

Teaching Non-Parametric Statistics to Students from a Non-Mathematical Background

Mehryar Nooriafshar¹

Faculty of Business
University of Southern Queensland
Toowoomba, Queensland
Australia

¹ Dr Mehryar Nooriafshar is a senior lecturer in Logistics and Operations Management at Faculty of Business of the University of Southern Queensland, Australia. Mehryar is actively involved in design and delivery of web-based multimedia teaching and learning materials.

Email: mehryar@usq.edu.au

URL: <http://www.usq.edu.au/users/mehryar>

Phone: +61 7 46311278.

Abstract

Many hundreds of hours have gone into the preparation of the multimedia system for the USQ unit, Introduction to Management Science. This multimedia system is placed at the heart of a total technology approach to teaching (TTAT) which interlinks various technologies in delivering unit material to both internal and distance education students. The System won the USQ Inaugural Award for Excellence in the Design and Delivery of Teaching Materials for the author in 1997. Student's performance and the results of a survey indicated the system's effectiveness and the students' enthusiasm that about the new multimedia package.

Keywords: Multimedia, Non-Parametric, Web-Based, Interactive, Computer Mediated Communication, Animations, Total Technology Approach.

Introduction

Introduction to Management Science is the very first unit within the discipline of Logistics and Operations Management in the Faculty of Business, University of Southern Queensland.

This unit grew in popularity in 4 years (from 50-60 students to 250-300 students per year). The subject provides a basic background and introduction to various decision-making tools, techniques and approaches which rely on both mathematics and statistics. All students, who wish to take the discipline as their first or second major, or study it as an option, take this unit.

The Unit Leader for Introduction to Management Science (the author) in conjunction with colleagues from the Distance Education Centre of the University of Southern Queensland has designed and developed the multimedia system for this subject. This project was supported by the Faculty of Business and endorsed by the Flexible Delivery program of the University of Southern Queensland. The main objectives of this project were to provide supplementary and additional components, which could enhance and complement the existing material and teaching methods.

This paper demonstrates how Non-Parametric Statistics can be taught to first year undergraduate in Business and Management related fields. It should be noted that the majority of these students do not have a very strong background in mathematics.

The paper starts with a discussion of the teaching/learning concepts and philosophies adopted in development of the multimedia system. It then leads to system's special features and the technologies used. It finally provides a discussion on the measurement and comparison of the system's effectiveness.

Active Learning in Mathematics

It is important to approach the teaching of mathematics 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.



Figure 1 - Helping the Learner to Overcome 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. See Figure 2.

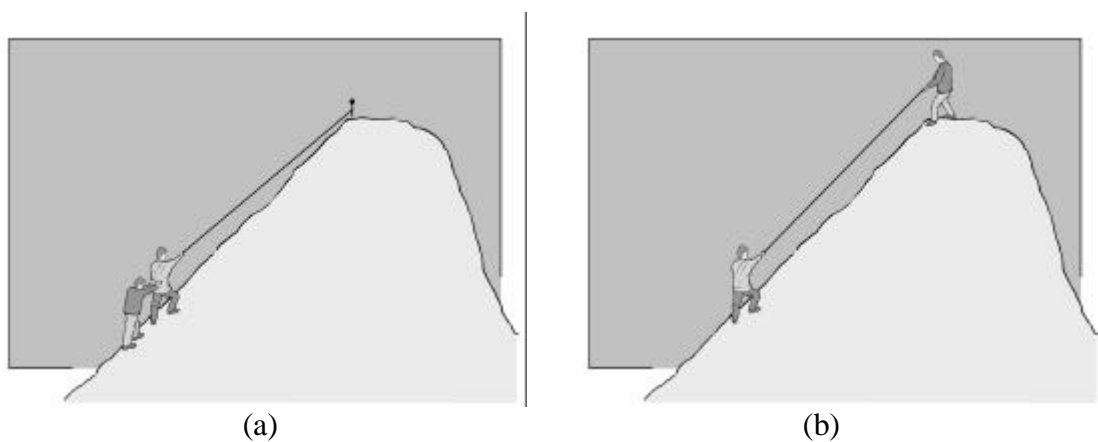


Figure 2 – (a) Pushing the Learner; (b) Pulling/Guiding the learner

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. See Figure 3.

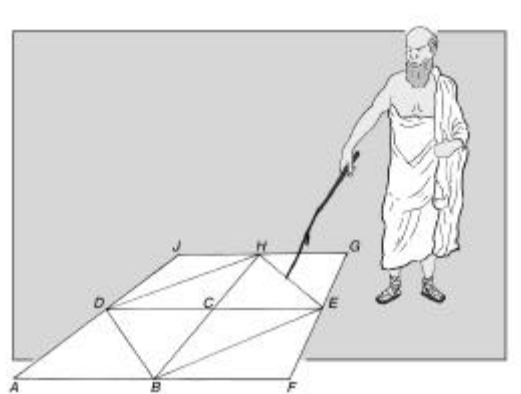


Figure 3 - Socrates' Geometrical Experiment

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.

Educational Philosophy in Developing the Multimedia System

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.



Figure 4 – Two Way Interactivity between Learner and Teacher

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.

Therefore it would be feasible to incorporate the learners’ different modal preferences (Visual, Aural, Read/Write and Kinesthetic or VARK for short) for learning information as suggested by Fleming (1995) in a multimedia system.

Above all, multimedia can offer all students the same opportunity, with added features such as the ability to allow the learners to sit in the driver's seat and steer the way towards the goals they wish to set. In the case of this particular system, a prescribed route or series of routes are also incorporated into the system for the benefit of those users who wish to have more guidance.

The next sections will provide information on the features and the technologies used in the multimedia system which was developed for teaching quantitative subjects such as non-parametric statistics.

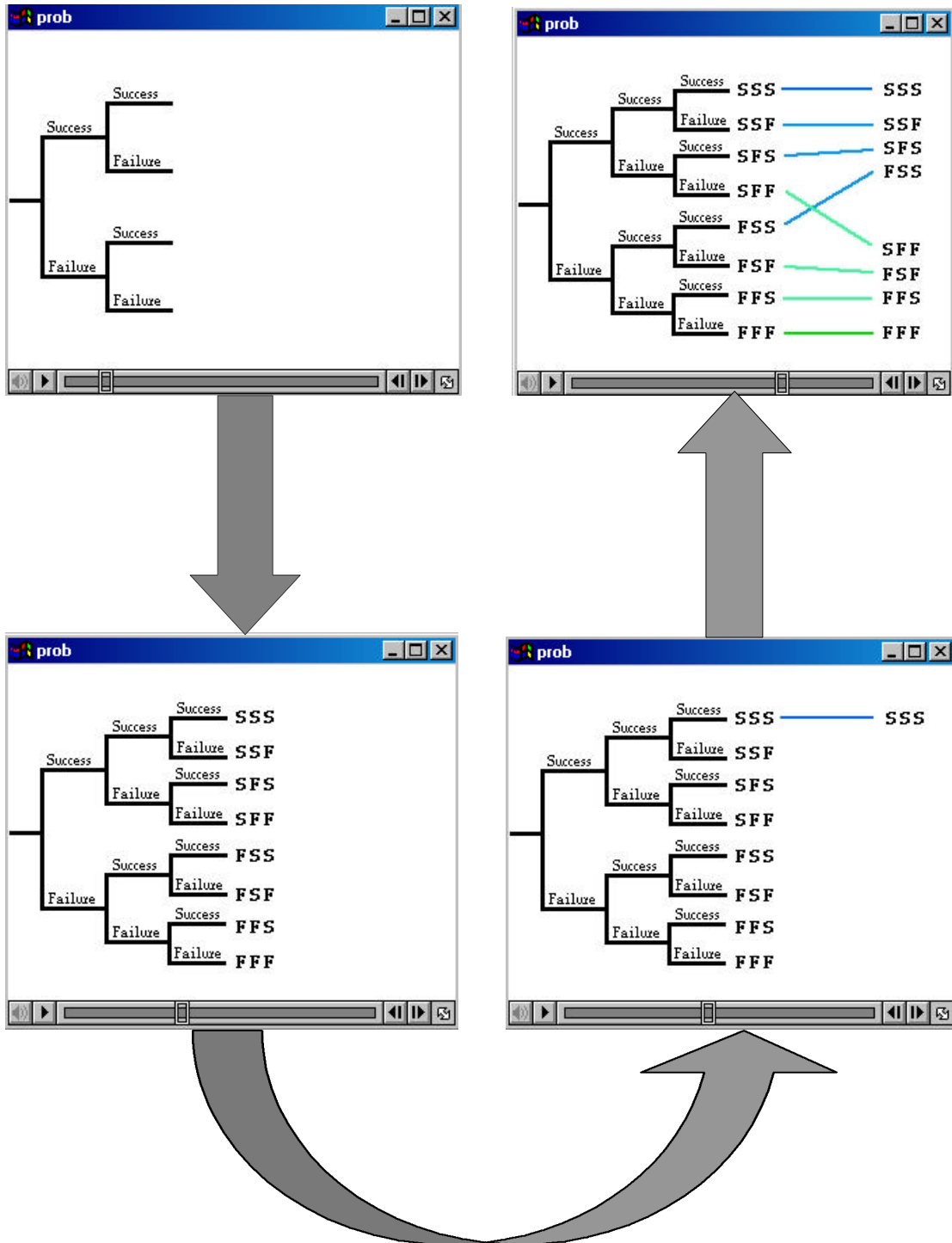
Special Features

One of the main features of this multimedia system is its ability to facilitate the teaching of complex concepts via specially designed animations and simulations. This feature enables all students, regardless of their geographical location and means of interaction with the University, to enjoy that extra level of explanation, which is usually conveyed during a traditional face-to-face lecture or tutorial situation.

For instance, the concept of the Binomial Theory is complemented by incorporating interactive facilities, which allow the students to interact with the animations and investigate different situations. See Figure 5.

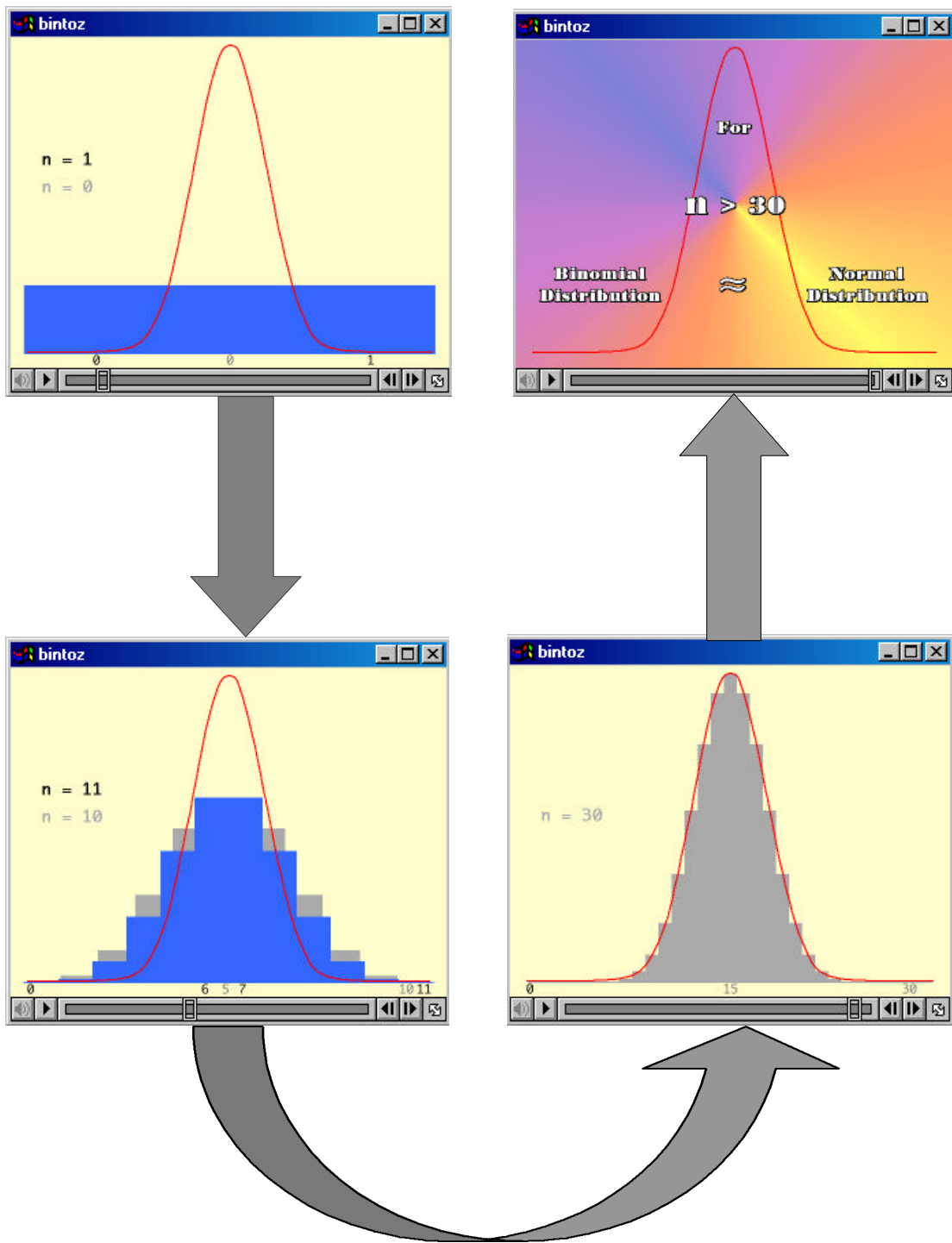
Similarly, the concept of Normal Approximation is supplemented with a specially designed animation, which provides that extra level of interactivity for students. See Figure 6.

This type of approach is adopted and used throughout the related topics. Hypertext links to explanations and links between various sections of the material are also amongst the features of the system. Students can even launch their Internet *newsreader* to connect to the *newsgroup* specially assigned to the Computer Mediated Communication (CMC) for this subject. This is achieved from within the same program.



The arrows indicate the progress from an earlier to a later shot.

Figure 5: Interacting with the System - Binomial Theory



The arrows indicate the progress from an earlier to a later shot.

Figure 6: Interacting with the System - Normal Approximation

Total Technology Approach to Teaching

It should be noted that this multimedia system is also adopted in conducting the face-to-face lectures. This is achieved in a lecture theatre equipped with a multimedia computer, multiscan projector and a large screen. This way of conducting lectures has had many benefits, including:

- instant access to the right piece of information via hypertext links;
- enhanced presentation of material with supplemented sound, graphics and interactive animations and,
- student exposure to more efficient navigational techniques as demonstrated during the lecture

The *newsgroup* specially set up for this unit is being used by the author as a means of virtual consultation with students (7 days a week), and for providing guidance and direction for using the system effectively. Sherry (1996), who notes that there is an increasing level of interactivity between students and teachers even in rural and isolated communities, supports the use of newsgroups and other electronic forms of communication. Their effectiveness has also been demonstrated by the positive feedback received from students participating in the multimedia project.

As we now believe that students construct their own knowledge, with guidance from teachers, many teachers are now offering students resources, which encourage their independent exploration of the materials provided (Berge and Collins, 1995). Jedge (1992) claims that constructivism (as it is termed as) does not view knowledge as a fixed entity but also recognises that it is not transferred from one knower to another. It is therefore important that learners be actively engaged with the instructional materials to construct their own meanings through an “interpretive process, which unravels their world in a personally meaningful way.” If Jedge is correct, then the more opportunities there are for students to interact with the study materials and the multimedia package, the more likely it becomes that the students will construct their own knowledge of a subject.

In order to motivate students to produce academic outcome in accordance with constructivist guidelines, “Download, Discussion and Quiz of the Week” have become regular features. These tests and quizzes provide instant feedback to students. For instance, the Download of the Week allows students to download new media such as multimedia tests, and the Quiz of the week lets students participate in on-line quizzes. The quizzes, which utilise Internet forms, are electronically sent to the Unit Leader of the course. After processing and marking, a feedback message is e-mailed to each student who participated in the Quiz. This process is not just allowing learners to interact with the materials, it is encouraging them. The feedback is assisting students to gain a better understanding of the subject matter.

Hence, this multimedia system is placed at the heart of a total technology approach to teaching (TTAT) which interlinks various technologies in delivering unit material to both internal and distance education students. This supports the beliefs of Prawat and Floden (1994) who claim that to implement constructivism into teaching, a more “complex interactive and evolving” model of instruction is needed. Perraton (1988) claims that the distance educator becomes a facilitator of learning through the most appropriate choice of the media available. Hence, the decision was made to use the mixture of media chosen for this unit.

Identifying and Measuring the Effectiveness of the System

The effectiveness of the multimedia system was identified and measured by:

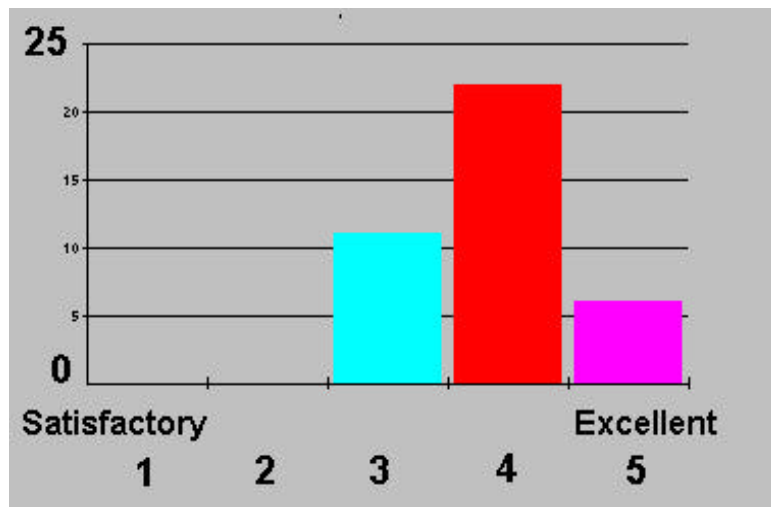
- Students' evaluation
- Students' performance in the formal assessments component
- Reduction in enquiries related to topic difficulties

Students' evaluation

To gain some idea of the students' responses to the material, a survey was conducted with a random sample of 40 out of 127 students in the fourth week of the semester. These students were asked to compare this unit with others they had studied that were similar in nature to Introduction to Management Science. Most of the students indicated that they thought the enhanced study materials were better than the material in the other units and that the multimedia package helped them to understand the content of the material better. They also believed that the multimedia system helped sustain interest in the materials.

When asked for their views on the multimedia package, comments such as ‘interesting’, ‘fun’, ‘good’, and ‘helps us to understand the course better’ were the main responses. All the responses indicated that the students had positive thoughts and comments about the package and enjoyed using it.

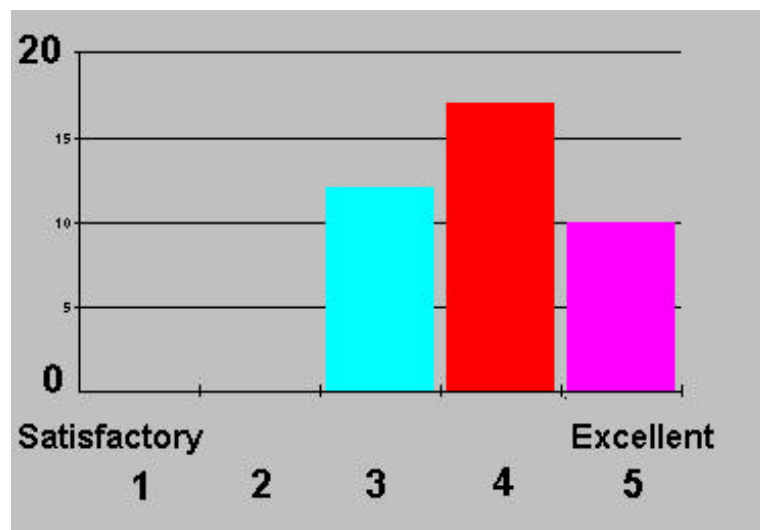
When asked about the user-friendliness of the system, the students rated it as good to excellent (see Figure7). Most of the ratings were good to very good and a few felt the user-friendliness was excellent. On a scale 1 to 5 (1 = Satisfactory and 5 = Excellent) the mean and standard deviation were 3.87 and 0.65 respectively. This outcome clearly indicates that the students regarded the system as user-friendly.



(The vertical axis represents the number of students)

Figure 7 - The User-Friendliness

When asked about the navigational features of the system, more students rated them as excellent with, again, all students listing them as good to excellent. See Figure 8. Similarly, on a scale 1 to the mean and standard deviation were 3.94 and 0.75 respectively.



(The vertical axis represents the number of students)

Figure 8 - The Navigational Features

Students' performance in the formal assessment component

The students' performance in the formal assessments was improved considerably. A comparison of the performance before and after the use of the system is presented in Table 1. As the table indicates, the performance has been enhanced significantly and the failure rate (marks <50) was reduced by about 60%.

STUDENTS' PERFORMANCE IN THE ASSESSMENTS (%)		
	BEFORE THE USE OF THE SYSTEM	AFTER THE USE OF THE SYSTEM
<50	13	5
50-65	47	45
65-85	30	35
>85	10	15

Table 2 – Comparison of Students' Performance before and after the Use of the System

Enquiries related to topic difficulties

Based on a substantial decrease in the rate of students' enquiries via the phone, fax, E-mail and in-person, an achievement of improvement in teaching and learning is a valid claim. See Table 2. Although the substantial decrease in fax enquiries may be attributed to use of E-mail, the E-mail enquiries were also lower than the previous semesters. It should be noted that these enquiries relate to difficulties in understanding the concepts and they do not include the administrative enquiries.

Table 2 – Reduction in Enquiries Related to Topic Difficulties

Conclusions

The use of interactive multimedia is a positive step in the direction of enhancing the learning process for this course. Integration with the web has allowed the author to update the materials continually and include quizzes and downloads for student further assistance.

The students' positive responses and performance also demonstrate that the system is an effective means of reinforcing the learning process, particularly for those students who are not able to take advantage of the traditional (face-to-face) mode of delivery. The developed multimedia system also makes it possible for the lecturer to further concentrate on teaching and research due a considerable reduction in students' enquiries.

Acknowledgements

The author wishes to acknowledge the advice provided by Dr Latif Al-Hakim of the University of Southern Queensland, Toowoomba, Queensland, Australia on preparation of this paper.

References

Berge, Z. and Collins, M. (1995) *Computer-Mediated Communication and the Online Classroom in Distance Learning*. Computer-Mediated Communication Magazine_2(4) Website: <http://sunsite.unc.edu/cmcmag/1995/apr/berge.html>

Clements,
1997,

% DECREASE IN STUDENTS' ENQUIRY RATE			
PHONE	FAX	E-MAIL	PERSONAL CONTACT
60	95	30	20

Douglas H.

'(Mis?)constructing constructivism', *Teaching Children Mathematics*, Vol. 4, Issue 4, p198, 3p.

- Fleming, N.D; (1995), *I'm different; not dumb. Modes of presentation (VARK) in the tertiary classroom*, in Zelmer,A., (ed.) *Research and Development in Higher Education*, Proceedings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australasia (HERDSA),HERDSA, Volume 18, pp. 308 - 313
- Jegede, O. (1992). *Constructivist epistemology and its implications for contemporary research in distance learning* in Evans, T. and Juler, P. *Research in Distance Education 2* ; (pp. 21-29). Geelong: Deakin University Press.
- Perraton, H. (1988). *A theory for distance education* In Sewart, D., Keegan, D. and Holmberg, B. (Ed), *Distance education: International perspectives* (pp.34-45). New York: Routledge.
- Prawat, R. and Floden, R.E. (1994) . *Philosophical perspectives on constructivist views of learning*. *Educational Psychology*, 29(1), 37-48.
- Sherry, L. (1996). *Issues in Distance Learning*. *International Journal of Distance Education*, 1(4), 337-365.