Multi-media technology – an opportunity for modern engineering education

G. Kohli, S. P. Maj, and D. Veal
Edith Cowan University, Perth, Western Australia.

Abstract

The last few years have seen an exponential growth of multi-media applications on the Internet. Video and audio data, is now in high demand as it can be delivered in a cost-effective manner via the Internet and CD-ROMs. Multi-media has its roots in network and computer technology but represents the convergence of a wide range of disciplines. There are considerable job opportunities in this field within Australia however the requirements are typically based on a creative arts background. The result within Australia is a proliferation of degrees in multi-media lacking a strong engineering basis. A possible danger with this approach is that it can lead to an 'applications' based education.

An analysis of students on the Multi-media degree at Edith Cowan University (ECU) found that most students had a good knowledge of multi-media products and their use, however they appeared to lack the depth of technical knowledge necessary to make professional judgments with respect to equipment selection and performance. Furthermore, most of the students interviewed wanted greater technical knowledge and associated workshops directly relevant to their field of study.

Research at ECU has found that the traditional approach to teaching computer and network technology fails to meet the expectations of students from a range of disciplines. Accordingly a new curriculum was designed to meet this demand. This paper presents details of this new curriculum and suggests that this represents an opportunity for a closer cooperation in the development of computer technology and multi-media education.

1. Introduction

Multi-media is a term that has been in use for many years. It refers to the presentation of information in two or more of formats: text, graphics, animation, video or audio [1]. Digital technologies have facilitated major changes in multi-media presentations. Digital storage media now allow multi-media productions to be stored and used interactively 'on-demand'. Interactivity allows users to access presentations in any sequence. Consequently education and commercial

organizations, in particular the entertainment industries are using multi-media as a form of 'edutainment', that is a blend of education and entertainment. In this context educators the world over are investigating the pedagogic benefits of using it in education. It seems an opportune time for us to stop and ask ourselves whether all this isn't just hype? All new PCs are marketed as 'multi-media machines' whether the user wants the capability or not. Educators and commercial suppliers are rushing to don the garb of multi-media creators in all that they do, making the world 'multi-media' the latest bandwagon of technology making the world 'multi-media' the latest bandwagon of technology.

The multi-disciplinary nature of multi-media places considerable demands on curriculum design and implementation. The demands include: wide range of topics, depth vs. breadth of curriculum etc. According to Lim:

> "In term of pedagogy, CS/ IS department need to also reexamine their curricula in order to prepare students to face the challenge of not only being able to function in a traditional data processing environment, but also to be productive in computing world that is now swamped with web technologies" [2].

Firstly some universities have elected to take a software-based approach. Secondly, some have elected for a hardware-based approach. Thirdly, others have adopted an arts based approach. Finally it is also possible to combine these different approaches.

The software approach primarily provides students with different web development skills, a range of different languages such as C ++, Java applets, HTML Java script, Java, CGI (Common Gateway Interface), web database design etc. This approach provides a sound knowledge of programming within a multi-media context. However, multi-media is not only about programming and Web pages. Other issues include streaming audio, video, image processing, graphic file format like (JPEG, MPEG) and computer animation. The second one is the hardware approach where students are taught how to build a network and trouble shoot multi-media PC. Reeves put this forward:

> "Our course is not about multi-media application, presentation style, models of cognition, or design theory. Rather, it introduces the tool and techniques for creating and playing multi-media content. In particular, student learn about the algorithms, hardware, and the standard upon which those tools are based" [3]

The problem with this approach is that it places a strong emphasis on the Engineering and Network side of multi-media, which students may find it difficult if they are from a non-engineering background. The arts based approach teaches student how to manipulate and edit both still images and

video. Typically this type of course teaches students how to use multi-media software as a tool. The main emphasis is on artistic creativity but at the expense of technical depth.

2. Multi-media Courses in Australia

An analysis was carried out some of the universities in Australia in order to find out how multi-media course are taught to students. All the universities analyzed placed Multi-media in the faculty of Arts and Science. According to Monash University:

> "The Bachelor of Multi-media is offered by the School of Information Management and Systems in collaboration with the Faculty of Art and Design. The aim of the Bachelor of Multi-media is to provide undergraduate students with the knowledge, skills and attitudes essential to the analysis, design and implementation of computer-based multi-media products, services and systems. The principal focus of the degree is on the development process, and all subject material is oriented towards the problems of identifying appropriate areas of application of multi-media, and developing products and systems to meet different user requirements. The course content is not specific to any particular application area for multi-media, but provides students with exposure to as wide as possible a variety of applications in business and government, while enabling them to develop specialized expertise in areas of greatest interest to them. The course has a very strong practical focus which emphasis's learning by doing. Students are required to carry out a lot of practical development of real systems for real-life clients to reinforce the theory covered in formal lectures and tutorials" [4]

The aim behind this course is to produce graduates that will work in both the public and private sectors developing computer-based multi-media systems, products and services. Students will gain experience in a wide variety of industry-standard tools and technologies used in web-based and CD-ROM-based systems. The course has a strong practical orientation, and will be ideally suited to meet the needs of advertising industry. The approach taken by Monash University is more toward a combination of software approach and arts based approach. According to RMIT University,

> "The course (Graduate Diploma in Interactive Multi-media) provides high-quality education relevant to the needs of the animation, interactive and 'new media' industries. It continues to build on a long and notable

> history of innovative media training. The partnership between image, sound, time and interaction is a powerful tool for communicating ideas. This intensive production-based course aims to foster creative talent through the practical production of short engaging works. The course provides a unique opportunity for students to realize a personal vision for either the big or small screen and to demonstrate tangible evidence of their talents and mastery over the medium through these published works. The Graduate Diploma program includes script writing, basic principles of animation, interface design, animation techniques, lighting computer animation, sound and soundtrack design, production methods, production management, cinematic language, interactive authoring, Internet projects and Web page authoring" [5].

This course produces graduates qualified to produce animated television commercials, children's television programs, video games, interactive and museum displays. The primary emphasis is on software and hardware based approach. ECU has a portfolio of courses in Interactive Multi-media Technologies at both undergraduate and postgraduate level. The emphasis of these courses is multi-media applications, presentation style etc. According to ECU,

> "The course provide studies of both a theoretical and practical nature in the are of IMM and draws together knowledge of the disciplines of information science, media art and graphic design, instruction design, computer cognitive science" [6].

It is possible to graduate with either a BA or B.Sc. in Interactive Multi-media. The course is centered around an Arts Based approach

3. Evaluation

Within Australia, the arts based approach to multi-media education is based on the requirements of the graphics industry. Skills specifically needed include:

- Business sense
- Visual literary
- Wed development skills
- Multi-media ability
- Instruction design skills.

In an analysis by Maj, Kohli and Veal, the multi-media students at ECU were interviewed in order to determine their knowledge of computer and network

technology. Fifteen students were interviewed of which 50% were arts based and other 50 % were science based. According to Maj:

> "Our conclusions are that: Multimedia students have almost no knowledge of computer and network technology.
>
> - They could not explain the internationally recognized Multi-Media PC standard (MPC).
> - One student with some knowledge of computer technology was entirely self taught.
> - Multimedia students demonstrated some basic misconceptions about video technology
> - Multimedia students had a good knowledge of compression standards and their applications" [7].

Furthermore, according to Maj:

> "It is significant that every student interviewed expressed the view that it would be extremely beneficial to have a much better knowledge of computer and network technology" [7].

The result of this survey clearly indicated that the arts based multi-media students at ECU believed they needed a better understanding of computer and network technology. The main problem with traditional engineering courses is that they lack direct relevance to this type of student. The authors therefore analyzed what hardware approaches, if any are best suited to teaching computer and network technology at an introductory level to multi-media students.

4. Constructivism

Prior to examining how to improve student learning we attempted to attain a deeper understanding of how students learn and construct knowledge. Constructivism is the dominant theory of learning today, the basis of which is that students must actively construct knowledge rather than passively absorb it via lectures. According to Ben-Ari considerable research has been undertaken in this field but commented:

> "However, I could not find articles on constructivism in computer science education compared to the vast literature in mathematics and physics education' and that 'it can provide a new and powerful set of concepts to guide our debates on CSE (Computer Science Education)" [8]

All constructive approach hold that knowledge is actively constructed by the learner and is not transmitted from the teacher to the student. Ben-Ari states that,

> "Constructivism is a theory of learning which claims that students construct knowledge rather than merely receive and store knowledge transmitted by the teacher. Constructivism has been extremely influential in science and mathematics education, but not in computer education" [8].

In this view learning, learner are seen to construct their knowledge in working memory with the assistance of retrieved memories from their long term memory store. The fundamental process here is one of scaffolding where the teacher builds a bridge between what the student knows to what they reasonably judge the student capable of, with their help scaffolding can occur through the use of key concepts, key people, mentors, media and the other students

A Constructivist approach may be therefore be a suitable framework on which to base the teaching of computer and network technology. Such a framework may provide the basis of good analogies, constructs and metaphors to assist with the development of understanding within the scaffolding process. According to this theory students have their own cognitive structures each of which is the foundation of the learning process. By example, a PC is understood very differently by Computer Science, Multimedia and Business IT students. Failure to do so results in fragile and incomplete learning in which new knowledge is merely a collection of facts to be memorized. The importance of the student's own mental model is illustrated by Scott Brandt who wrote:

> "The user's ability to apply a previously held mental model to the target (knowledge goal) will enhance the incorporation and construction of new knowledge" [9].

We suggest that it is a common experience of multi-media students to perceive the PC as a modular device (CDROM, Zip Drive, Modem etc) used to store, view and process either local or networked data. The traditional method of teaching computer technology (digital techniques, assembly language etc) is not a good constructivist approach. We attempted used this approach as a common conceptual framework held by students, from different disciplines (especially multi-media), as the basis for a cognitive structure.

5. Design of new Curriculum

At ECU a new curriculum was designed consisting of four units – Computer Installation & Maintenance (CIM) and Network Installation & Maintenance (NIM) both prerequisites to Computer Systems Management (CSM) and Network Design & Management (NDM). The units CIM and NIM were introduced first. The success of these two units led to the introduction of the

other two units. The unit CIM attempts to provide a practical, inter-disciplinary, problem oriented approach. Rather then lowering academic standards Professor Lowe, cited by Armitage, argues that:

> "the complexity of the real world is more intellectually taxing than living in imaginary worlds of friction-less planes, perfectly free markets or rational policy analysis" [10].

There are no unit pre-requisites for the CIM unit, hence one of the main problems is to control complexity as PC architecture can become complex very quickly. Accordingly a systems engineering approach is employed i.e. a top down, hierarchical, modular analysis. According to Scragg:

> "Most (perhaps all) first courses in computer hardware are created "upside down" –both pedagogically and pragmatically'. This has the consequence that 'Pedagogically, this approach provides no "cognitive hooks", which might enable students to relate new material to that of previous courses - until the semester is almost complete" [11].

Accordingly Scragg recommends a top down approach starting with material already familiar to students and then working towards less familiar models. In contrast to traditional units in computer architecture/technology the unit CIM does not include digital techniques (combinatorial and sequential logic), details of processor architecture at register level or assembly language programming. Rather the PC is considered as a set of inter-related modules, each of which is then addressed in detail appropriate to a first level unit. In particular the PC is treated as a 'whole' with detail carefully controlled on a 'need to know' basis. For example, the lectures on memory devices address the principles of operation of primary and secondary memory. Disc drive operation is considered along with typical performance figures and the advantages/disadvantages of the different types of controller (IDE, EIDE, SCSI). This is complemented by the associated workshops with a working demonstration of a disassembled but operational hard disc drive. Furthermore, in the workshops students are required to perform experiments that include: installation of a second floppy disc drive; addition of a second (slave) Integrated Drive Electronics (IDE) hard disc drive; upgrading from an Industry Standard Architecture (ISA) input/output card to a PCI Local Bus etc. This is complemented by experiments in fault diagnosis, correction and management.

Rather than consider the technical detail of one particular type of PC architecture, a range of PC architectures are used thereby ensuring vendor independent and generic maintenance skills. The principles of computer operation along with an emphasis on the skills associated with installation, fault diagnosis etc. provides skills that are readily portable between different PC

architectures. Given the rapid changes in technology this emphasis on generic skills is a non-trivial issue.

The CIM unit is followed by a second unit, Computer System Management (CSM), in which students are introduced to more advanced technologies. Accordingly workshops include installation and testing of: Digital Video Disc (DVD), flat bed scanner, PC video camera, Infrared communications link, Zip Disc etc. Other workshop exercises include establishing and testing a videoconference communications link via a local area network.

The workshops are based on typical Multi-media applications. It must be stressed that CIM is a pre-requisite to CSM. The equipment used in CSM is expensive, 'state of the art' technology. The prerequisite link helps to ensure that students are able to correctly handle expensive equipment in a safe manner. We suggest that even with the higher-level units there is no requirement to teach electronics or digital techniques. The Network Design & Management (NDM) unit is based on Window NT Application server.

This unit provides students with the opportunity to establish: web server, Domain Name Server (DNS), Remote Access Server (RAS) etc. Furthermore during the workshops they establish and test a video conferencing using a Local Area Network.

6. Discussion

It must be recognized that computer science has fragmented into many other disciplines. The relevance of the standard curriculum in computer and network technology is of questionable value to multi-media students. Analysis of students on an arts based multi-media course at ECU found that they did not have a good understanding of computer and network technology.

However all those interviewed expressed the view that it would be extremely beneficial to have better understanding of these technologies. Accordingly a new curriculum was designed at ECU based on a constructivist educational framework. Using this framework technology is taught using a 'need to know', top-down approach in which students are given the opportunity to work with a range of computer and network equipment more directly relevant to their perceived needs.
The NDM unit is an elective unit and was offered for the first time this semester. Approximately 25% of the students enrolling on this unit were multi-media students. A preliminary analysis of these multi-media students indicated a high student satisfaction with the majority of the workshop exercises. Further work is currently being undertaken including a detailed analysis of employer expectations.

Bibliography

1. Mcfedries, P. *Windows 95*. Sams Publishing. (1998).

2. B.L.Lim, B. Teaching Web Development technologies in CS/IS Curricula. *SIGCSE Technical Symposuim on Computer Science Education*, February. (1998).
3. Reeves, *D.S*, A course on Multimedia Technology for Computer Science and Computer Engineering Students .*SIGSCE Technical Symposium on Computer Science education*, (1997).
4. URL: http://www.monash.edu.au/pubs/handbooks/undergrad/ug0317.htm;*University Handbook*. (1999).
5. URL: http://www.courses.rmit.edu.au/InterCrs.cfm?SCrs=153400&Cmp=CY; *Course*, (1999).
6. URL:http://www.cowan.edu.au/acserv/handbokk/pg/chs;*Post graduation course*, . (1999).
7. P.Maj, G.Kohli., D.Veal, Teaching Computer and network Technology to Multimedia Students: a novel approach. *The 3rd Baltic Region Seminar on Engineering Education*, UNESCO. 64-67. (1999).
8. Ben-Ari, M. Constructivism in Computer Science. *SIGSCE on Computer Science Education*, (1998).
9. D, S. B. Constructivism: Teaching for Understanding of the Internet. *Communications of the ACM*,
Vol 40 No 10, 112-117, (1998).
10. C, Amitage. Irrelvevant degree factories must change with times, in *THE AUSTRALIAN*. 1995.
11. Scragg, G.W., Most Computer Courses are built Upside Down. *ACM SIGCSE bulletin*, Vol 23 No 1, 341 - 341, (1991).

GRUPREET KOHLI

I received my Electronic Engineering Degree from Nagpur University in India. I decided to pursue a Masters Degree Information Technology at Edith Cowan University, Perth, Australia. I chose an international university because it gives me a chance to study in a different culture and to compete with people from a different countries and universities. My Masters project work includes investigating real time data on the Internet such as audio and video applications and finding ways in which these services can provide improved performance.

My project work not only includes looking into new technologies, but also experimenting with different networks and investigating the data transfer rate (Bandwidth). Video conferencing and the Internet telephony are also an area in which I am experimenting. I am a graduate assistant and tutor taking Network Installation & Maintaince and Network System Management at Edith Cowan University.

PAUL MAJ

Dr S P Maj is a recognized authority in the field of industrial and scientific information systems integration and management. He is the author of a text book, *'The Use of Computers in Laboratory Automation'*, which was commissioned by the Royal Society of Chemistry (UK). His first book, *'Language Independent Design Methodology - an introduction'*, was commissioned by the National Computing Center (NCC). Dr S P Maj has organized, chaired and been invited to speak at many international conferences at the highest level. He has also served on many national and international committees and was on the editorial board of two international journals concerned with the advancement of science and technology. As Deputy Chairman and Treasurer of the *Institute of Instrumentation and Control Australia (IICA*) educational sub-committee he was responsible for successfully designing, in less than two years a new, practical degree in *Instrumentation and Control* to meet the needs of the process industries. This is the first degree of its kind in Australia with the first intake in 1996. It should be recognized that this was a major industry driven initiative.

DAVID VEAL

David Veal received his honours degree in Theoretical Physics from the University of York in England. He lecturered in Physics at South Devon college UK for 10 years. He now lives in Westrn Australia where he has taught Computing and Physics at high school level. He is studying for his PhD in Computing Science at ECU in Perth, Western Australia and is investigating competency based techniques in Computing Science as well as the modeling of computers to aid student understanding.