Supporting the Teaching of Computer Graphics, Visualization, Multimedia and Virtual Environments

Workshop Report

29-31 May 1996

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The Advisory Group On Computer Graphics is an initiative of the Joint Information Systems Committee of the HEFCs and the Research Councils.

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Introduction

This is the report of a workshop held 29-31 May at Burleigh Court, Loughborough University, UK. There were 20 participants at the event including Scott Owen (Georgia State University) and Gitta Domik (University of Paderborn, Germany) from the SIGGRAPH Education Committee. The workshop call is attached as Appendix 1, the programme for the event as Appendix 2 and the participants list as Appendix 3.

All participants at the workshop wrote position papers and were involved in the discussions which led to the recommendations. The papers which were presented are written up in this report. These helped to guide the discussions.

This is one of a series of workshops organised by the Advisory Group On Computer Graphics which is an initiative of the Joint Information Systems Committee of the HE Funding Bodies and the Research Councils.

Executive Summary and Recommendations

Liaison between AGOCG and SIGGRAPH Education Committee

There is a lot to be gained from increased liaison as we have similar aims in mind — supporting educators through provision of materials and through collaboration.

It was agreed that we ought to mirror the SIGGRAPH Education WWW site in the UK and that SIGGRAPH would look to mirror the AGOCG site.

We agreed that we should work together to develop materials of common interest.

What Sort of Resources do we Want?

We had a lot of debate about the need for flexible resources and distinguished between "raw materials" and "perspectives" on these. Raw materials are clips of things — images, models, programs etc. Perspectives present a view of the raw materials — an overview of resources available, a courseware module including the raw materials — this would be a personal view of the materials. In this sense Hypergraph is Scott Owen's perspective on a set of resources. We felt that one of the problems with materials that have been developed is that they are too complete and that people do want to have raw materials to enable them to put together their own perspective.

It was agreed to review HyperGraph and HyperVis with a view to some restructuring.

Link to Knowledge Gallery

The Knowledge Gallery is a joint venture between the commercial and HE sectors in the UK to provide a gateway to image-related resources. It was agreed that this presented a possibility for achieving some of our aims and we should monitor this. We are working internationally and need to ensure availability beyond UK.

Potential resources are from: SoftImage, PIXAR, SIGGRAPH, EG.

We would like to see it include polygonal and non polygonal models, worked examples, MPEG clips, clips from our pilot studies (see below).

Quality Assurance

We need to set up an Editorial Board to recommend and evaluate resources to be made available.

Range of Resources

We want more than just clips and text. We want other resources such as contacts, exam questions, self assessment, collaboration tools, FAQs etc.

Pilot Studies

It was recommended that we should conduct some pilot studies of particular areas to see if we can put together the kind of range of raw materials which would be useful. This detailed work would then raise the issues that need to be addressed when the topic materials were broadened.

The following topics are recommended for the pilot:

- animation
- visualization techniques

These would include the following resources:

raw materials - images, movies, VRML, scripts

linking text

annotated biography

links to projects/information sources

teaching datasets

multiple choice self assessment - QMWeb

FAQs - probably using AnswerWeb

Teaching Virtual Environments

This emerged as having different needs due to the different level of maturity of the subject and the cost of equipment.

There is a need for a central repository of resources and conversion tools for taking these at different levels of detail.

We need to have UK HE access to high level immersive facilities to give students exposure to what is possible.

We need to keep raising awareness of current technology.

The poor mathematics of students is a problem for departments.

Introduction — Ken Brodlie & Anne Mumford

Background

Ken Brodlie started by asking why we needed another workshop and wondered if we had been here before.

There have been a number of workshops which have considered the question "what to teach?" These include:

- ¸Eurographics (EG) workshop on "Teaching Computer Graphics", Manchester, 1985 which looked at a core syllabus.
- ¸EG workshop on "Future Directions in Computer Graphics Teaching", Leeds 1989, which created a taxonomy of computer graphics teaching.
- ¸IFIP workshop on "Computer Graphics and Education", Barcelona, 1991 which enabled participants to share international experiences.

Current activities include:

Sharing Experiences of Teaching:

- ¸EG Working Group on Education which meets annually at the EG conference (next one is in Poitiers 24-25 August 1996)
- ¸SIGGRAPH Education Committee who have an annual educators programme at the SIGGRAPH conference (August 1996 in New Orleans)

Sharing Resources:

- ¸SIGGRAPH Education Committee through their slide sets and through HyperGraph providing online material
- ¸AGOCG activities to provide training materials, slide sets and online materials

So, where are we now? We have a growing understanding of WHAT to teach in the fundamentals of computer graphics. We also have access to a growing set of teaching and training materials through organisations such as SIGGRAPH and AGOCG. The various workshops and conferences provide opportunities to exchange ideas.

We need this workshop because we have an opportunity to consider new areas which include:

- ¸we need to understand WHAT to teach in the new themes of visualization, multimedia and virtual environments

• ,we have greater opportunity than before to collaborate on shared resources through the WWW. This includes resources beyond text and media and extends to 3D models, interaction and animation through Java and VRML.

Can we seize this opportunity?

Advisory Group On Computer Graphics (AGOCG)

The Advisory Group On Computer Graphics (AGOCG) provides a single national focus for computer graphics, visualization and multimedia within the UK higher education community. AGOCG is concerned with all aspects of visual information and its processing and presentation. AGOCG's programme of work is directed on a day-to-day basis by the Co-ordinator, Dr Anne Mumford, who is based at Loughborough University. AGOCG has employed support officers in areas of new technology where the community needs extra assistance in learning about new tools and techniques (visualization and multimedia). AGOCG acts as an "umbrella programme" providing funding for a series of small projects which are timely and cost effective and enable experts in the HE community to advise others on best practice. These projects include preparing state of the art reports, training materials, courses and software evaluations.

Through this workshop AGOCG hopes to facilitate interaction between institutions and organisations and to take up the recommendations with appropriate funding bodies and agencies.

see:

http://www.agocg.ac.uk/

ACM SIGGRAPH Education Committee

SIGGRAPH is the ACM's Special Interest Group on Computer Graphics. ACM SIGGRAPH is extremely interested in supporting both Computer Graphics education and the use of Computer Graphics in education. The ACM SIGGRAPH Education Committee was established to accomplish this task. The Education Committee currently has over twenty different projects, involving more than fifty volunteers from around the world in the areas of curriculum studies, resources for educators, and ACM SIGGRAPH conference related activities. The Education Committee is always soliciting new ideas and volunteers to implement the ideas.

see:

http://www.education.siggraph.org/

WWW Technology in Courses in Computer Graphics and Scientific Visualization — G. Scott Owen

Abstract

The rapid emergence of the World Wide Web and its associated tools has provided educators with an opportunity to incorporate this technology into their courses. The author has developed a Web based system for class presentation and class text that includes HTML and PDF documents, VRML worlds, and Java applets. His students use HTML for project reports and examinations. In addition, the computer graphics students learn VRML in the first course. This has enabled the paperless class to become a reality.

Introduction

Educational institutions need to take advantage of World Wide Web (WWW) technology to deliver instructional materials. The state of Georgia and the entire USA is in the process of enhancing the Internet to create an "Information Superhighway". The goal is the high speed delivery of information and entertainment into homes, offices and schools. We as academics need to leverage this effort by creating multimedia instructional materials that can be delivered, via this high speed network, directly to students. This material will supplement, and partially replace traditional classroom lectures. Eventually an entire course can be delivered in this fashion with only occasional scheduled class meetings. The teacher will interact with students via electronic conferencing, and students will work together collaboratively on problem solving as a way to make their understanding of the material more real and relevant.

In this paper I will discuss how the use of HTML, VRML, and other Web technologies have been integrated into our graphics and visualization courses [OWEN95]. I will not discuss searching the Web for external material, although that is done in the courses, but will focus on how HTML documents are used for in-class presentation, as the text in the course, and for student assignments.

Background and Development of HyperGraph

In the past several years I have been moving from a conventional lecture course to a hypermedia based course to an Internet based hypermedia course, both in instructional delivery and in student assignments. I primarily teach three different courses: Computer Graphics, Advanced Computer Graphics, and Data Visualization. The primary texts in the courses are the hypermedia systems HyperGraph and HyperVis.

The origin of HyperGraph was in a set of notes that had been developed for my computer graphics classes. For an overview of the material taught in these courses see [OWEN91a], [OWEN92b], and [OWEN94]. These notes were extended and used for the National Science Foundation Faculty (NSF) Enhancement Workshops on Computer Graphics in August, 1990 (NSF Grant #USE-8954402) [OWEN91b]. In our computer graphics courses I have used a variety of texts and found that my notes were becoming incompatible with any single text and the students were using the outside texts less and less. With support from the ACM SIGGRAPH Education Committee plus residual NSF funds, these notes were converted to the initial version of HyperGraph [OWEN92a]. I decided to use HyperGraph as the primary reference for teaching the computer graphics classes, starting winter quarter, 1993. HyperGraph was also used in Faculty Enhancement Workshops on Computer Graphics held at GSU in August, 1993 and 1994 (supported by the ACM SIGGRAPH Education Committee and the NSF (Grant #DUE-9255489)).

There are several considerations when developing a hypermedia system. One of these is portability and longevity. It requires a huge amount of work and effort to create a substantial system. Thus, one wants it to be able to adjust to changing technology and be portable among different platforms. Of course, one consideration about using a proprietary system is that the company that supports the software may disappear. When I first started developing HyperGraph there was no widespread public domain system so I had to choose a proprietary system.

The hypermedia authoring system used was Guide [GUID93]. Guide is a window based system wherein one or more windows can be opened and each window can be scrolled and may contain an entire file of text and graphics. The windows can be dynamically resized and so are easy to port to systems with different screen resolutions. Although HyperGraph contains different media types, there is a large amount of text, just as there is in conventional computer graphics textbooks. Thus, it required an authoring system that was very capable and flexible in the handling of hypertext. Guide was originally designed for hypertext and so has excellent text handling facilities with several different types of links or buttons for text.. It also has easy ways to launch external commands, which can display images, an animation, video, or interactive programs.

The Guide system also seemed to address the portability issue in that it ran on both IBM PCs and Macintoshs and a version was being developed for UNIX. Unfortunately, the company stopped development on both the Macintosh and UNIX variations and so the newer versions run only on DOS/Windows platforms. Also, authoring documents in Guide required the purchase of the authoring system, about $300 educational price, which meant that other faculty could not easily contribute to the development, and that students could not create their own hypermedia documents or modify HyperGraph.

After the WWW and HTML appeared, in 1993, I decided to start using this system. As previously discussed, the WWW became an international phenomenon by mid-1994; it was clear that HTML had become the defacto world standard for hypermedia documents and that this was an important technology that our students should learn. There are some problems in the current version of HTML, e.g., no mathematical symbols, and its text handling is not as flexible as that of Guide. But new improvements are being constantly made so these drawbacks should disappear. We are investigating the use of the Adobe Acrobat PDF system to address some of the above formatting issues.

Use of HyperGraph for Class Presentation

Because of its origin as a set of notes, the initial version of HyperGraph was organised as a book with a table of contents and links to the different chapters. While this view has been preserved and is still available to the students, the information space has been restructured in terms of a set of conceptual maps, represented as directed graphs, that cover the topics in computer graphics.

The student now has the option of moving through the set of conceptual maps until they arrive at a specific information node consisting of text, graphics, and interactive programs. Some of the interactive demonstration programs were written at GSU and some are from external sources. The ACM SIGGRAPH Education Committee Computer Graphics Courseware Repository (CGCR) is housed at GSU and we incorporated programs from there, such as the set of interactive demonstration programs written by Lt. Col. Dino Schweitzer of the U.S. Air Force Academy. Many of the programs were initially written for a DOS environment and we converted them to the Microsoft Windows environment. We are now converting some of these programs to Java so they will run over the Web.

Student Creation of HTML Documents

Since most Web/HTML tools are free, this meant that I could integrate HTML into my courses for student use. I started with the Computer Graphics course in the summer of 1994. In our upper division courses, taken by both undergraduates and graduate students, the graduate students must do a special project that goes beyond the undergraduate assignments. In the first Computer Graphics course [OWEN94] the students write their own ray tracing programs and also create images using the Pixar Renderman package. The special project of the graduate students was to create an HTML document which described their projects for the course. For each project they would describe the input data file, the characteristics of the output image, and then show the image. They turned this in as a set of HTML files plus the associated images.

This experiment was successful so the next quarter (Fall, 1994) in my Data Visualization course this was generalized to all of the students, both undergraduate and graduate. In this course the students do a set of projects, using the package IRIS Explorer, on Silicon Graphics Workstations. The projects are done by teams of students who then produce a report, consisting of images and text, on each project. All project reports were done as hypermedia documents in HTML format. The teams placed their reports on one of the workstations where I graded them. The student projects were accessible for all the students to view, so that they could learn from each other. The quality of the HTML documents improved during the course as the students read the other teams' documents and we critiqued them in class.

In these courses I sometimes give take home midterm and final examinations, so the students did these as HTML documents. I created a directory on a workstation for them to submit their examinations. Each student created their own subdirectory, placed their examination consisting of documents and images in the subdirectory, and then changed ownership of the directory and files to me. This way students could not read each others examinations. Since all assignments were sent as e-mail messages to the class this was a truly paperless course, except for the Syllabus, which legally must be on paper.

Effectiveness

There are three areas of effectiveness that I will address. The first is the effectiveness of using HyperGraph in the classroom, second is the effectiveness of using HyperGraph as the primary text in the course, and third is the effectiveness of having the students create their own hypermedia documents using HTML.

Classroom Effectiveness

At this point, it would be extremely difficult to teach my courses without HyperGraph and/or HyperVis. Computer Graphics and Data Visualization are both highly visual disciplines. It is extremely effective to be able to discuss an algorithm or technique using images as aids and then show the resulting image or animation. The students, both in written comments and informal discussions have stated that this has been very effective.

There are some improvements that need to be made, however. Some of these are technological and require better computer equipment. In showing the graphics images, it would be much better if the images could be shown in "true colour", i.e., at a colour resolution of 24 bits per pixel, rather than be restricted to the current 8-bits per pixel. This restriction causes colour artefacts to appear that hamper the interpretation of the images. Since many of the images are large, faster cpus, disks, and video cards would improve the speed of the presentation. Of course, this is even more true for the animations and digital video.

One must be careful in such a presentation to not just show students large amounts of text. This is a potential problem with HyperGraph since it is designed to replace a conventional textbook. So I use an overhead projection system to supplement HyperGraph. A better solution would be to use a tablet and write the notes directly on the screen.

Text Effectiveness

Generally the students have liked using HyperGraph as a text. All of the students, with one or two exceptions per class, have their own home systems that are capable of running HyperGraph. While some parts of it still need to be supplemented by conventional texts, as it evolves the goal is that it will be sufficient in itself. Many students do not purchase the supplemental texts but use only HyperGraph.

Student Creation of Hypermedia Documents

The students have responded very favourably to this aspect of the course. They know that by creating these documents and learning this technology, they are gaining valuable experience. It is also more fun for them. In the team reports, the students customised their documents and each team member had their own home page, with pictures of themselves, significant others, children, etc. This helped in building team spirit and helped engender a friendly competitiveness between the teams.

A danger in incorporating any new technology, especially in having students create their own hypermedia reports, is that the students will be so enthralled with the technology that they will focus on the glitz aspects and slight the content. I was very careful to avoid this and made sure the students knew that while the design and appearance of the reports or examinations were taken into consideration, the major part of the grade was based on the actual content. The quality of the reports and examinations has actually improved over previous paper based ones since the students can easily incorporate drawings and external images to illustrate their points.

Teaching VRML

In the Winter, 1996 Computer Graphics course, we switched from Renderman to the Virtual Reality Modeling Language (VRML). VRML is similar to Renderman in that the student can create a text file that describes the scene, and then input the text file to a VRML Browser that renders the scene. In the workshop I will describe how VRML was used in the course, resources to support VRML, the problems encountered, the student reaction to the use of VRML, and suggestions for the use of VRML in this and other courses [OWEN96].

Conclusion

In the last year, I have incorporated Web/HTML technology into my courses, for class presentation, for creation of a teaching text, for student created documents, including examinations, and for searching the Web for information. The student response has been quite positive. It will now be my practice that for all written reports, the students will create them as HTML documents.

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Resources for Computer Graphics Courses

Steve Maddock

This part of the Workshop report is unavailable. Sorry!

Discussion following the papers by Owen and Maddock

The WWW is now assumed to be of vast economic importance. We have an opportunity to leverage off this for education. Cable is offering a potential mass access with internet services to the home. This potentially helps part time and modular course students work flexibly.

Maths presents problems. PDF can display but this is not helpful where the objective is to allow anyone to take the materials and edit them.

We need to decide what format to use for video clips - AVI, Quicktime, MPEG are preferred on different platforms.

Scott recommended reading some fiction to see a vision of the world which is emerging:

Neuro Master by William Gibson (VRML 1.0)

Snowcrash by Neil Stephenson (VRML 2.0)

3D graphics will become a commodity.

Java is attractive as it is platform independent.

WWW technology does not have to be delivered on the internet.

Technology can help cut down the number of student contact hours but cannot replace them.

Dissemination of Resources — Roger Rist

Dissemination

At Heriot-Watt University, the need for dissemination of results has always been recognised as being of equal importance with original research and development. From the nature of university teaching and learning, much initiative and exploratory work derives from enthusiastic individuals. The priority for dissemination thus reflects appreciation of the need to build within Higher Education a community dedicated to innovative teaching developments, of comparable commitment and impetus to the prevailing subject discipline and academic research communities.

Knowledge sharing and support of other institutions

This was the basis of the successful bid from the Institute for Computer Based Learning (ICBL) to act as the centre for the Learning Technology Dissemination Initiative (LTDI), a SHEFC-funded programme. In the first year (1994/95) the Institute's LTDI staff were directly involved in 92 implementation projects in 20 institutions across Scotland. LTDI has the aim of supporting new learning technology to a point where its effective use is widespread and institutions have infrastructures through which they can provide their own support. A very practical implementation support is provided which ensures that appropriate methods can be introduced into effective use. In addition, LTDI provides awareness and training seminars and materials, has established a large collection of computer-based learning resources representing good practice, and synthesises this expertise in direct support of co-operating groups in Scottish HE institutions. LTDI is wholly based at ICBL but operates across all the Higher Education Institutes in Scotland serving a wide community of lecturers and, through them, students. Publications are also produced including a substantial handbook, and guides for using information technology and networks have been disseminated through LTDI and have been widely requested and taken up by other organisations, beyond Scotland, for further distribution.

The ICBL has recently been identified as one of eight national support centres established throughout the UK. The Teaching and Learning Technology Support Network targets much of its effort on helping higher education institutions which are considering change or which have embarked upon a programme of change. In this way, the experience in areas such as staff development approaches, culture change, restructuring to achieve efficient courseware production, and in the effective integration of materials into existing educational provision, are made available throughout the higher education sector. The Support Network centres are active in promoting the development and use of technology to support learning. For individuals, the Support Network is a front-door to information and guidance, increasing the accessibility of these technologies. The Support Network also co-ordinates with other initiatives such as Computers in Teaching Initiative (CTI), Information Technology Training Initiative (ITTI) and the Learning Technology Dissemination Initiative (LTDI) to provide advice, training and examples of institutional development in practice, drawing together national resources to achieve best effect. This service is similar to that recommended by the Further Education Funding Council's 1996 Higginson Committee report on the promotion of technology to enhance the provision of further education, providing a useful model to guide the expansion into the FE sector.

Computer networks and human networks

Naturally, electronic media and in particular the World Wide Web have become a prime mode of dissemination. In addition to operating a server for itself, both LTDI and TLTP information is provided through World Wide Web servers located at ICBL. The TLTP Central server provides an authoritative gateway to TLTP sites as well as giving newsletter and contact information. At ICBL World Wide Web servers now form a part of many projects from serving of simple information to developing new ways to provide access to computer based learning material.

Without ongoing dissemination activity much of the benefit of specific technology investments and implementation programmes would be lost. This lesson has been learnt and is reflected in the Use of MANs (Metropolitan Area Networks) initiative. Scotland is making a large investment in broadband networking for the Higher Education sector with the recognition that it is not enough to provide the infrastructure investment must also be made in the applications to make appropriate use of the high bandwidth available. A key part of the initiative was the provision of training and support for staff throughout Scotland. SHEFC decided not to award this to a range of proposals but instead to invite the ICBL at Heriot-Watt to operate a programme across all the Higher Education Institutions. This project will start in June 1996 for at least two years.

Summaries and URLs of relevant projects follow:

LTDI

The Learning Technology Dissemination Initiative started in August 1994 with the aim of promoting the use of Computer Based Learning by academic staff in the Higher Education Institutes in Scotland. To do this LTDI organises workshops throughout the year, produces leaflets and hand-outs and offers direct support by the Implementation Support Consultants. The equivalent of six full time staff are involved in LTDI, although in practice in the last year more than nine staff have been involved allowing for specialised areas to be given appropriate support. Funding is confirmed until August 1997.

URL: http://www.icbl.hw.ac.uk/ltdi/

TLT-SN

The Teaching and Learning Technology Support Network is funded by TLTP as a follow on to the eight Institutional Initiatives supported by Phase 1 of the programme. The project overall intends to offer regional support bases and to allow each site to promote and disseminate the outcomes of their earlier institutional projects. The ICBL also serves as a resource collection centre and the home of the TLTP Central Web and TLT-SN access point. This project has close links to the work of the internal Learning Technology Support Service. Support is for 1 year in the first instance from September 1995 but is expected to be continued for a further year.

URL: http://www.icbl.hw.ac.uk/tltsn/

MARBLE

MARBLE (MAN Accessible Resource Based Learning Exemplars) is funded under the Use of MAN Initiative. This is a collaborative project between three Universities. The project proposes to develop 10 sub-projects ("marblets") with lecturers at the 3 sites. In each case an element from a course modules is being transferred for delivery using the World-Wide Web. This project is funded until the end of July 1996. In addition to the support work a "marblet" has been developed based on the teaching carried out by ICBL for the MSc in Human Computer Interaction.

URL: http://www.icbl.hw.ac.uk/marble/

C-Web

The C-Web (Courseware Web) project has two main strands, one is the support of the TLTP Central Web and the network needs for the TLT-SN, the other is development of Web delivery of courseware. C-Web will develop the necessary programs on the server and client side to enable relatively easy transfer of existing CBL packages to run

on local machines. This will be piloted primarily with programs produced as output of the existing TLTP. The project is funded to the end of July 1996 and the Project Officer has been employed since December 1995. C-Web will also fund the improvement or replacement of the existing TLTP Web server.

URL: http://www.icbl.hw.ac.uk/c-web/
URL: http://www.icbl.hw.ac.uk/tltp/

CAUSE Beginner's Guide

CAUSE is a project across seven sites most of which were involved in the Information Technology Training Initiative programme to produce training material. The project aims to collectively produce a WWW based Beginner's Guide to Learning Technology partly building from the ITTI material. The main role at ICBL is to provide the main access point and to develop an introduction to the guide and basic guidelines. There is a small amount of funding in this project to August 1996.

URL: http://www.icbl.hw.ac.uk/begin/

Interact

The Interact project funded under TLTP aims to produce simulations for use within Engineering courses. The techniques used exploit the Web for communication and allow students to share information and follow tutorials using the simulation packages. The direct involvement of ICBL is in evaluation. The project is in its final phase of funding and will be followed up with a related project (Multiverse) funded under JTAP.

URL: http://www.icbl.hw.ac.uk/projects/INTERACT.html

TALiSMAN

TALiSMAN is Teaching And Learning in Scottish Metropolitan Area Networks and will be funded by SHEFC from May 1996 to August 1998. TALiSMAN has a training focus and has similarities with LTDI in that it will offer workshops and support but differs in targeting the technology (networking) rather than subject areas. TALiSMAN will carry out a training needs analysis across Scotland and will develop its own training material but may also adapt training material from other projects, in particular the NetSkills project based in Newcastle. TALiSMAN will support a manager, a part-time secretary, 1 Technical officer and 3 training officers, though all will be involved in the training programme. The project also brings an initial start up element for re-equipping a training room, establishing new servers and adding video links at four sites, one in each of the Scottish Metropolitan Area Networks.

EEVL

This is the Edinburgh Engineering Virtual Library funded under the eLib (Electronic Libraries) programme. It is concerned with the classification of engineering resources. Selection is made by qualified staff who filter and index the information.

Discussion

There is a need for integration of technology and to redesign to enable this.

Evaluation is critical — we need to learn the lessons of when/where things work. 2 useful tools may be:

AnswerWeb for collecting questions and answers, see:

http://www-interact.eng.cam.ac.uk/

QMWeb for assessment: http://www.qmark.com/index.html

Using Multimedia in Teaching — Terry Hewitt

Terry Hewitt reported on the workshop on the theme of Multimedia Presentations run as part of the SIMA Project by Sue Cunningham and himself. The summary of the event and the recommendations are given in the paper below.

Background

Recent years have seen a rapid increase in the numbers of computers used in education. Computers are now regularly used by staff and students, for a variety of tasks from computer aided learning to word processing and E-mail. However, presentations, and particularly lectures, are probably the last area to be affected by computer technology.

The fact that multimedia presentations are not in common use shows there must be a number of problems, and these are not only associated with production of multimedia materials, but also delivering them, particularly at remote sites. It is well known that producing any multimedia materials can be expensive and time consuming, and materials for presentations are no different. In addition once produced the materials must often be used at foreign sites, creating problems of portability. Finally, despite the increased investments in computers on many sites, lecture theatres often lack the facilities necessary to give electronic presentations.

Despite these problems, multimedia presentations offer sufficient benefits to make them worth pursuing. During the course of the workshop a number of benefits were identified including:

- ¸Increased student motivation - lectures are perceived as more interesting and informative.
- ¸Increased understanding and retention - often complex ideas can not be easily explained using only text and graphics.
- ¸Electronic presentations can easily form the basis of ancillary support material, allowing students to explore lecture material in more depth.

As an example of some of the issues that have been raised, let us consider a recent international conference '3D and Multimedia on the Internet, WWW and networks', held at the National Museum of Film and Photography, Bradford in April 1996. This has been highlighted simply because it happened close to the workshop, and is typical of a high profile, well organised and well equipped conference.

Despite the nature of the conference, the vast majority of speakers used 35mm slides or OHP transparencies to give their presentations, supplemented by analogue video clips in some instances, including analogue videos of computer animations. Only a couple of presenters actually used electronic presentations, indeed they were recommended not to in the presenters notes (see Case Studies).

> 'Computers can give very effective presentations and for interactive demonstrations - but we have seen many examples of computers not working during the actual presentations even though they have been tested out beforehand'

Resolution was also a problem, not necessarily of the projection equipment, but also screen resolution of portable computers (the venue did not provide computers). One presenter commented, that although he had intended to use a computer, when magnified on the large screen, 600x800 resolution seemed very poor quality.

Even so, the final advice to the presenters, highlights the need for multimedia presentations.

> 'The main thing which will survive in the long term memory of your audience will be your visual images and/or animation, so be sure to include visual results in your talk, and make them of high quality'

Issues and Recommendations

Multimedia presentations are time consuming to produce

A good multimedia presentation will require considerably more time and resources to produce than a traditional one, making it impractical for individual presenters to develop suitable material alone.

Recommendations

- ¸Set up a database of media clips (copyright cleared or easily obtainable). This might include video, audio and image clips as well as interactive simulations, perhaps written in a standard authoring package like Toolbook, or programming languages such as JAVA.
- ¸Commercial resources should be investigated, including resource banks and commercially available configurable CD's.
- ¸Institutions should give more academic recognition for production of such material.
- ¸More publicity is required for national and institutional facilities which can help presenters, such as video and scanning services.
- ¸Promote the use of standard formats for all types of media, so that clips may be easily exchanged.
- ¸A cost benefit analysis of CBT/CAL is needed to show that it has value and will improve teaching

There are perceived problems moving from traditional methods of generating presentations to electronic ones.

Many people are reluctant to learn to user new applications, particularly if they are perceived to be very technical or require programming skills, and they will not wish to discard existing materials.

Recommendations

- ¸Develop a list of criteria for choosing presentation software, including features such as wizards or templates to help novice users
- ¸Survey of presentation tools based on the above criteria.

- Provided access to staff development to learn the skills required to develop multimedia presentations.

Multimedia does not necessarily mean good quality

Any presentation can be good or bad, but while a fairly simple set of rules for producing good quality text only presentations has been established, no such guidelines really exist for multimedia presentations

Recommendations

- Develop a set of guidelines for developing multimedia presentations.
- Create a repository of good examples.
- A central unit should be set up to disseminate good practice.

Lecture theatres are not 'multimedia ready'

Presenters are reluctant to use electronic presentations as presentation equipment in lecture theatres is often unavailable or unsuitable. Even if they bring their own computers, projection equipment is often low resolution and low brightness, and there may be problems with connections. Using computers provided by host sites may cause software compatibility problems.

Recommendations

- Adequate technical support must be available to presenters.
- Develop a set of guidelines for the creation of a multimedia delivery box.
- Develop a set of guidelines for a minimum standard for presentation equipment in lecture theatres:
- Institutions should provide an information sheet describing the hardware and software available in each theatre
- Encourage institutions to invest in and improve their facilities. They should be prepared to be loss leader initially.

Working Towards a Shared Corpus of Material — Phil Willis

Goals of Students

Different students have different goals. This is also true within a university classroom but far less so. Material freely available on the web needs to be more like night school:

- ¸prepared for all ages and backgrounds
- ¸accessible to those studying for interest
- ¸accessible to those studying for academic qualifications
- ¸accessible to those studying for professional qualifications
- ¸retraining is not the same as training

Target Audience

If I write a lecture course, I know my target audience is (say) second year undergraduates. This is not necessarily the case if I contribute a section to a web-based publication. The audience may be anywhere but at any level of background Understanding or experience. This encourages a take-it-or-leave-it attitude among authors, making the reader decide what is appropriate. Superficially this is not different to books: does the new medium offer anything new, apart from the delivery mechanism?

Timeliness of the Material

A potential win for the web is the ability to do instant updating. But:

- ¸How do you avoid annoying existing readers?
- ¸How do you synchronise multiple authors?
- ¸How do you ensure the integrity of the document?
- ¸Do you need to revise income-sharing/ownership/

Virtual Universities and Classrooms

- ¸Why not offer classes/laboratories, rather than chapters of a virtual book?
- ¸Does a group of like-minded authors become a virtual university?
- ¸In general, do we need to reinvent the existing structures, or are there alternative, better ones?

Layout Style

The issue here is how to give all pages a consistent appearance. This is not the same as saying all pages are identical: the problem is harder than that.

Some possible tools:

- Cascading style sheets
http://www/w3.org/pub/WWW/Style/

- Adobe Acrobat
http://www.adobe.com/acrobat/

- Yale style guide
http://info.med.yale.edu/caim/Manual-1.html

- Documentation: the paper stuff!

Legal Issues

A potential nightmare!

- Who owns what?

- Who may copy what?

- Which country's law applies?

- Which country's taxation applies?

- How can you get income to support the world?

Content Style

The issue is a consistent style of writing. Compare:

Hey dudes this is the hottest thing from Sil Val since they nuked LA…

with

Silicon Graphics are pleased to announce a new high performance workstation…

Solving this is much harder than getting the layout right.

Interactive Laboratories

A novel feature of the net is its ability to support interactive experiments.

- Java and Perl

- Physical simulations, e.g.

  the Virtual University
  http://www.sgml.com/
  Frog dissection
  http://george.lbl.gov/ITG.hm.pg.docs/dissect/info.h

- Real experiments e.g. the Bradford telescope:
  http://www.eia.brad.ac.uk/rti/guide/

A Shared Corpus of Material

To be effective, sharing requires much more than the will to share. At least the following will have to be addressed:

- Layout style

- Content style

- Target audience

- Goals of students

- Timeliness

- Legal issues

- Interaction?

- The virtual classroom

- The virtual university

Education for Visualization — Gitta Domik

The subcommittee "Education for Visualization", or EVC, of the ACM SIGGRAPH Education Committee is dedicated "to further development of guidelines and teaching materials for visualization curricula and courses". It has been in existence since 1992. The need for such a committee is rooted in the fact that visualization courses have been offered since the late 1980's with a variety of topics. With the debut of "Visualization in Scientific Computing", as described in the much cited publication [McCormick, DeFanti, and Brown, 1987], the need to inform about visualization came into existence, but no formal training for educators to teach such courses, nor a common understanding of the "main themes" of visualization was available. This lead to a most unbalanced form of visualization courses, focusing on individual topics, and leaving out important issues such as definitions, goals, or concepts of visualization. Over these last years, our committee has discussed and published specifically on the topics of taxonomy and curricula for visualization. We still continue to explore and improve the contents of visualization courses. At the same time, however, we have also moved on to provide support materials and investigate interactive teaching methods (e.g. over WWW) for visualization courses. In the Loughborough AGOCG workshop in May of 1996, Scott Owen and I are planning to discuss WHAT and HOW to teach in visualization courses. While Scott will concentrate on successful teaching techniques, I am planning to discuss the content and structures of visualization courses and curricula as a result of recent workshops and tutorials.

Main themes for teaching visualization have been identified as the following:

Definitions and Goals of Visualization

For any visualization course it is important to discuss background, definitions, and goals in order to provide a common understanding of visualization. Recommended subtopics are:

- ¸History of (scientific and information) visualization
- ¸Definitions of visualization
- ¸Goals of visualization

Abstract Visualization Concepts

It is necessary to establish a framework for the use of visualization to learn how to make use of concepts and paradigms. Recommended subtopics:

- ¸General visualization models and taxonomy
- ¸Examples of specific visualization models and paradigms

Human Perception Concepts

This section enhances the understanding of how to use graphics tools to support human perception in order to gain insight into phenomena that we seek to interpret. Recommended subtopics:

- The human visual system (biological, psychophysical and cognitive issues, visual phenomena, texture and colour perception)
- Perception theories
- Presenting complex information to the H(V)S (e.g. data exploration, natural computing, integrated displays, using senses additional to vision)
- Practical considerations (e.g. expressiveness, effectiveness, interactivity, annotations, avoiding pitfalls)
- Evaluation methods

Scientific Methods and Concepts

This theme explains the relationship between the 'real world' and the 'models' we have available in order to understand the real world and the 'empirical (data) measurements' we have of the real world. Non-science students have usually little approach to models, data concepts and reality.

Recommended subtopics:

- Scientific concepts: what is a model; model vs. acquiring; going from macro-to micro worlds
- Modelling concepts: mathematical methods to represent reality; mathematical concepts; computational models
- Data concepts: how to represent reality; data collections; errors

Aspects of Data

Various aspects of data, such as acquisition, classification, storage and retrieval of data, are to be discussed. Appropriate subtopics are

- Acquisition of data (Simulation vs. measuring devices)
- Discipline-independent classification of information sources
- Data base issues
- Query languages
- Reliability of data

Visualization Techniques

This section discusses the wealth of possibilities for visual representations. This includes 2-d, 3-d and multi-dimensional visualization techniques, such as colour transformations, glyphs for high dimensional data sets, volume visualization, particle tracing, animation, or techniques in virtual environments.

Interaction Issues

Interaction techniques are fundamental to the design and use of visualization systems. Appropriate subtopics are approaches to interaction issues from the standpoint of ergonometry, HCI and hardware.

Existing Visualization Systems/Tools

Available visualization systems need to be discussed and compared in order to provide a valid basis to make decisions on usability and functionality of such systems.

Aesthetics in Visualization

Appropriate subtopics are:

- ¸Aspects of successful visualizations
- ¸Comparison of good and bad visual representations

Related Topics

A visualization course might include fundamental aspects of mathematics and computer science. The presentation of appropriate subtopics depends on the objectives of the course and the background of the students. Appropriate subtopics may be:

- ¸Mathematical techniques (e.g. vectors, matrices, interpolation approximation, transformations for 2- and 3-d, parametric versus implicit versus explicit representations, curves, surfaces, fractals)
- ¸Computer graphics (e.g. 2-d drawing, clipping, filling; 3-d modelling, rendering, lighting; transparency, translucency; raytracing, radiosity, volume rendering; graphics standards and libraries)
- ¸General computer science (e.g. user interface design; computational geometry; computer hardware architectures, input/output technologies; data structures, data models, data formats, data transfer; programming languages)

Literature

Domik, G. O, 1994, Visualization Education, Computer & Graphics, 18(3), pp. 277-280.

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Domik, G.O., 1993b, An Agenda for Education in Scientific Visualization. Visualization '92 Workshop Report, Computer Graphics, 27:1, p.6, January 1993.

Domik, G., 1993c, Guidelines for a Curriculum in Scientific Visualization, Eurographics Workshop on Graphics and Visualization Education, Eurographics Technical Report Series, ISSN 1017-4656.

Domik, G., 1993d, Education in Scientific Visualization, Proceedings of the IFIP WG3.2 (Computers in University Education) Working Conference, University of California, Irvine.

McCormick, B.H., DeFanti, T.A., and Brown M.D. (eds), 1987, Visualization in Scientific Computing. Computer Graphics 21 (6).

Scientific Visualization - Some Novel Approaches to Learning — Ken Brodlie

Ken Brodlie reported on the work at the University of Leeds to utilise new technologies to help the user of visualization systems. Scientific visualization is becoming an important part of the curriculum in a number of disciplines. It is a very practical subject, but the commercially available visualization software systems are not easy to learn. Thus the work at the University of Leeds is concerned with exploring the use of novel technology to help in teaching students to use IRIS Explorer. The work includes online tutorials, shared sessions involving teacher and student over a network, and the use of WWW. This work, which has been stimulated by teaching applications, has also motivated research into the wider area of collaborative visualization.

This paper is written up as:

Brodlie, K.W., Wood, J. and Wright, H., "Scientific Visualization - Some Novel Approaches to Learning", Proceedings of the SIGCE/SIGCUE Conference on Integrating technology into Computer Science Education, Barcelona, 1996.

The online training materials for IRIS Explorer are being developed under an AGOCG grant and ported to the WWW.

Teaching Virtual Environments — Nick Avis and Derek Wills

Nick and Derek started by discussing their MSc in Computer Graphics and Virtual Environments course at Hull. This started in 1994 when it had 8 students, rising to 13 in 1995/6 and is expected to be over 25 in 1996/7. The student backgrounds include computer science, physics, business studies, etc. The department has EPSRC support

The course involves eight taught modules plus dissertation project:

- ¸Computer Graphics
- ¸Visualization
- ¸Object oriented Software Engineering
- ¸Computing Skills
- ¸Project Skills
- ¸Graphics Application Systems
- ¸High Performance Computing for Graphics
- ¸Virtual Environments

The speakers see virtual reality as the integration of:

- ¸Computer Graphics
- ¸Visualization
- ¸Object Oriented Software Engineering
- ¸Computing Skills
- ¸Project Skills
- ¸Graphics Application Systems
- ¸High Performance Computing for Graphics

The course involves both taught modules and practicals and the assessment is through exams and coursework. Open book exams and 100% coursework are being considered.

Hardware ranges from PCs to unix workstations and a ratio of 1 workstation to 2 students is the aim. dVS/dVISE (version 2, upgraded to version 3)is used as the package for most applications.

Examples of projects include:

the use of stereoscopic vision in arthroscopy training
video walkthroughs
interactive soft object animation tool
Monte-Carlo radiosity

Group projects are also undertaken.

The department collaborates with various companies including: PERA
Halifax, VR Solutions Ltd

Student feedback and lessons learnt include:

- students find module enjoyable/challenging
- exposure to new concepts is enjoyable
- students expect exposure to immersive technology which is achieved through a trip to SGI Reality Centre to see state-of-the art systems/peripherals

This is an ever changing area and the course needs constant update. There also needs to be a greater robustness of software tools with systems not yet sufficiently stable. There is a need for standards in this area and for support of teachers. Textbooks are needed.

The speakers suggested that people could be helped by the following:

- need to collaborate to produce robust, high quality teaching material
- on-line archives of models etc
- executable lecture notes
- better textbooks
- loan equipment?
- support on curriculum development
- identify VE centres to develop key components of lecture material
- list of visiting speakers

Discussion Groups — Day One

How Should HyperGraph Develop?

The issues raised in this group were:

What view do we want on resources?

- ¸lecturer raw materials?
- ¸self standing material
- ¸alternative perspectives on the raw materials

Hypergraph contains a lot of useful resources but is one person's perspective on those resources. It needs to be made more widely useful and flexible.

The recommendations of this group were:

- ¸we should set up an Editorial Board to oversee, review and annotate resources
- ¸mirror sites should be set up for SIGGRAPH Education and AGOCG sites in the UK and USA respectively
- ¸HyperGraph and HyperVis structure should be reviewed (action Maddock and Domik)
- ¸we should make use of the Knowledge Gallery as an opportunity to develop resources and to index and link them.
- ¸we should develop resources which should include a whole range of types of materials and links

How can we Work Together and Keep Quality Uniform?

Issue:

There is a lack of experience of shared coursework development

Recommendation:

We should conduct a small scale experiment which is Web-based, using a specific topic, to reveal a range of representative problems. This should include a full range of course materials, only some in depth.

Issue:

Configuration support is a problem — varied platforms, software support, hardware)

Recommendation:

Extend the pilot project accordingly

Issue:

Threading the elements together in various ways

Recommendation:

Summarise the relevant needs from the pilot study. Investigate and evaluate existing tools.

Developing Highly Interactive Tools for Teaching, Assessment and Support

Issues:

Personalised active textbooks existed 5 years ago but are little used. Why? Is this a platform issue? Surely the Web is now the infrastructure for this.

Use of proprietary code vs public domain code

Interactive animated algorithms are valuable. Java has unproven potential.

Layered access to animations of fundamental algorithms.

Assessment is an issue. Large classes mean that a pool of multiple choice questions on the WWW for self assessment needs to be addressed — tools such as QMWeb may be useful.

Recommendations:

- develop an active textbook for computer graphics, multimedia, visualization, virtual environments that allows separate development, which uses WWW, VRML etc and which includes self assessment
- investigate QMWeb (and others) for assessment
- undertake Java and VRML case studies to investigate potential power and limitations

Discussions Following Group Reports

It was agreed that a pilot would be useful to examine all the required information and resources needed. User requirements need to be examined and the pilot would help evaluate benefits.

A redesign of HyperGraph and HyperVis would be useful.

We need to look at the literature relating to the benefits of CBL.

Hyper-G may prove to be better for resource provision as links are updated.

Much of what we are talking at is making collaboration effective and to enable the resulting whole to be better than any individual could produce.

Discussion Groups — Day Two

Developing Resources

2 of the groups considered the nature of the pilot(s) which could be taken on to illustrate the range of materials and resources which could be created and linked.

Resources which could be included are:

raw materials - images, movies, VRML, scripts

linking text

annotated biography

links to projects/information sources

teaching datasets

multiple choice self assessment - QMWeb

FAQs - probably using AnswerWeb

The 2 groups suggested pilots in the following areas:

- visualization techniques
- colour
- animation

It was agreed that the topics which should form the basis of the pilots should be: visualization techniques and animation.

Image Resources and the Knowledge Gallery

The groups also discussed the resources which might be usefully placed in the Knowledge Gallery. Clips and examples from companies such as SoftImage, PIXAR, Alias Wavefront as well as SIGGRAPH examples and models including non-polygonal would be useful.

Teaching Virtual Environments

The key question is "can the UK afford to teach virtual environments?

the target audience is two-fold:

- ¸teaching fundamentals of VE
- ¸teaching the use of VE in applications

Resources are a problem:

- ¸access to relevant facilities is not easy for all sites and many involved in teaching do not have sufficient facilities on site.
- ¸worked examples can usefully be shared
- ¸which tools are the right ones? we need evaluations and appropriate price agreements through CHEST
- ¸models need to be created and shared
- ¸filters and converters are needed
- ¸both immersive and non-immersive facilities have value. Immersive facilities are expensive

The cost of equipment was discussed at some length. Possible options such as a "VR Bus" with state of the art equipment for loan were discussed. This is not really practical. We need to focus on the people and their training, awareness and support.

The issue of the need for students with suitable mathematical background was discussed and recognised as a common problem.

Appendix 2: Workshop Programme

29th May

18.45¸Welcome Drink in the Seminar Room (see board for details)

19.00¸Introduction to the Workshop — Ken Brodlie & Anne Mumford

20.00¸Dinner

30th May

9.00¸WWW Technology in Courses in Computer Graphics & Scientific Visualization — Scott Owen

9.45¸Resources for Computer Graphics Courses — Steve Maddock

10.30¸Coffee

11.00¸Dissemination of Resources — Roger Rist

11.40¸Using Multimedia Resources in Teaching — Terry Hewitt

12.05¸Working Towards a Shared Corpus of Material — Phil Willis

12.30¸Introduction to Groups

12.45¸Lunch

14.00¸Group Sessions ¸

How should HyperGraph develop?

How can we work together and keep quality uniform?

Developing Highly Interactive Tools for teaching, assessment & support

15.30¸Tea

16.00¸Reporting Back and Discussion

17.15¸Teaching Visualization — Gitta Domik

17.45¸Session Closes

19.30¸Dinner

31st May

9.15¸Teaching Visualization — Ken Brodlie

9.45¸Teaching Virtual Environments — Nick Avis & Derek Willis

10.30¸Coffee

11.00¸Group Sessions

Developing pilots for teaching resources

Supporting the Teaching of Virtual Environments

12.30¸Lunch

13.45¸Report Back and Recommendations

15.15¸Tea & Depart

Appendix 3: Workshop Participants

Nick Avis, University of Hull

Ken Brodlie, University of Leeds

Sue Cunningham, University of Manchester

David Dench, University of Huddersfield

Bernard Diaz, University of Liverpool

Gitta Domik, University of Padderborn, Germany

Terry Hewitt, University of Manchester

Fiaz Hussein, De Montfort University

Roy Kalawsky, Loughborough University

Steve Maddock, University of Sheffield

Anne Mumford, Loughborough University

Scott Owen, Georgia State University

Allan Reese, University of Hull

Roger Rist, Heriot-Watt University

Venkat Sastry, Cranfield University

Eric Tatham, Coventry University

Adrian Thomas, University of Sussex

Sylvia Wilbur, Queen Mary and Westfield College

Phil Willis, University of Bath

Derek Wills, University of Hull