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Technology and Innovation in Teaching and Learning Production and Operations Management

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MEHRYAR NOORIAFSHAR
University of Southern Queensland, Toowoomba
Australia
mehryar@usq.edu.au

OMAR ROMERO
Instituto Technologico Autonomo De México, México City
Mexico
oromero@itam.mx

Abstract

This paper explores the use of innovative and technology aided teaching methods, which utilize different modes and senses for the purpose of learning enhancement.

The study was undertaken by analysing groups of students from the English and non-English speaking universities. The objective is to compare the teaching effectiveness of the same multimedia system on these two groups.

The English-speaking students were chosen from two universities in Australia and the United States. A similar sample of students was also chosen from a Mexican university.

The paper provides recommendations with regard to practical ways of internationalising the language of education by choosing and incorporating different media in a balanced manner so that teaching materials become less language-dependent. Hence, students from different language and cultural backgrounds in different parts of the world will be able to benefit from the same multimedia system.

Keywords: Multi-sense, Educational Multimedia Learning Styles, Learning by Association, Learning by Understanding

Introduction

Over the past few years we have been hearing about the use of the multimedia and web-web-based technologies in teaching and learning. Many successful educational

multimedia products have been developed which have made significant contributions to teaching and learning at various levels. Unfortunately, it is not always clear what exactly the position of technology in education is. In other words, do the technology-aided means of learning actually enhance learning and add value to the conventional materials. How are they supposed to supersede or excel the learning effectiveness of the face-to-face (chalk and talk) methods of teaching?

This paper explores the role of the technology in creating better and further opportunities for learning Project Management via multiple senses. The same approach can be applied to other areas of Production and Operations Management.

The *Web Enhanced Multimedia Learning Environment* (WEMLE) for Project Management is based on the simulation of the way project management is taught within an undergraduate course at the University of Southern Queensland (USQ). It incorporates established educational concepts and the latest in web-based multimedia design. WEMLE has been developed by the author and his colleagues at the University of Southern Queensland (USQ – Australia), see http://www.usq.edu.au/course/material/MGT2102/

WEMLE for Project Management has been based on established learning principles. It caters for different learners' modal preferences and provides them with the opportunity to utilise the whole brain (both right and left hemispheres). Hence, the learner sits in the driver's seat and has control of the learning path.

WEMLE was adopted as the instrument for determining the learning preferences of Operations Management students from both English and non-English speaking universities. Before presenting the research findings, let us discuss some of the main teaching/learning principles used in designing WEMLE.

Educational Multimedia

When a teacher utilises speech, text (reading/writing) and images, and complements them all with the body language to reinforce learning then a multimedia-learning environment is created. Provided this teacher is knowledgeable in the field and possesses patience and is prepared to repeat and explain, as many times as necessary, then we would have an ideal multimedia environment. So, why do we need to simulate this situation as multimedia on CD or on the Web? Some of the reasons could be due to:

- **Lack of access to the face-to-face sessions** - Unfortunately, not every student has the opportunity to attend a live face-to-face session. This could be due to distance or commitments in life, which make it difficult for the student to attend the face-to-face sessions. It is noteworthy to mention that the market for tertiary distance education has been growing and will continue to become even larger.

- **Recording and storing the sessions** - A computer-based multimedia teaching material is almost like a movie version of a play. Using computer based multimedia technology (on CD or the Web), we can capture a well rehearsed teaching session, record

it and make it available for many students in different geographical locations. The technology will also make it possible for us to simulate some of the teacher-learner interactions too.

Regardless of the mode of learning, the teaching materials and approaches must be based on certain established learning principles. For example, the learners' modal preferences should be taken into consideration so that they can have a choice for learning via their preferred styles and senses. Different people learn in different ways. For instance, some prefer listening, some people like reading and others prefer seeing how things are done. It does not necessarily mean that each person must have only one preferred way. Often people have more than one preference. It is a good idea for any leaner to find out about their dominant learning style. There are several types of questionnaires, which can determine the learner's modal preference. Fleming (2001) provides a comprehensive insight into theory and practical uses of learning styles. The chart provided under: *Learning Styles* (n.d.) at: http://www.chaminade.org/inspire/learnstl.htm is an easy and quick method of getting an indication of leaning style preference.

Learning approaches such as learning by association (attaching a memory handle for recalling and remembering) and learning by understanding (building on learners' existing knowledge) are some of the important and effective learning methods. The following sections will discuss these approaches.

Learning by Association

Learning by association is based on associating a new piece of information with a prompter, which will help us with remembering. The prompter can be an image (actual or virtual). This way of learning is compatible with the general idea of Dual Coding theory proposed by Pavio (1986). According to this theory, by presenting information in both visual and verbal forms the effectiveness of remembering and recalling is improved.

For instance, when it comes to learning the vocabulary of a new language, we may associate a new word with an image or sound with which we are familiar. Every time, we want to recall the new word, we can simply think of the link, which will prompt us to remember the new word. Gruneberg (2002) approaches language learning in a similar manner. However, the images become virtual rather than actual. In other words, the learner is instructed to use their mind's eye to visualize an image related to the segment for 10 seconds. For example, in order to learn the word *valise* (suitcase in French), the learner is asked to visualize the image of suitcases, which are strewn all over the valleys. This is probably more than just the use of the mind's eye as the "mind's ear" is also encouraged to associate the sounding (pronunciation) of the word valise with valeez (valleys). Another interesting example presented by Gruneberg is:

Imagine that you are looking at a plate (in French: *assiette*) and saying to yourself *I-see-it.*

Learning by association can also be applied to remembering and playing melodies on a musical instrument without sight-reading. We can divide the piece into smaller portions and associate them with some appropriate lyrics/words. We can then be reminded of what should follow by listening to the words in our mind's ear. Similarly, using the same approach, we may learn how to recognise various celestial objects in the night sky. We can learn the position and features of some key objects and then use them as the base to learn and remember the positions of less visible and hard to spot objects, (Nooriafshar, 2004). In mathematics, we can associate complex concepts with analogies. For example to learn the concept of *recursion* in Dynamic Programming, we may use the following analogy: *Imagine yourself standing between two facing mirrors and looking at your reflection reflected several times through the mirrors*. This analogy becomes the basis of a general purpose recursion formula, see Module 3 at: http://www.usq.edu.au/course/material/MGT2102).

Another example of learning by association in a quantitative subject relates to decision-making under uncertainty. Suppose we have a number of options which yield different outcomes (costs or profits) under different events and we do not know which event will occur. If we wish to select the most promising option, then we may apply either MINMAX or MAXMIN techniques depending on whether we have costs or profits. To remember which one we should apply, we only need to understand the concept by remembering: *Best of the Worst*. In other words if we have costs, select the worst (highest cost) for each option and then choose the best (lowest) of these worst cases. So, in this case we have applied MINMAX. On the other hand, if we have profits, then choose the worst (lowest) profit for each option and finally select the best (highest) of them. Hence, in this case, we have applied MAXMIN.

Learning by Understanding

Methods of teaching quantitative subjects have certainly been influenced by modern computing (multimedia and online). They will change even more dramatically in the years to come. One thing however remains the same; and that is the ability of the teacher (human or machine) to convey the underlying concepts to the learner. Hence, the learner can build new meanings without simply memorizing pieces of information received from the teacher. This way of learning is known as constructivism, which encourages the learner to construct their own meanings rather than simply memorizing someone else's. Under constructivism the nature of learning takes a different form. An appropriate definition of learning under constructivism is by Bruner (n.d.) who considers learning as an active process in which the new ideas or concepts are constructed based on the existing ones.

It should be remembered that the general concept of "constructivism" is quite simple and practical and the underlying theory, perhaps, goes back to the Socratic times. The concept of guiding and leading the learner to find out the solution or the right answer to a problem was discussed by Plato (the ancient scholar) almost 2400 years ago. If we analyse Plato's famous "dialogue" Meno, we will realise that Socrates demonstrates to

Meno how a mathematically ignorant person solves a geometrical problem through a controlled guidance procedure rather than being told directly.

In the dialogue Socrates conducts his geometrical experiment on one of Meno's retainers who was totally ignorant of mathematics.

In this experiment, Socrates asks the boy to determine the dimensions of a square, which is exactly twice as large as a given square (say, abcd). The boy, eventually, after a series of questions, finds out that the correct solution is obtained by constructing the square (twice as large as abcd) on a diagonal (say, ac) of the given square. See Figure 1 for an illustration.

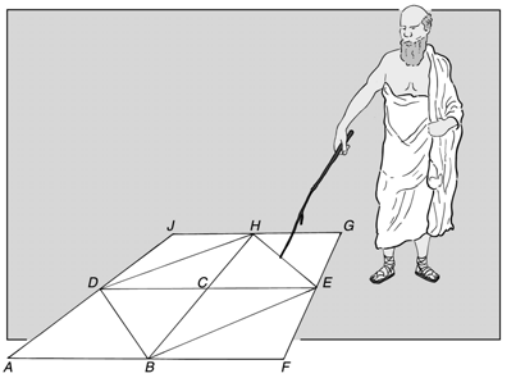

Figure 1 – Socrates pointing to the Square
(Source: The Author)

Even if learning is only the recovery of the pre-existent knowledge in the human soul, as Socrates argues, it can be passed on from teacher to learner by simply guiding the learner to find out for himself. The above-mentioned learning principles have been incorporated into WEMLE for Project Management. The system has been deliberately designed in such a way that reliance on text and language-dependent features is kept at minimum. Hence, the learning is re-enforced by the use of specially designed visual features. The next section presents the findings of using the system at a number of international universities.

Research Findings

A sample of 100 Business students from the Universities of Southern Queensland (USQ - Australia) and the University of Texas in Arlington (UTA - USA) were chosen to participate in the survey. The objective was to identify the learning effectiveness of the same system (WEMLE) on these users and determine the learners' learning style preferences. These students were given the opportunity to use the system on their own and then complete the online survey questionnaire.

A very large proportion (88%) of the students who used the system indicated a favourable experience with the multimedia way of learning.

When the data was further analysed it was found out that the preference for learning using different senses was certainly high amongst the users. Figure 2 illustrates the students' learning modal preference with regard to this (WEMLE) multimedia system. Visual features and interaction with the system appear to be most popular amongst the users. Almost every user who favoured the system's interactive tools suggested that ease of understanding was the reason. A very high level of preference for all types of modes clearly indicates that there is a desire for using a number of senses in educational multimedia. It should be mentioned that giving choices for enabling/disabling media features to users (learners) is important. In addition to minimizing the cognitive loading problem, the ability to choose gives the student a feeling of being in control.

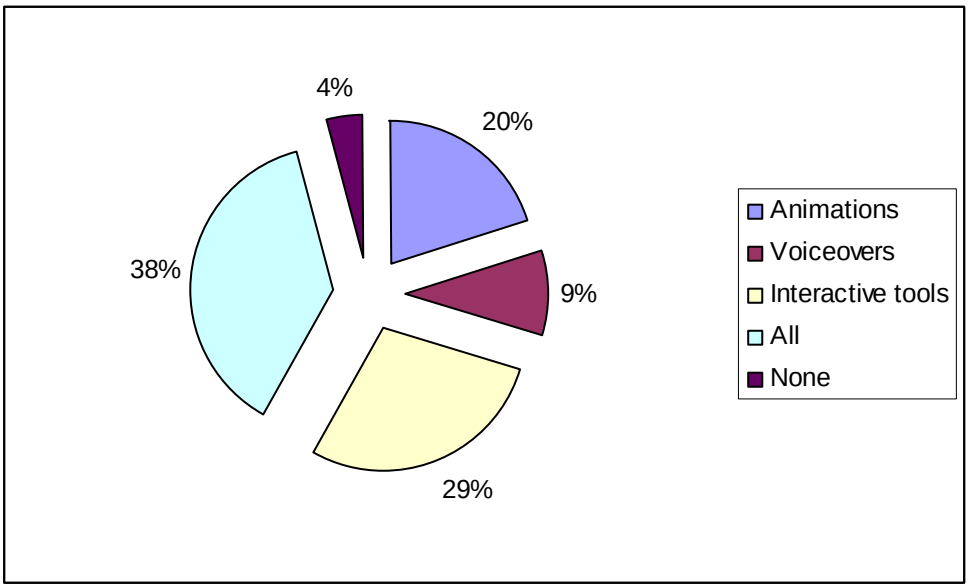

Figure 2 – Users' learning style preference

Figure 3 indicates that students find the multimedia materials less time-consuming compared with the text-based materials. The majority (over 80%) of students have reported either very positive or positive influence on their understanding by the multimedia materials. This finding is compatible with other research outcomes, see Najjar (1996).

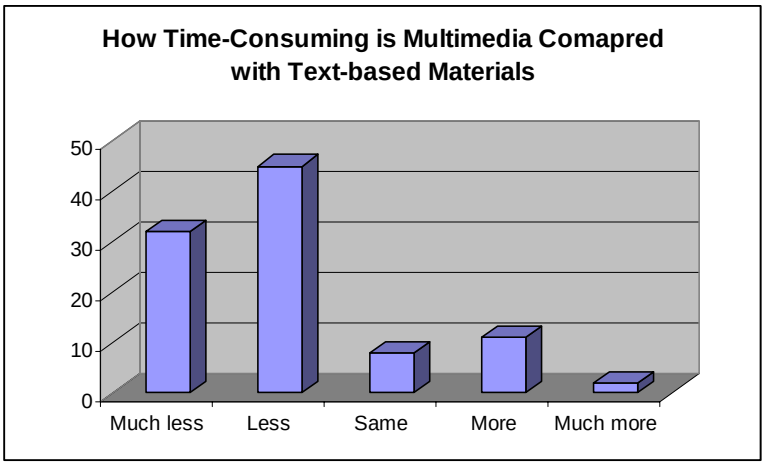

Figure 3 – Comparison of the time spent on multimedia with the text-based materials

34 students at the Insituto Tecnologico Autonomo de Mexico (ITAM) in Mexico City, with very similar characteristics as the Australian and American (English-speaking background) students were also given the same opportunities to evaluate WEMLE for Project Management. According to the survey results, a vast majority (97%) of these students believed that visual features play a very important role in understanding the concepts. Although the native language of all of these students is Spanish, 41% of them have indicated a preference for having the multimedia materials in English rather than Spanish. These findings indicate that the use of visual effects would certainly assist with internationalisation of the language of education, see Figure 4. Hence, educational multimedia materials can be developed in, say English and be available to students whose native tongue is another language. Like the Australian and American (English-speaking background) students, the Mexican (Spanish-speaking background) students have also shown their preference for learning via a multiple of senses. See Figure 5.

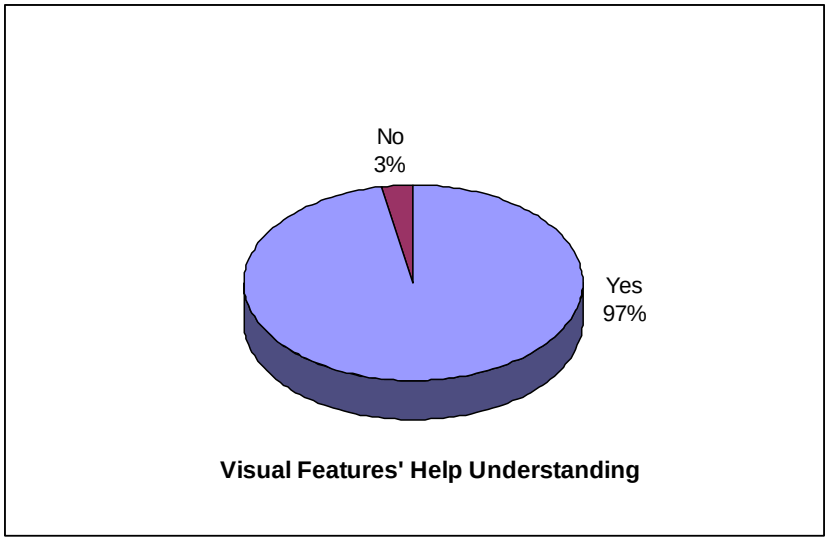

Figure 4 – The visual features' role with understanding the Project management

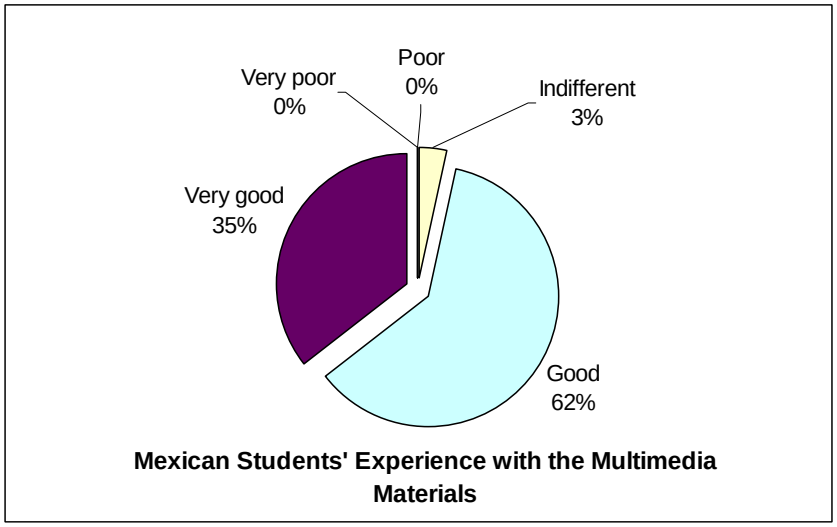

Figure 5 – The Mexican students' experience with the multimedia materials

Conclusions

The use of analogies and visuals in teaching materials are identified as ways of encouraging learners to become "whole-brained", see Funderstanding (n.d.). When Aristotle said that without images thinking is not possible, he was probably referring to virtual images created in human mind. So, perhaps the visual feature of our mind is the most active part in creating thoughts.

The findings for both groups of students (English and non English-speaking backgrounds) have shown that complementing learning by visuals is an effective method. As indicated by all students, a combination of various senses to convey the message is probably much more effective.

It is intended to extend this investigation and find out the characteristics and preferences of other non English-speaking students for technology-aided education materials. The existing and future findings will be used in educational multimedia developments.

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