly Disagree, 2 for Disagree, 3 for Undecided, 4 for Agree, and 5 for Strongly Agree. There are important items found in the environment survey where the results show that the student centered learning environment using interactive multimedia module does contribute forward student motivation, better understanding and makes the learning process more interesting and engaging.

From Table 3, it is shown that students with the mean of 4.29 were very concern on the presence of lecturer during learning process. Though student centered learning approach was adopted, the lecturer still plays important role to facilitate the learning. This is because lecturer was needed to support their learning if they have any doubts on the content. Next, it shows students agreed that the content designed using Mayer's design principles were appropriate and the module was easy to understand, (82.7% respondents, with a mean of 4.00). 75.9% agreed that the multimedia made learning fun and motivating. 72.5% stating that they liked being able to learn at own pace and time (with a mean of 3.90). 75% respondents stated that they found learning on the Web to be interesting and engaging (mean 3.90). 72.4% stating that multimedia made understanding the content better (mean 3.86), they liked the use of multimedia to illustrate ideas and concepts (mean 3.83) and they were motivated learning on the Web (mean 3.74).

Table 3. Means and percentage for the perception on learning environment.

No.	Questions	Mean	%
1.	The presence of the lecturer helped me in the learning process.	4.29	88.0
2.	The content was easy to understand.	4.00	82.7
3.	I was able to search for more information on the topics from the web.	3.98	79.3
4.	Important information or key concepts were easy to identify	3.98	75.9
5.	The instruction in the application was easy to understand.	3.97	84.5
6.	Multimedia made learning fun and motivating.	3.93	75.9
7.	I was able to search for the answers on the web to questions I have on the content.	3.93	75.9
8.	I enjoyed learning in the web environment.	3.93	75.9
9.	I liked being able to learn at my own pace and time.	3.90	72.5
10.	I liked the multimedia content in the web module.	3.90	75.8
11.	I find learning with the web interesting and engaging.	3.90	75.9
12.	Multimedia made understanding the content better.	3.86	72.4
13.	I liked the use of multimedia to illustrate ideas and concepts.	3.83	72.4
14.	I understood the course content in the web-based module.	3.83	70.7
15.	I was motivated learning on the web.	3.74	72.4

Observation

These groups of students were happy when they were told to browse the learning module on their own. The lecturer was present in the class in case the students would like to clarify anything related to the contents. The lecturer saw some students copied some contents onto their notepads because they believed the information would be useful for them to do revision. The students also made use of the search function provided in the module. After the lessons were completed, some students even asked if they could have more of this for the following chapters and they also requested to have access to the modules. Yet, there were some students who quickly navigated the module without properly.

Interview with Students

Students reported that they found the Web -based module interesting and enjoyed it since they could learn at their own pace. The positive comment received was “able to learn own pace by having full control during the lecture”. They also highlighted another important point where they preferred the presence of lecturer even though they were having independent learning. Moreover, they could visit other websites to find other additional information on any topic they want. They were happy to see the multimedia elements and they found them very interesting. The graphics and animation helped them to better understand on the chapter. They would like to see more of this in their study.

CONCLUSION

Multimedia learning has become common nowadays and there were many success stories on the usage of multimedia in learning. On top of that, multimedia technology with web-based learning environment would enhance the learning. This study received positive feedback and results. Hence, the interactive multimedia web-based learning module was able to help the students to have higher retention rate and also to understand the module better. This teaching and learning approach encourages student centered learning and allows the students to be independent and have better control in their learning pace. This will promote student centered learning practice in university.

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