

THE IMPACT OF NEW EMERGING EDUCATION TECHNOLOGIES ON THE EDUCATION AND TRAINING OF ENGINEERS IN THE CARIBBEAN NOW, 2000 AND BEYOND

By M.W. Chin*

INTRODUCTION

There is little doubt that the emerging technologies of the information age will have a significant effect on all our lives in the years to come. The application of these new emerging technologies in the field of education will most likely yield immense benefits. In this Paper, therefore, the potential impact of such technologies on the education and training of engineers and allied professionals now, 2000 and beyond is discussed and several examples are briefly described to illustrate the future potentials of some of these modern educational technologies. The paper concludes that the application of some of these technologies such as the Internet and telelearning will extend access and bring high quality engineering education to all engineers and allied professionals regardless of their location, age or status.

BRIEF REVIEW OF EMERGING EDUCATION TECHNOLOGIES

It is instructive to first of all briefly review some of the new emerging education technologies used for the education and training of engineers and allied professionals around the world as follows:

- print - desktop electronic publishing
- audio and video cassettes
- radio and television: cable and satellites
- telephony
- computer-based instruction (CBI)
- audio conferencing and audio graphics
- video conferencing and interactive compressed video (ICV)

- computer conferencing, the Internet and the world wide web (WWW)
- multimedia and telelearning

Alexander (1995) has reviewed the evolution of educational technologies and her comments are illuminating:

"Since the invention of writing, there has been a continued passing parade of new technologies, each of which it is claimed has the potential to 'revolutionise learning'. These technologies are released in a flurry of excitement but often end in disappointment when evaluation studies fail to reveal the much-anticipated improvement in learning. One such technology was the introduction of computers to learning Not to be discouraged by the roar, stumble and fade of Computer Based Instruction (CBI), the last few years have seen the promises of multimedia draw yet another enthusiastic crowd and yet more unqualified predictions And now, the latest in this long line of learning technologies is the world wide web (WWW). The greatest potential of the web however, lies in the fact that we have a chance to learn from the lessons of the previous faded technologies, and an opportunity to develop new learning experiences for students which have not been possible before There is a great deal of research available to WWW developers, not only about the way people learn and the strategies that promote the kind of learning we value, but also on the lessons learnt by earlier technology developers. If we use this knowledge to inform our practice, the students of today can look forward to new learning experiences

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which will not only provide them with an education, but a capacity for life-long learning as well".

Chin (1992) has reviewed the different forms of Information Technology (IT) currently in use in the West Indies for Continuing Engineering Education (CEE) and has concluded that initial and continuing education will become overlapping phases of life-long learning and that the forms of IT adopted will provide many more opportunities for independent learners in engineering to undertake updating and upgrading courses in appropriate topics.

Based on the foregoing reviews, there can be little doubt that some of the modern computer and communications technologies can be used in conjunction with traditional print, video and audio-based course materials to provide learners with innovative and integrated sets of learning opportunities and the WWW is one such example. However, it should be noted that the provision of written and visual information in electronic format on the WWW is not by itself an effective teaching and learning tool. Biggs and Moore (1994) suggest that 'deep' learning involves both communication between learners and teachers and learners being engaged in interactive learning processes. It is therefore of interest to briefly describe some of the current attempts being made to develop such interactive WWW courseware.

SOME ILLUSTRATIVE EXAMPLES USING SOME OF THE MODERN EMERGING EDUCATION TECHNOLOGIES

Since the public's awareness of the Internet was raised by Vice President Gore's term "information superhighway" and the advent of easy access through the worldwide web (WWW), there has been an explosion of interest and today, there are some 30 million people on the Internet and it is growing at a rate of 10% a month. The WWW is officially described as a "wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents". Special software termed "browsers" provide a user-friendly interface to this vast web of information. Thus, the challenge facing educational developers is to design learning experiences which promote 'deep' learning and the WWW has a number of features which might be used for teaching and learning. One such feature of the

WWW is the facility for educators to make links between formatted text and graphics with sound and video in one web document which would be accessible on computers worldwide. It is therefore proposed to briefly describe some illustrative examples which make use of the WWW to give a flavour of the range of applications in this interesting experimental field.

Mind Extension University (ME/U) and the International University College (IUC)

The ME/U: The Education Network, is a subsidiary of Jones Education Networks (JEN) Inc., and was launched in November 1987 by Jones International Ltd. and delivers fully accredited college and graduate level courses and degree programmes - via cable TV and home satellite dishes to approximately 26 million households in the United States, Mexico and the Caribbean. It has plans to expand globally. The IUC is an affiliate institution of ME/U and offers courses, certificates and degrees to individuals worldwide using a combination of education technologies - cable TV, videotapes, telephones, computers, electronic bulletin board systems (BBS), the WWW and other technologies - to deliver its courses and to facilitate interaction with teaching faculty members and other students and to overcome the barriers of distance and time. ME/U is currently developing curricula that will be available on-line via the Internet. Lectures will be a combination of text, graphics and full-motion video and audio. All assignments and communications will be handled electronically.

Another exciting element of the Information Highway is the World Distant Learning Center with five international "Electronic Campuses" being planned by Glen Jones founder of ME/U and IUC in Denver, Colorado, USA. The first interactive programme offering 35 credits in Business Management was scheduled to begin in May 1995 and other professional programmes are being developed. Further details can be found in Hypertext Reference HREF 1.

Since many Caribbean islands now receive ME/U on cable television, this offers an excellent opportunity for The University of the West Indies (UWI) as it moves towards becoming a dual mode institution to explore through its Distance Education Unit the possibility of some form of collaboration with the ME/U and the

IUC in adapting some of their courses for the Caribbean.

World Lecture Hall at the University of Texas

The World Lecture Hall (WLH) contains links to pages created by faculty worldwide who are using the WWW to deliver class materials. For example, one can find course syllabi, assignments, lecture notes, exams, class calendars, multimedia textbooks, etc.

Some of the disciplines and course materials in the WLH are given in **Table 1** in **Appendix 1** which also gives some of the courses in Environmental Science and Civil Engineering. There is also the University of Texas (UT) at Austin Lecture Hall which contains links to course materials published by (UT) Austin faculty. It should be noted that the Lecture Halls will only list free, academic courses and courses in any language. They will not list commercial courses and courses delivered through Gopher. Further details can be found in Hypertext Reference HREF 2.

The University-Enterprise Training Partnership in Environmental Engineering Education (UETP-EEE)

The UETP-EEE was founded in 1990 under the European Community (EC) COMETT programme with its head office in Helsinki, Finland and promotes environmental education and training tailored to the needs of industry through:

- (i) Coordinating international university enterprise cooperation and
- (ii) Providing administrative, expert and financial support for environmental education projects.

UETP-EEE is providing an Open and Distance Learning (ODL) course in Environmental Management as part of the Trans European Learning System for Cross border Open and Interactive Applications (Tele Scopia) project. Details of the WWW implementation of the course can be found in the URL:

<http://www.dipoli.hut.fi/TechNet/org/EEE/>

Access can be gained by using "demo" user account with password "tsuptsup". Further details can be found in Hypertext Reference HREF 3.

This is an excellent example of what could be done on the WWW for courses that would be of interest to engineers and allied professionals throughout the world. Such a course would be of particular importance to practising engineers in the Caribbean in light of the recent resolution on environmental engineering education adopted by the Commonwealth Board on Engineering Education and Training (CBEET) of the Commonwealth Engineers' Council (CEC) at their meetings in Jamaica in 1993. It was felt that all engineers should be familiar with environmental impact assessment (EIA) and this topic is covered in the UETP-EEE Environmental Management Course.

The TeleLearning Research Network (TL-RN)

TL-RN is a national collaboration between Canadian researchers and organisations involved in the development and application of advanced education technologies. The aim of the network is to bring together leaders who share a vision and interest in giving Canada a competitive edge in the development of new learning technologies. Telelearning is defined as the use of multimedia learning environments based on powerful desktop computers linked by the information highway. The principal goal is to develop telelearning as an environment that will provide students with access to learning experiences not available or achievable in conventional classrooms. The TL-RN is being led by Dr. Linda Harasim of the School of Communications and Dr. Tom Calvert of the Centre for Systems Science at Simon Fraser University, British Columbia, Canada. They are joined by a team of over 125 researchers from education, the social sciences, computer science and engineering from 28 universities and other research organisations along with partners in the client community geographically distributed across Canada.

Further details can be found in the Hypertext Reference HREF 4. The TL-RN was officially launched on November 25, 1995 with a total of CAN\$13.1 million approved for the next three and a half years.

There is no doubt that the VIRTUAL-U™ which will be one of the first networked multimedia systems in the world specifically customised for teachers and learners, will be of great interest to educators not only in the Caribbean but in other parts of the world. Simon

Fraser University (SFU) was planning to offer two courses using the VIRTUAL-U™ approach - one in engineering science and the other in communication. Details of the experimental implementation of the online version of the Engineering Science 125 (Basic Electronics Engineering) course at SFU have been given by Harasim, Calvert and Collings (1996).

CONCLUDING REMARKS

It is appropriate to make the following concluding remarks in order to bring together the main points of the paper:

1. The present scenario in the Caribbean in respect of the use of new emerging education technologies leaves much to be desired and based on the illustrative examples given, there is an urgent need for educators in the Caribbean to make greater use of these new technologies if we are to extend access and bring high quality engineering education to all practising engineers and allied professionals in the Caribbean regardless of their location, age or status.
2. The UWI and the professional engineering bodies need to play a more catalytic and dynamic role in using these new education technologies, thereby providing many more opportunities for lifelong learning of Caribbean engineers now, 2000 and beyond.
3. Of the new emerging education technologies, telelearning linked to the Internet and the

WWW offers the greatest potential for bringing virtual campuses and educational resources into the homes of practising engineers and allied professionals in the Caribbean tailored to their specific needs.

REFERENCES

1. Alexander, Shirley (1995). "Teaching and Learning on the World-Wide Web". Paper presented at Aus Web 95, May 1995, NSW, Australia.
2. Biggs, J. and Moore, P. (1993). "The Process of Learning". Prentice Hall, Sydney, pp. 312-313.
3. Chin, M.W. (1992). "Information Technology and its Impact on Continuing Engineering Education in the West Indies". Proc. 5th World Conference on Continuing Engineering Education, June 2-5, 1992, Espoo, Finland, Vol. 2, pp. 985-991.
4. Harasim, L., Calvert, T. and Collings, T. (1996). "A Networked Learning Environment for Continuing Engineering Education". The BC Professional Engineer. March 1996, pp 9-11.

HYPertext REFERENCES

- HREF 1: <http://www.iuc.com/>
HREF 2: <http://www.utexas.edu/world/lecture/>
HREF 3: <http://www.dipoli.hut.fi/TechNet/org/EEE/>
HREF 4: <http://telelearn.ca/telelearn> ■


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A	Accounting Agronomy Architecture Atmospheric Sciences	Agricultural Education Anatomy Art and Art History	Agricultural Engineering Anthropology Astronomy
B	Biochemistry Biotechnology	Biology and Botany Building Science	Biomedical Engineering Business Administration
C	Chemical Engineering Classics Comparative Literature Criminology	Chemistry Communication Computer Science	Civil Engineering Communication Sciences & Disorders Cultural Studies
E	Earth Science Electrical and Computer Engineering Environmental Engineering	Economics Engineering Science Environmental Science	Education English and Technical Writing
F-G	Finance Geology	French German Studies	Geography
H-K	History Industrial Engineering	Humanities Journalism	Immunology Kinesiology
L	Language Library and Information Science	Law Linguistics	Liberal Studies
M	Management Mathematics Meteorology Molecular Biology	Management Information Systems Mechanical Engineering Microbiology Music	Marketing Medicine Middle Eastern Studies
N	Neuroscience	Nuclear Engineering and Engineering Physics	
P	Pharmacy Psychology Public Health	Philosophy Political Science	Physics Public Affairs
R	Religious Studies	Recreation and Park Administration	
S	Science and Technology Soil Science	Social Work Spanish	Sociology Statistics
T	Telecommunications	Theater	Travel Industry Management
V-Z	Virology	Zoology	

Table 1: Some of the Disciplines and Course Materials In the World Lecture Hall

World Lecture Hall

Environmental Science

Environmental Chemistry Laboratory

A junior-senior environmental laboratory course. An analytical course aimed at characterising environmental sites and problems. Field monitoring is included. Syllabus, lecture notes, student work, and links to related materials.
By J.C. Baird, Brown University.

Environmental Pollution Science (MSc)

This course comprises a programme of lectures, tutorial and practical classes, directed reading, visits and a field trip. Progress is monitored by continuous assessment and sessional examination, after which students progress to a dissertation on a topic of their choice. A distance learning version of the course is being prepared. Syllabus and links to related materials. By Dr. S.M. Grimes, Brunel University, Uxbridge, Middlesex, U.K.

Global Change

This course examines global environmental change issues ranging from trends, sea-level rise, land-use, sustainable development, and societal responses to environmental change. The course has net-based pre-lecture and post-lecture interactive exercises and an electronic dialogue for discussing ethical issues relating to global change as well as course topics. Syllabus, calendar, lecture notes, assignments, exams, student work, and links to related materials.
By Eugene S. Takle, Iowa State University.

Integrated Resources Management

The capstone senior-level course required of all Natural Resources majors. Web used to supplement class activities. Syllabus, calendar, assignments, exams, student work, and links to related materials. By D. Jelinski and S. Ernst, University of Nebraska.

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Civil Engineering

Engineering Hydrology

Introduction to hydrology. Quantitative aspects of processes relating to precipitation, runoff and groundwater flow are reviewed with simple applications to water resource problems. The emphasis is on the basic scientific aspects, rather than on design. Syllabus, calendar, assignments, and links to related materials. By Upmanu Lall, Utah State University.

Hazardous Waste Management

This course is designed to provide the student with the principles of hazardous waste management and engineering. Topics include a historical perspective of the hazardous waste problem; federal and state laws and regulations for hazardous wastes and site remediation; transport and fate of hazardous substances in natural systems and the effects of hazardous wastes on human health and terrestrial and aquatic organisms; hazardous wastes control through treatment processes, disposal methods, and waste minimisation; hazardous waste facility development and management, and remediation of abandoned sites in which hazardous wastes present a danger to humans and/or the environment. Syllabus. By Neal E. Armstrong, The University of Texas at Austin.

Hydrology

Introduces students to modern computer methods for the solution of engineering problems. Syllabus, calendar, lecture notes, assignments, exams, and links to related materials. By Daene C. McKinney, The University of Texas at Austin.

Project Management and Economics

Students are acquainted with the principles of engineering economics and construction management. Syllabus, homework assignments, exams, and lecture notes. By Carl Haas, University of Texas at Austin.

Structural Engineering

Compilation of syllabi and homework assignments for undergraduate classes related to structural engineering. By Jack Kayser, Lafayette College.

Water Resources, Hydraulics, Water Resource Modelling

Complete courses and courses under construction. It is the main page for finding Web-based information for Civil Engineering courses at the University of Central Florida. Lecture information is added daily. Some links may be inactive during semester breaks so that they may be updated. Syllabus, calendar, lecture notes, assignments, and links to related materials. By Dr. R.D. Eaglin, University of Central Florida.

Water Resources Planning and Management

Introduction to the planning, design, and operation of water resources systems using mathematical simulation and optimisation methods and models. The use of mathematical techniques to aid in the planning, design and operation of water resources projects is the major focus of the course. The student will learn basic economic analysis (engineering economic and microeconomic analysis) and operations research techniques (linear, nonlinear and dynamic programming, and combinatorial optimisation) and will apply them to various problems in surface and ground water resources allocation. Syllabus, calendar, lecture notes, assignments, exams, and links to related materials. By Daene C. McKinney, University of Texas at Austin.

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