EFFECTIVE APPROACHES TO DESIGNING MULTIMEDIA METHODS OF TEACHING AND LEARNING QUANTITATIVE SUBJECTS

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ABSTRACT

Recent advances in Information Technology and its applications have certainly made an important contribution to our learning and information sharing. The Internet, in particular, has taken us to different heights in terms of information storage and communication. A general comparison of the current computers’ capabilities with the ones 20/30 years ago, would demonstrate the modern computers’ significant contribution to teaching and learning. For instance, we can collect data in multimedia format from various sources, analyse it and create multimedia presentations to be given to students. These presentations can also be, at very low costs (or no costs to the user), sent to several people around the world. Hence, we are in a very good position to utilise the technology and incorporate different types of media (text, sound and vision) into the teaching and learning materials. As part of a research project by the author, a number of surveys on learning style preferences were carried out on different groups of students at different international universities. The findings have indicated that visual features play a very important role in learning and teaching. The main purpose of this paper is to explore the effectiveness of using visual features, anecdotes and analogies in developing multimedia-teaching materials for quantitative subjects.

Key Words: Multimedia, Anecdotes, Analogies.

1. INTRODUCTION

For an effective and successful lecture, a lecturer must utilise a number of different forms of media in its delivering. For instance, audio is used when a lecturer enters a lecture room and starts talking to the students. Text is used when a reference to a section of a book is made. When an image is placed on the overhead projector or drawn on the board, and the lecturer starts explaining various features by moving their hands or the pointer over it, an attempt to make ‘animations’ is simulated. If a student stops the lecture, requests for a repeat or asks further questions, the lecturer would respond accordingly. We may refer to this feature as interactivity. More effective interactivity would, obviously, be a two way one in which both teacher and learner may respond to each other's requests.

It is reasonable to assume that, without these different forms of media, a lecture (even on a very interesting topic) can appear lifeless and dry. So, really, a good lecture is a multi-media lecture. However, the term ‘multimedia’ is generally used with a different connotation. It usually refers to an implementation of those different types of media (audio, text with links, video/animation) on a computer.
2. EVOLUTION OF INFORMATION TRANSFER AND SHARING

A very important achievement for human beings was the devising of the means of recording information so that it could be archived for future reference or transferred to others. Writing was a significant step in the right direction. The earliest form of writing dates back to about 8000 years ago. Symbolic and pictographic writings such as hieroglyphics were gradually replaced by alphabetic ones, which were based on sounding out or pronouncing words.

The establishment of the universities can be traced back to the Middle Ages. Initially, these institutions were either ecclesiastical or had royal links. Some of the oldest universities in Europe include Oxford, Cambridge and Paris; these were established sometime in the 12th Century. Until the late 19th Century, women were not allowed to enter universities, and most of the medieval universities were developed to educate young men in law, religion and medicine.

Text-based learning was the main approach until the Second World War when the US military introduced audiovisual learning. Its main applications included the use of maps, graphs and recorded sound. When it became possible to incorporate sound and video features into computers, a new generation of audiovisual instruction was born. This was interactive multimedia-based teaching and learning.

3. CURRENT TECHNOLOGIES AND EDUCATIONAL MULTIMEDIA

We know that the trains of thought run in parallel in our mind. With the minds’ eye, we visualise an image of an idea. This image may consist of a number of sub-images, which are linked to each other. Could we somehow, transfer the blueprint of an idea to a learner in an almost original format? If we could transfer our thoughts in a more direct manner to other sources or people without the use of intermediate conversions then a great deal of time and effort would be saved. Using new technologies, one day, we may be able to transfer large amounts of information (data), and the necessary mental and physical skills to another person directly too.

We are able to create the most sophisticated animations and multimedia in our thoughts as we can select different types of thought-based “audio” and “visual” effects as well as “actors”. In other words, we have an unlimited amount of resources to choose from to design our thought-based multimedia system. One day, we will be able to utilise the technology to capture and store these animations and multimedia directly. Therefore, the technology will play a significant role in transferring our knowledge and ideas onto storage devices for future reference and other people’s use.

At the present time however, we do not have the technology for any direct interface and transfers between humans and machines. The existing computer technology is ideal for creating multimedia materials. Therefore, we should focus on feasible approaches such as effective use of visual and sound features to complement the teaching materials. Visual effects are very effective in conveying the underlying messages to the learners.

According to a recent survey undertaken by the author, it was discovered that most (about 58%) of High School students in the Darling Downs region of Queensland, Australia have a preference for visual learning with regard to the topic of Statistics, see Figure 1. This survey was part of a formal research project funded by the Faculty of Business, at the University of Southern Queensland in 2002. The study was conducted by surveying year-12 students of ten High Schools in and around Toowoomba in Queensland. Both public and private schools were included in the study. The sample comprised 133 randomly selected students.

This finding indicates that learning via multimedia, with interactive animations, appears to be an attractive approach in 'new times'. Although the focus of the study was on Statistics, there are likely to be many similarities and commonalities with other subjects, which require data manipulation and model building.
In another research project, a sample of 100 Business students from a University in Queensland, Australia and a University in Texas, USA were chosen to participate in a survey. The objective was to identify the learning effectiveness of a multimedia system called WEMLE on these users and determine the learners’ learning style preferences. Web Enhanced Multimedia Learning Environment (WEMLE) has been developed by the author and his colleagues at one of the Universities in Queensland – Australia, see http://www.usq.edu.au/course/material/MGT2102/). WEMLE utilises visual features in demonstrating and showing concepts and techniques of Project Management. The surveyed students were given the opportunity to use the system on their own and then complete the online survey questionnaire.

It is noteworthy to mention that a very large proportion (88%) of the students who used the system indicated a favourable experience with the multimedia way of learning.

As an extension of the same project, 34 students at a Mexican institute 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 2. For details see Nooriafshar et al (2004) and Nooriafshar and Todhunter (2004).
Let us explore the principles and ideas for developing multimedia presentations in the following sections.

4. DEVELOPING MULTIMEDIA PRESENTATIONS

It is important to approach the teaching of quantitative subjects in such a way that meanings and concepts are conveyed to the learner and at the same time the learner is not frightened and put off as soon as he encounters obstacles.

A very effective way is to adopt a constructivism-based approach to teaching and learning. Whether constructivism in education is teaching, or learning based as suggested by Clements (1997), teaching experience has led the author to adopt a view that active learning and guiding the learners to find out for themselves rather than "holding their hands" and giving them all the information in a passive manner is a preferred method of instruction. Let us introduce an analogy here. Suppose someone wishes to learn rock climbing and he has a very limited amount of time.

- The instructor can either push the climber to the top of the cliff; or
- the learner can be guided by the instructor and learn how to climb the rock right from the beginning.

It is interesting to note that the concept of guiding and leading the learner to find out the solution or the right answer to a problem was also 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. The boy, eventually, after a series of questions, finds out that the correct solution is obtained by constructing the square (twice as large) on a diagonal of the given square.

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. For an appropriate definition of learning under constructivism see Bruner (n.d.) who considers learning as an active process in which the new ideas or concepts are constructed based on the existing ones. Teaching mathematics thematically which is also based on constructivist ideas is reported by Handal and Bobis (2003).

5. THE USE OF ANECDOTES AND ANALOGIES IN TEACHING MATHEMATICAL CONCEPTS

The use of anecdotes and analogies in explaining concepts is also an effective way of teaching. The author often asks his students to think about a scenario in which a layperson asks them to explain (obviously in a language they can understand) what they are studying at university. There are three alternative ways of answering this hypothetical question:

1. Answer by using the technical jargon and totally confuse the poor friend who may courteously keep nodding his head to indicate an understanding,
2. Tell the person that it is not possible to describe it in a few words, or
3. Use an anecdote or analogy to convey the message in as few words as possible and in an interesting manner.

It is obvious which alternative will be attractive for our layperson that does not have a great deal of experience in the field, but is keen to find out about it. As an example, the following analogy is used by the author:
If the author is asked by a layperson what is meant exactly by statistics, a reference to the following old Persian saying will be made: *A handful represents the heap.*

This brief statement will describe, in one sentence, the general concept of inferential statistics. In other words, learning about a population by studying a randomly chosen sample from that particular population can be explained by using an analogy similar to this one.

 Chanter (http://science.ntu.ac.uk/rsscse/ts/bts/chanter/text.html) presents an interesting collection of anecdotes and analogies used in the teaching of statistics. According to Chanter an old favourite is the person with his head in a fridge and feet in an oven who is said to feel ‘quite comfortable’ on the grounds that his average temperature is normal.

Another favourite is the story of two soldiers who congratulate each other on the grounds that, on average, they hit the enemy target. They both miss the target by equal distances; one misses it to the left and the other to the right!

These types of anecdotes are very effective in conveying the message to the learners that one cannot simply quote an average without indicating the variability.

Friedman, Halpern and Salb, (1999) present an anecdote, which can teach students an important lesson on choosing a representative sample. It also conveys the message that in a survey sample, the number of respondents is not the important factor, but the percentage of the respondents should be considered. In this anecdote, “Professor Klutz” claims that based on his survey, 30% of Americans have been abducted by aliens from other planets!

If students examine Professor Klutz’s survey carefully, they will find out that two million questionnaires were sent out and 100,000 people responded. Although 100,000 is a reasonably large figure, it is only 0.05 percent of two million! So, the message about the difference between the response numbers and response rate would become quite clear to a learner of statistics.

An analogy developed by the author for explaining the concept of *complete* and *partial enumeration* techniques, has been incorporated as an interactive animation into a computer multimedia system. The purpose of this analogy is to explain the concept of how we can become more selective in searching a problem space. This concept will help students to appreciate a variety of techniques and approaches in quantitative areas.

The analogy is based on a missing watch, which is assumed to be lost on Campus. As the problem space (the Campus) contains the solution, a complete enumeration by looking in every building is a possible method. In the animation an icon of an “eye” searches every possible location on the university campus until it finds it.

Alternatively, a more efficient way of partial enumeration is demonstrated by focusing only on the buildings visited during the day that the watch was lost. In the animation an icon of an “eye” searches only a selected sample of possible locations on the university campus until it finds it.

In the multimedia system, the student can interact with these animations by pausing, moving forward or backward in the animation to get to the desired positions until a satisfactory understanding of the concept is achieved.

Future information technology products may also facilitate capturing, digitising, storing and transferring human thoughts as an independent medium directly to other sources. Imagine the ability of directly transferring an animation of a concept to a

6. CONCLUSIONS

As is demonstrated throughout this paper, things have been taken one-step forward by adding the medium of image to presentation of the concepts, anecdotes and analogies. Therefore, by designing, drawing and presenting these special illustrations in conjunction with our text or verbal description, we are moving closer to having a ‘multimedia’ method of presentation.
Such basic multimedia presentations (manual or computer aided) will be more interesting for learners. They will learn and remember the concepts and, in future, one quick look at the images will prompt the whole story and logic. After all, human beings receive, decipher and store information using different senses.

By incorporating appropriate visual features, educational multimedia materials can be developed in a generic language like English, and be available to students whose native tongue is another language. Although this is not quite like a direct transfer of ideas to others, it is a step in the right direction.

The use of analogies and visuals in teaching materials are identified as ways of encouraging learners to become “whole-brained”, see Funderstanding (n.d.). In other words right brain is invoked through creative activities such as the visual features. Hence, we would not just use the part of the brain which is referred to as “50% of brain’s mighty toolkit” by Buzon (2002). 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.

Future information technology products may also facilitate capturing, digitising, storing and transferring human thoughts as an independent medium directly to other sources. Imagine the ability of directly transferring an animation of a concept to a learner in a 'thought file'. After all, the language of thought is probably universal and is not based on a particular type of language. In a strictly natural way, we do not have to pronounce words in our thoughts to describe ideas. Our ideas can be “seen” in our thoughts like Plato's Forms (Plato's Republic) or Aristotles' Essences (De-Anima).

REFERENCES