BREAKING TRADITIONAL BARRIERS IN TEACHING ENGINEERING STUDENTS

A.I. Al-Shamma'a[1], A. Shaw[1]

Abstract—*Using the approach of interactive/real time of teaching Engineering students, in Engineering Education and multimedia methods, to get a chance to "do" and "understand". This urges the development of a system in which humans and machines work in harmony, each playing the appropriate and affordable role for the purpose of creating intellectual as well as fiscal wealth. This means creating a better-educated workforce, at all levels, by building on existing skills, ingenuity and expertise, using new science and technology-based methods and tools, such as interactive multimedia. The goal of this paper was the improvement of mathematics, computer programming and usage of computer applications tools for first year Engineering students. The computers tools student used for their studies was MathCAD, Matlab, HTML and XML, C++ and JAVA compliers.*

Index Terms—Mathematics, multimedia, engineering education, computer programming and software.

INTRODUCTION

Recently there has been concern over the level of mathematics ability and instruction throughout the Universities in UK and other countries [1,2]. Early in high school our students drop out of an academic mathematics sequence. By dropping out they are unprepared to pursue careers in engineering, science, mathematics, and technology. In an effort to reverse this trend, some attempts are being made to change mathematics instruction in our high schools but is failing in some cases to provide basic skills needed to enable the student to learn more advanced mathematics. The effect of improving and developed learning skills has been known for a long time [3]-[5]. H. Poincaré pointed out that 'some students' prefer to treat a given problem 'by analysis', others by 'geometry'. The first are incapable for imagining and solving problem in space and the others are tired of long calculations. Therefore no wonder that one area of particular interest to few school teachers is the potential of using interactive 3D mathematical software's as a tool to overcome the above problems.

However, at the university level, the trail approach of changing from a passive way of teaching, in which the student is viewed as an empty container into which we pour information, to an active approach where the student learns by doing. The fundamental basis of the interactive way of teaching is the belief that an interactive/real time usage of multimedia can provide an environment in which students are actively involved and can explore mathematics, computer programming and usage of software's with understanding. An interactive teaching engages students, encourages teamwork, stimulates creativity, extends and refines knowledge. Students solve problems by reasoning. They communicate their results and focus on solving problems, not on several repetitive processes. The interactive/real time teaching removes that drudgery so that students can focus on real problems, which make the connections to many other fields.

CURRENT TREND

There is something decidedly different between students reading a textbook and student reading the lectures of their instructor 'teachers or lecturers'. It is a psychological difference; students begin to get impression that their instructor someone whom they can identify by sight and sound is talking to them rather than anonymous author whose name adorns the cover of the text. The goal is to breakdown the traditional barrier between the instructor and students and to empower students with knowledge rather than hide that knowledge as if it were the instructor's intellectual property alone.

INTERACTIVE MULTIMEDIA

Interactive multimedia combines and integrates text, graphics, animation, video and sound. It enables students to extend and enhance their skills and knowledge working at a time, pace and place to suit them as individual and/or teams and should have a range of choices about the way they might be supported and assessed. In other words:

- The student has a choice and the freedom to learn.
- The student is supported by the multimedia based learning materials and technology.
- The instructors are creating an effective, enjoyable learning environment and infrastructure.

The application of multimedia in education and training helps to make the learning process more effective and better adapted to student needs [6]. However, this does not automatically lead to better education. The technology itself is usually less of a problem, especially in engineering education, where the application of the technology itself can be part of the learning process. However, to achieve the shift from teacher-driven to learner-centred education requires, first and foremost, a change in attitudes and behaviour-as

---

[1] The University of Liverpool, Dept. of Elec. Eng. and Electronics, Liverpool, L69 3GJ, UK.

well as institutional frameworks and infrastructures - and this is a much slower process. There is a multitude of experience in applying multimedia to engineering education in UK and across Europe, much of it in small-scale local projects with small groups. Valuable lessons, good and bad, have been learned, but too little of this experience have been transferred to other units and sectors. Integration and institutional transformation has been much slower to appear and, although engineering through its universal nature seems most suited to trans-national co-operation, international application is remarkably rare. Therefore there is a need for institutional support for innovative teaching and learning methods and identify the:

- role of interactive multimedia and communications technology in the new learning environment;

- how to adopt teaching and learning attitudes to support modern networked university;
- new learning technologies and methods in support of learning through design, projects and team work;
- multidisciplinary methods to encourage self-direction and an entrepreneurial spirit.

However, we are living in an era when competitive advantage cannot be maintained without continued and sustained commitment to innovation, research and development and high quality student centred teaching methods.
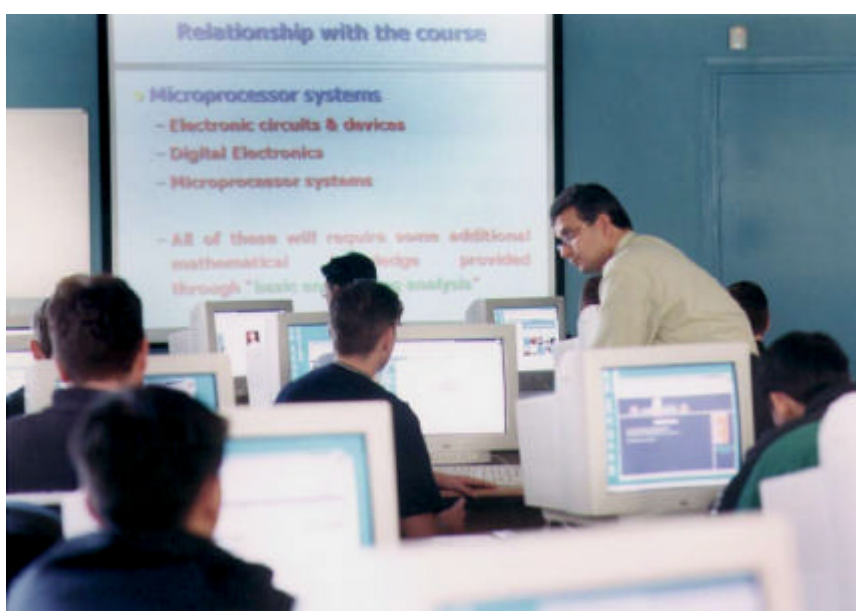

FIGURE 1
STUDENTS AT A LECTURE SESSION USING THE INTERACTIVE /REAL TIME TECHNIQUE

INTERACTIVE/REAL TIME TEACHING

Based upon the experience gained from the traditional passive way of teaching, use of computer based learning for specific subjects and multimedia tools, we have adopted a trial method of teaching the engineering students interactively on time by combining the above methods all together. The interactive lecture has been conducted by describing the aims and objectives of a subject and its purpose of studies. These days the students are very keen and interested to know that their subject's materials are related to the outside world 'industrial and commercial'. Therefore it is very important to emphasize these particular points to the students during the lecture/tutorial sessions. Teaching the students mathematics, computer programming and usage of various software's, the lecturer will show the

students step by step the procedures of learning and how to solve problem for the related subject interactively by using the interactive board, the data projected where the lecturer materials displayed on the board and on the students computer screens during the lecture session, figure 1 shows an interactive/real time class seesion for first year undergraduate students. Thereafter the lecturer will encourage the students to apply the information just described into working examples followed by an extra problems need to be solved as homework then course assignments. This way the students after digesting the main objectives and the background of the subject can work through many examples, solve problems and make use of an Internet for further information. After comprehensive case of study by applying this technique of teaching we have found the followings:

- Interactive teaching engage students

  Students are required to explore and solve specific subject ideas. In case of mathematics, the use of computer eliminates the boring labour necessitated by hand computations. Students working with an interactive MathCAD, Matlab, HTML, XML and programming languages in C++ or Java cannot be passive learners. They must master the concepts through their own efforts. Students gain ownership of a concept or relationship.

- Interactive teaching encourage teamwork

  Often interactive teaching is applied to all students and also used for targeting groups of students in computer laboratories. The bantering of ideas with contributions from each member is a critical part of the learning process. Our society and its workplace require team efforts. Learning can no longer be a process in isolation.

- Interactive teaching stimulate creativity

  Our world today requires imaginative solutions to its problems. With the interactive teaching, and since the students established the strong confidence in understanding the subject materials then be in a position to wonder what if, and explore the subjects conjectures. The capabilities of the computer make this possible.

- Interactive teaching help students to extend and refine knowledge

  Because computation is so much easier, applications beyond the scope of traditional courses can be addressed. Mathematical modelling to its fullest extent can be applied. The problem can be translated into a mathematical model, the model can be solved, and the solution can be translated back to the problem. Interactive teaching allows and encourages the students for doing so.

CONCLUSION

The interactive/real time teaching affects the learning process by engaging students, encouraging teamwork, stimulating creativity and extending and refining knowledge. The instructor 'teacher or lecturer' role in the classroom is one of a lecturer, an advisor and an encourager. The student is an active participant making things happen. This method has been applied in some modules for first year undergraduate students and proven successfully from the students feedbacks after completing the case of a study.

ACKNOWLEDGMENT

REFERENCES

[1] Grunwald, N, Kossow,A, "Cross-discipline co-operation in engineering using computer algebra systems", *Global J. Eng. Educ. Vol,2, No.2, 1998, pp.177-180.*

[2] Guimaraes, L,C, Belfort,E, "Tools for teaching mathematics: a case for java and VRML", *J. Computer Applications in Engineering Education, Vol, 8, No 3, 2000, pp.157-161.*

[3] Poincaré, H, "The foundations of science, translated by Halsted, GB", *The Science Press:New York, 1982.*

[4] Director, S.W., "Reengineering the curriculum:design and analysis of a newundergraduate electrical and computer engineering degree at Carnegie Mellon University", *Proc. IEEE, 1995, pp.1246-1269,*

[5] Hartley, M, G, "Trends in electrical engineering education a 25-year retrospective", *International J. Electrical Eng. Education, 1988, pp.209-217.*

[6] Lee,E,A, Messerschmitt, D,G, "Engineering an Education for the future", *Proc. IEEE, 1998, pp.77-85.*