

Balancing the Use of Technology and Traditional Approaches in Teaching Mathematics within Business Courses

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Abstract

Technologies associated with modern computing are being commonly used in education. Over the past few years, the usage has increased considerably. This increase is also attributed to the availability of more improved technology products and services at much lower costs.

As a result, many successful educational multimedia products have been developed which have made significant contributions to learning and teaching mathematics at various levels. However, it is not always clear what exactly the position of technology in education is. In other words, to what extent does the technology-aided means of learning enhance learning and add value to the conventional materials? How are they supposed to supersede or excel the learning effectiveness of traditional methods of teaching?

This paper explores the possibilities of utilizing the latest technologies such as Virtual Reality (VR) environments and Tablet PCs in conjunction with the traditional approaches and concepts in creating a balanced and more effective learning and teaching conditions. It also demonstrates how the creation of a situation where 'one cannot see the wood for the trees' can be avoided by striking the right balance. **Key words:** Technology, Quantitative, Teaching, Traditional

Introduction

This paper explores the role of the technology in creating better and further opportunities for quantitative techniques via the use of multiple senses. Before presenting the research findings, let us discuss some of the main teaching/learning principles used in designing effective learning resources for the purposes of teaching mathematics and related topics.

The technology will make it possible for us to simulate some of the teacher-learner interactions too. Imagine a Powerpoint presentation with the lecturer's narration recorded as a voiceover with various marking such as highlighting sections recorded at the same time. The final result will be an ideal record of an interactive face to face session captured as it takes place in a classroom. This method is very much suited to teaching mathematically oriented subjects. The saved file in various formats such as Flash or compatible MS Media Player can be distributed to all students for further and future reference.

The teaching materials and approaches, regardless of the mode of their delivery mode, 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 learner to find out about their dominant learning style.

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.

Let us take a brief look at a comparative study of employers' and students' needs and expectations in terms of learning and teaching in the next sections.

The Needs and Expectations of the Employers

It can be argued that the employers are the ultimate customers of the educational institutes. Hence, their needs and expectations should be taken into consideration in designing teaching materials.

As an initial study, in 2005, a sample of 50 organisations representing both goods producing and service providing industries were randomly selected from the Darling Downs Region (in and around Toowoomba) of Queensland in Australia. Most (90%) of these industries employed less than 100 employees. Data collection was carried out by telephone

and a specially designed brief questionnaire was completed during each call. The questions aimed to identify the applicability of quantitative Production and Operations Management techniques favoured and utilized by these industries.

It is interesting to note that 50% of the surveyed employers believe that university graduates do not possess the necessary practical skills to undertake tasks within industries.

These findings can help course improvements with a view to catering for the needs of the industries. The next section investigates students' learning needs and preferences with a view to linking them with the employers' requirements. Hence, improvements in conveying the underlying messages and concepts to the students can be a basis for addressing the employers' problem.

The Learning Needs and Preferences of Students

A group of twenty first-year undergraduate students were selected for the purposes of an experiment on the effectiveness of teaching basic mathematics concepts via practical teaching aids. These students were from different mathematical backgrounds and the majority did not have a very strong background in quantitative fields.

These students were taught the basic principles of identifying and plotting graphs of polynomial equations of different degrees. It should be mentioned that these basic skills form the foundations of understanding, learning and using more advanced techniques in quantitative subjects. Curve fitting, regression, linear programming and its derivatives are some of the examples. The students were taught the main concepts in a very practical manner by shaping and positioning the flexi-curve on the axes drawn on a whiteboard. The basic scientific calculator was used to work out angles associated with the slopes. The protractor was used to measure and mark the angles on the whiteboard. The main purpose was to equip the students with the ability to recognize and visualize the general shape of a polynomial equation by simply looking at its main components such as the coefficients, powers and constant values.

The equipment used included basic scientific calculators, protractors and a flexi-curve. This experiment was based on the idea of guiding the students towards finding the answers instead of simply giving them the information. It also placed an emphasis on the visual aspects of teaching and learning methods.

The effectiveness of the above-mentioned approach (teaching basic mathematics concepts via practical teaching aids) was tested by identifying and measuring students' performance and learning preferences. A comparison between students from different mathematical backgrounds was also made.

The findings of this study suggest that students, regardless of their background in mathematics, have a preference for visual methods of learning mathematical concepts. It was also demonstrated that most students who participated in the study, enjoyed learning mathematics and believed that they would benefit from it in their future studies and career.

Finally, about 10 students were selected randomly and then were tested on the concepts provided to them. The performance of these students was quite satisfactory. The marks considered by the author ranged between 70% and 95%. This was achieved by asking students different questions based on the materials presented to them. The above findings illustrate that students' needs and preferences are not very much different from the employers. Both parties recognize the importance of the quantitative fields and have a preference for practically oriented approaches.

The Latest Technologies and Approaches in Learning and Teaching

The clicker technology has successfully been used in classroom teaching. As reported by Hafner (2004) Paul Caron uses Classroom Performance System (CPS) in his law classes at the University of Cincinnati to break through the "cone of silence". In 2005, the author devised a method of utilizing the technology in such a way that incorporated the established and traditional methods and concepts in learning and teaching. Hence, the system was adopted and used in an interactive and constructivist manner. It is noteworthy to mention that it was the first time at a Queensland university that this kind of technology was adopted in the classroom. The outcome of this experiment was very encouraging as both formal and informal feedback by students confirmed their interest in attending all classes and learning much more quickly.

They also suggested that this way of learning made the lectures interesting and exciting (Nooriafshar, 2005).

The applicability of Virtual Reality in teaching was tested by the author in 2007 by carrying out a comparative study (Nooriafshar, 2007). In this study, the visually rich multimedia ideas were taken a step further by enhancing them so that the learner can interact with the subject in a more realistic manner.

As an extension of the application of VR in quantitative subjects, a latest 3D development environment called *VirtualStage* by Dakine Wave Limited (<http://www.dakinewave.com/>) was adopted to create simulations of classroom sessions in a realistic manner. As part of this project, various learning situations were created and produced as virtual reality productions. Learning and teaching methods which were adopted in these developments are based on established concepts such as learning by guidance.

A series of 3D presentations were developed in *VirtualStage*. The topics included Decision Theory basics and Introduction to Goal Programming. These presentations demonstrate how the Socratic method of teaching, which usually takes place in a face to face situation, can be simulated, created and captured for replay. The findings of the VR research demonstrated that:

Visually rich 3D presentations can provide effective teaching and learning environments. A virtual reality multimedia can even further enhance learning by incorporating more realistic images, visual features and dialogue. This combination would lead to a situation where the learners could immerse themselves in the environment and interact with objects and scenarios in a dynamic manner.

Another latest technology which is worth a mention is the Tablet PC or graphically enabled computers. The University of Southern Queensland is now using tablet PCs across faculties, in a coordinated approach funded through a university Learning & Teaching fellowship. These devices are ideal for teaching mathematical topics to distance education students. A constructivist approach which was successfully tested by the author is as follows:

- The teacher sets some questions for the learners
- The learner receives the questions via email.
- The learner attempts solving the problems using either a Tablet PC or a digital notepad.
- The learner sends the attempted solution to the teacher via email.
- The teacher corrects the submitted solutions as one does on paper and in hand writing.
- The digitised file, with corrections, is sent back to the learner.
- The cycle can repeat until satisfactory results are achieved.

The Tablet PC is an excellent tool for explaining mathematical concepts and procedures, in a symbolic manner, in the class and also recording the session for off campus students.

Although not a highly technical method, Mind Mapping is an excellent way of teaching, learning and revising mathematical concepts. The original idea of Mind Mapping goes back to the 70s when Tony Buzan developed this very useful, practical and natural way of representing ideas. Originally, Mind Maps were developed manually using, ideally, colours to stimulate Right Brain activity. Nowadays, comprehensive computer software programs can assist with drawing, enhancing, storage and distribution of these learning resources. As suggested by Buzan Online Limited (2006-2009), the iMindMap can be utilized for the purposes of Planning, Organising, Creating and Innovating. Teaching and learning mathematical topics will certainly be assisted by using the iMindMap software and mind mapping in general. The latest versions and related environments such as MindGenius (2009) can also add interactivity for exploring and carrying out what-if analysis.

The following mind map shown as Figure 1 was developed by the author using the iMindMap software, for teaching how to choose the most appropriate Forecasting technique to use under different circumstances.

After showing the Mind Map to the students in the class, the lecturer can then present various possibilities to the them. Some examples are as follows:

- If Data Size is Small and Type is Stationary then apply Simple Exponential-Smoothing.
- If Data Size is Large and Type is Non-Stationary and Cost is Low then apply Regression.

- If Data Size is Large and Type is Non-Stationary and Forecast Needed is Short Term then apply Double Exponential-Smoothing.
- If Forecast Needed is Long Term then apply Judgemental Forecasting.

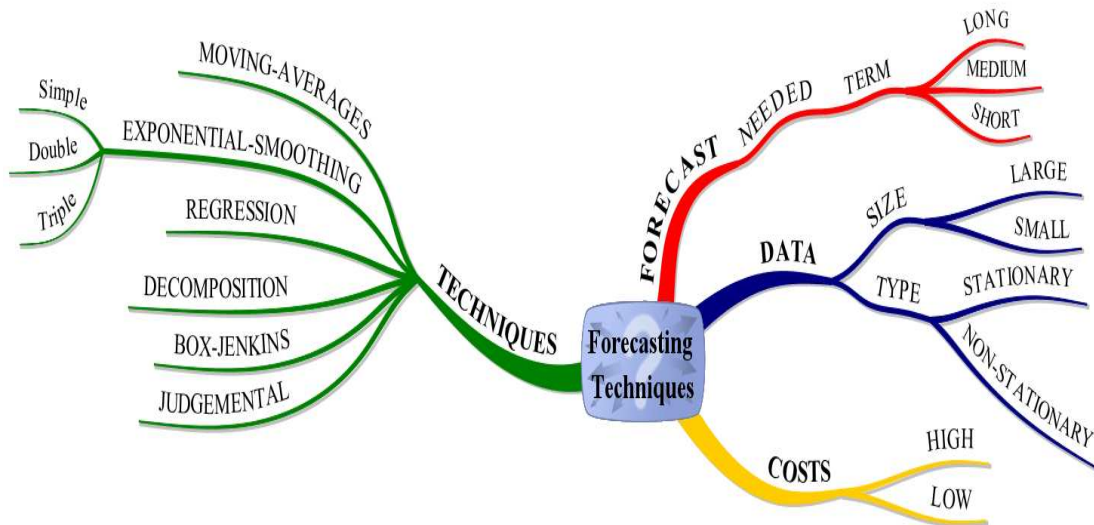


Figure 1 – Mind Map Representing Forecasting Techniques

It should be mentioned that as additional enhancements, various graphics and image-associations along the branches, can be incorporated into the mind map.

A commonality of the way that the above-mentioned technologies were used by the author is the consideration of established learning and teaching concepts. In other words, the technology has not been simply used to substitute the traditional and successfully tested and established methods. In developing technologically based teaching materials, means of incorporating students' learning preferences, allowing them to build new knowledge based on what they already know and learning by association were always considered a priority.

Conclusions

It was demonstrated that teaching approaches have a significant effect on students' learning and meeting their future employers' needs. It was shown how to link both the students' and employers' needs through effective methods of designing teaching materials. Hence, the main purpose is to make it possible for the learner to build new meanings without simply memorising pieces of information received from the teacher.

A number of methods and means of utilizing the latest technologies suitable to mathematics education were presented in the paper. An important message and finding was that in spite of the fact that the technology plays an important role in modern day education, it must not be regarded as a substitute for the established methods and concepts. Having a balanced approach in design of the technologically based learning and teaching materials will certainly help with meeting the needs of the ultimate customers.

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