What is the problem to which interactive multimedia is the solution?

Views on the nature, place and value of multimedia in education

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Introduction

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This is something of an unusual paper. It serves as both the reason for and the result of a small number of leading academics in the field, coming together to focus on the question that serves as the title to this paper: What is the problem to which interactive multimedia is the solution? Each of the authors addresses this question from their own viewpoint, offering informed insights into the development, implementation and evaluation of multimedia. The result of their collective work was also the focus of a Western Australian Institute of Educational Research seminar, convened at Edith Cowan University on 18 October, 1994.

The question posed is deliberately rhetorical - it is asked to allow those represented here to consider what they think are the significant issues in the fast-growing field of multimedia. More directly, the question is also asked here because nobody else has considered it worth asking: for many multimedia is done because it is technically possible, not because it offers anything that is of value or provides the solution to a particular problem.

The question, then, is answered in various ways by each of the authors involved and each, in their own way, consider a range of fundamental issues concerning the nature, place and use of multimedia - both in education and in society generally. By way of an introduction, the following provides a unifying context for the various contributions made here.

Communication, instruction and knowledge

Multimedia is simply and fundamentally about providing good, effective, communication. Much of the research currently being conducted into multimedia is concerned with identifying the rules that need to be established for this communication. Many of the guidelines or rules already identified and currently applied in educational multimedia derive from attempts in instructional psychology, and particularly the work of Glaser, to provide prescriptive principles of instruction (Glaser, 1987). At the same time others criticise attempts to provide the "prescriptive principles that can guide the design of instructional techniques and materials" (Glaser, 1987 vii), indicating that instructional prescriptions are and will always be elusive (Laurillard, 1993); that, in trying to provide good communication and good instruction, we must turn away from seeking to describe rules and principles and look towards describing interactions - between teachers, learners and materials. In this sense, Phillips (part 2) maintains that effective multimedia must seek to facilitate interactions between these agents - interactions, for example, that are based on exploratory and generative approaches to teaching and learning.

In the practice of designing and evaluating multimedia it is comparatively easy to recognise what is good - what is good instruction or good communication - but it is much harder to identify what makes that instruction good or that communication effective. It is harder still to take what we think are effective attributes of instruction and

communication inherent in the use of one multimedia product and successfully apply them to a different context and a different product. Oliver, (part 1), argues that when we get multimedia design wrong, we often get it badly wrong, and suggests that some of the more serious problems with multimedia products include, on the part of the user, disorientation (difficulty of knowing where one is); navigation inefficiency (difficulty in moving from point to point); and cognitive overload (exposure to an amount of knowledge that exceeds that required).

The problems that Oliver highlights here are the problems facing instructional designers for all forms of multimedia. Certainly there are standard and recognised ways of reducing the impact of such problems (eg. using conceptual maps and semiotic paths to aid navigation; using metaphor to provide meaning and a sense of place) but there remain fundamental issues to be faced in this context. For example, there has been a tendency for multimedia products to be big - in concept, in design, in the amount of information conveyed. But in fact, it may be that encyclopedia and such large scale knowledge or informational systems are not well-suited to multimedia, and that topics with a limited yet clear focus are. Communication and instruction are more likely to succeed when the topic focus is clear, when the boundaries of the topic are well established and when the knowledge structures of the topic are apparent. This point is explored by Phillips (part 2).

Multimedia for all

Multimedia is different to print and other media - the combination of media allows the communication of whole concepts, whilst 'hyper' structures to multimedia facilitate creation of complex networks of concepts - what might be called 'conceptual clusters'. One of the challenges in multimedia is to provide the means to navigate these clusters, to provide conceptual maps and pathways through multimedia knowledge bases. This challenge is perhaps manageable, although by no means easy, when dealing with a definitive, static and readily defined amount of material - the situation we have, for example, when producing multimedia on CD. This challenge is much less manageable when dealing with dynamic knowledge bases, changing knowledge structures and knowledge that is forever growing - the situation we have, for example, when dealing with on-line multimedia, now available to us through the use of tools such as NCSA Mosaic and Netscape, providing access to networked hypermedia put into place on systems such as the World Wide Web. Rehn, (part 3), maintains this constitutes the real challenge to multimedia and also provides its biggest potential. Rehn argues that in providing multimedia access to the vast and growing seas of knowledge available through the Internet and other on-line systems, we will democratise the processes of producing, maintaining and using multimedia. Currently multimedia is the preserve of those who have the technical and financial resources to produce multimedia based on CD, a time-consuming, expensive and technically problematic affair. With access to networked multimedia using standard telecommunications systems, just about every desktop computer user will be empowered to produce, to own and to maintain multimedia.

Research and multimedia

One of the primary functions of instruction is to promote and guide active mental processing on the part of the student (Merrill, 1994, 72). Dickinson, (part 4), describes the sort of mental processing that multimedia might invoke, suggesting that there are probably certain characteristics of multimedia that lead to higher levels of cognitive activity on the part of the learner. Oliver, (part 1), reflects a similar sentiment, suggesting that the structures of hypermedia actually mimic at least one type of cognitive processing that learners undertake naturally, thereby making learning more efficient. It is clear, however, that we need to do more research into the effects of multimedia use and into the responses of learners to various instructional forms of mul timedia. For example, we need to identify what criteria need to be put into place in multimedia to provide for effective instructional transactions. Merrill would have us believe that these criteria are already known and universally applicable; others would no doubt argue that such criteria remain unverified and far from being universal. As Dickinson infers, when research does begin to identify the criteria necessary to effective instructional transactions, they are likely to be localised and entirely contextual in effect.

Conclusion

Multimedia currently represents a somewhat strange and unchartered territory. We have still yet to establish the most appropriate topics and designs for multimedia and to provide the tasks to which multimedia is most suited. We also

need to be aware that in a culture that is still dominated by the print media, we probably need to develop new ways of thinking about and evaluating multimedia before we get anywhere near providing an answer to the question: What is the problem to which interactive multimedia is the solution? We may already have the solution; but the problem is yet to be discovered. This is probably not so surprising, for just as the novel wasn't envisaged at the beginning of the print revolution in the sixteenth century, we can't possibly yet know what will be the most pervasive forms of multimedia, whether in education or in society more generally.

Part 1: Interactive multimedia: Solutions and problems

Ron Oliver
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Introduction

What is the problem to which interactive multimedia is the solution? Answers to this question will depend on one's background and previous experience. In the eyes of many, multimedia is the solution to computer based training across a variety of applications. I suggest that this is not the case. Computer based training has always been a possible and effective medium and much of the software produced using multimedia is very similar (and often not as good) to that produced with previous technologies.

Judging by the enthusiasm with which multimedia products are now being advertised and marketed, it would appear that multimedia has become a solution to a pressing marketing problem for those dealing in personal and home computers. While many householders may be pondering their need for a home computer, the computing marketeers are convinced that the need arises from the opportunities afforded by the multimedia software that is available. How else can you and your children 'flick through an encyclopaedia, see a dinosaur first hand and/or admire world famous paintings?'

We are frequently reminded that we are all living in the Information Age (Gawith, 1986). Access to information is seen as the means by which people and cultures will soon be distinguished. The different media forms have never before been integrated - with multimedia they are. Learners have previously used text as the prime information source. Through multimedia all media are made equal and the wealth of information available through non-text sources is opened up. With multimedia we have the means to provide truly effective learning environments using hypermedia structures to mimic our own cognitive processes (Simpson, 1994). Is this the problem and the solution?

Hypermedia

The terms hypertext and hypermedia were first coined by Ted Nelson in 1960. In these early days of teletype connections to mainframe computers, he had a vision of a world of interactive computer screens employing interactive media and open electronic publishing, where all could browse and link freely. In the technological advances that have occurred since this time, it is only now that this dream has the potential of being realised.

Ted Nelson criticised his own schooling which tended to

- reduce everything to lists;
- revolve around the personality of the teacher; and,
- reduce a world rich in knowledge to a few bland and common elements.

There are many who would argue that these criticisms are still current. Nelson saw computers as the means by which we could finally overcome the restrictions and problems with traditional teaching and learning. As early as 1960, Nelson predicted all forms of work would be completed through a screen with new systems of media between writing and movies. Furthermore he saw computers connected across a wide network where users could browse and link in a vast hyperspace of information and knowledge. Interactive multimedia through the Internet has finally brought us to

the point where Ted Nelson's vision is able to become a reality and it is this problem that I think multimedia has finally provided the solution.

Teaching and learning with hypermedia

But having identified the problem to which multimedia is the solution, there remains a question regarding which types of multimedia offer the most appropriate solution. Today, commercial multimedia products abound on retailer's shelves. The application of new technologies such as hypermedia systems appears to provide the means by which meaningful and effective information skills teaching and learning can finally be achieved (eg. Sheingold, 1987; Downes, 1989; Shaw, 1991; Megarry, 1991; Riding & Chambers, 1992; Russell & Russell, 1993). But studies have revealed that the new technologies despite their facility to provide increased avenues of access to information, have not fully lived up to expectations. In describing children's use of electronic data sources, Fasick (1992) noted that much research activity has focused on investigating the knowledge required by the user in adapting and learning to use the new system.

Hypermedia and interactive multimedia have inherent problems in use and application as information sources in educational settings (Ford & Ford, 1992). Some of the more serious problems have been described as

- disorientation, difficulty knowing where one is in the book,
- navigation inefficiency, difficulty moving from one point to another,
- cognitive overload, exposure to information that vastly exceeds that required by the problem of question (Collie, 1991).

Many potential users of hypermedia have been found to lack the cognitive skills, the motivation and attitude to learning required to take full advantage of the medium (Heller, 1990; Trumbull, Gay and Mazur, 1992). Although many publishers build design metaphors into their interface and navigational structures, naive users are often unaware of this encompassing and potentially useful structure (Gay & Mazur, 1989). Trumbull, et al., (1992) found that novices typically tend to browse when seeking information and this was a very inefficient form of navigation when compared to indexing and using on-line guidance.

Conclusion

Interactive multimedia is the solution to the provision of hypermedia information and learning systems. This form of learning system has the potential to provide powerful learning environments that are capable of overcoming many of the problems associated with conventional teaching and learning. Hypermedia provides a learning environment that is motivating to use which also facilitates constructivist principles of teaching and learning. Hypermedia offers flexibility of delivery and high levels of learner control and through the Internet, access to vast stores of information. Current research is aimed at maximising the effectiveness of the application across broad target audiences. As with all other technological developments, the future can only tell how much of this potential will be realised and whether this will be the one computer technology that will have a significant impact on teaching and learning.

Part 2: Using multimedia for learning rather than teaching

Rob Phillips
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Introduction

The use of Interactive Multimedia (IMM) as a medium for Computer-based Learning (CBL) is currently very popular as a source of innovation in education. The emerging technology has enabled many teachers and acad emics to produce their own multimedia materials, either on their own or in small teams with support groups. Most, if not all,

universities in Australia are involved to some extent in such developments. While the cost of producing such materials is relatively high in comparison with other modes of delivery, economies of scale have made IMM attractive to administrators seeking to educate more students for less cost.

I contend here that much of the material which has been developed since multimedia became popular is educationally flawed and not suited to the medium. Too much material has been developed because it is possible to do it, and too little attention has been paid to producing educationally sound material which takes account of the unique new capabilities offered by multimedia. In part, the reason for this is that it is extremely difficult to break from old pedagogical paradigms. I will use this argument to address the question upon which this paper is based: What is the problem to which IMM is the solution?

Essential aspects of the teaching-learning process

It is informative to examine the ideal teaching-learning process, as proposed by Diana Laurillard (Laurillard, 1993; Laurillard, 1994). She argues that there are four aspects of the teaching-learning process:

- Discussion between the teacher and learner.
- Interaction between the learner and some aspect of the world defined by the teacher.
- Adaptation of the world by the teacher and action by the learner.
- Reflection on the learner's performance by both teacher and learner.

She then considers how different educational media and styles can be described in these terms. For example, a text book represents a one-way flow of knowledge from the teacher's conceptual knowledge to the student's conceptual knowledge. A lecture or tutorial may be seen the same way, but there is a possibility of meaningful discussion between teacher and learner.

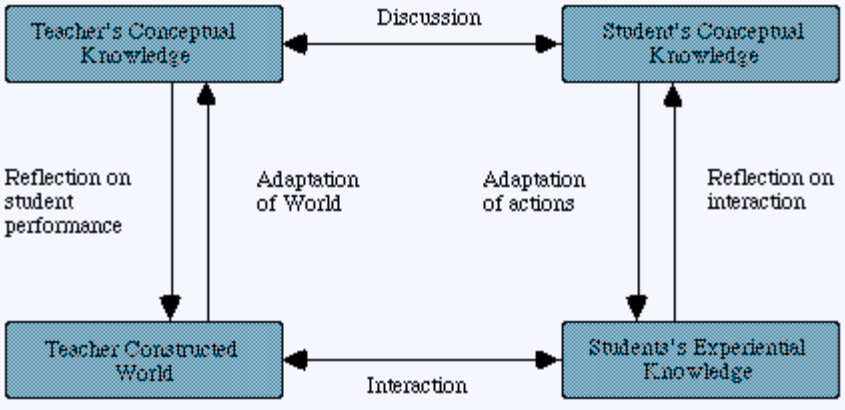

Figure 1: Essential aspects of the ideal teaching-learning process

Weaknesses of IMM CBL

Given this theoretical framework, how well does Interactive Multimedia Computer-based Learning fare? While there are exceptions, the overwhelming majority of IMM packages available are very book-like.

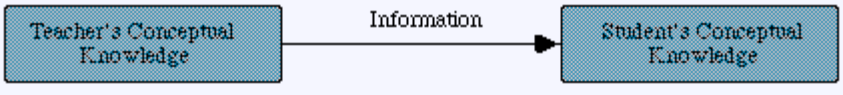

Figure 2: Characteristics of book-like interactive multimedia

There is a natural tendency to take the narrative style of lecturing and replicate it on the computer - indeed, many ways of providing information (lectures, books, videos) are narrative in construction. It is natural for the content expert to

structure information in a linear form and to impose this on the student. IMM material produced in this way tends to be book-like. There is little learner-engagement, and interactivity tends to be sprinkled on as an afterthought, rather than being an integral part of the design.

Also, a book or a lecturer is far better than this form of multimedia. Students understand the metaphor of a book. There are visual cues (shapes of words on a page, headings), as well as formal mechanisms (such as the contents and index) to allow the reader to easily find information. Some of these functions can be programmed into IMM, but do not appear as intuitive or useable as in a book. Furthermore, a human teacher or lecturer is better than linear or narrative forms of IMM - the lecturer can provide discussion and appropriate feedback, as well as adaptation and reflection. Such human responses make even a mediocre lecturer better than many IMM programs.

Using multimedia appropriately

Multimedia should be used in a way that takes account of all the aspects shown in Figure 1. For example, multimedia should immerse the student in a teacher- constructed world, allowing the student to interact with it, and build concepts by reflecting on it. Clearly, IMM is well suited to treating complex processes, such as culvert design, carbohydrate metabolism, and any three dimensional processes; to visualising microscopic processes, such as chemical reaction mechanisms and processes which occur in the cell; and to dynamic processes, such as muscle contraction.

The teacher-constructed world should be adaptable based on student feedback and performance and the teachers' reflection on that. The left hand side of Figure 1 translates into evaluation and modification in the IMM sense. This has typically been ignored or given lip-service in most cases, but is an extremely important factor in producing educationally effective material. However, effective evaluation strategies are still being developed for IMM. It is also harder to modify IMM, because of the cost. This contrasts with the traditional teaching process, where it is easy and natural to annually review your lecture notes based on your perceptions of how the course went last year.

IMM should furthermore, provide a context for the teacher-constructed world the student is exploring. It is important to allow the student to make links between ideas and build up their own knowledge. The user interface needs to be designed so as to encourage active student involvement and to give a feeling of ownership to the student. It is difficult to initiate a two-way discussion between student and teacher (computer), in the absence of advances in artificial intelligence. However, the student should be able make their own notes about the program, and make these available to other students or to the teacher. Almost all current examples of IMM, including the Carbohydrates program (described below), fares badly in this aspect of the teaching-learning process. Let us consider these desiderata in the context of the Carbohydrates package, which investigates the metabolism of carbohydrates, from food to use by cell.

Carbohydrates

The *Carbohydrates* program is one of a series of interactive multimedia programs funded by the Committee for the Advancement of University Education (CAUT), reported in full elsewhere (Slack-Smith et al., 1994). It was based on the experience of a first program, *Mitochondria and ATP*, reported at the ASCILITE 1993 Conference (Slack-Smith, et al., 1993). The two projects take different educational approaches. Mitochondria has a traditional 'menus and buttons' approach, and the material is structured in a very linear fashion, with little interactivity. The Carbohydrates program takes a more exploratory approach, allowing the students to discover the structure of the program and construct their own knowledge.

Our experience with the Mitochondria program (and others) was that the use of a hierarchical structure and a 'menus and buttons' interface constrained the content to a linear form - an unfolding narrative. The logical interface for this sort of design is menus and buttons, which are the computer equivalents to the contents page and to turning pages in a book. In the Carbohydrates program, we set out to provide for a more intuitive interface, with which the user can interact naturally without needing training and 'help' features. We settled on a simple learner interface where navigation is by means of a graphic of the human torso, which is explored with the mouse. This is shown in Figure 3.

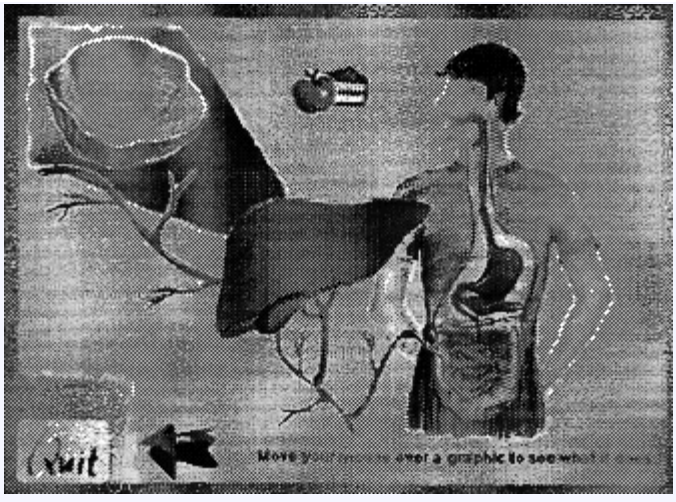

Figure 3: Interface design with carbohydrates

Students move between screens by using *hotwords* instead of clicking on an arrow at the bottom of the screen. The first sentence on any screen is a summary of the previous screen, and it contains a hotword to take you back to that screen. Other hotwords take you deeper into the material. The student is free to explore this material in any order they wish. The way in which the Carbohydrates program fits Laurillard's ideal teaching-learning process is shown in Figure 4. The program clearly allows an interaction between the student's experiential knowledge and the tea cher-constructed world, and reflection and adaptation of their conceptual knowledge. There is narrative information from the teacher to the student, but no corresponding response from the student is possible. ie. there is no discussion. The teacher's reflection and adaptation is represented here as evaluation and modification, and is in grey because it is less extensive than in traditional teaching.

Evaluation of the software revealed that some students find it helpful to be given a better-defined context in their user environment - to better know where they are in the program and what scope it has.

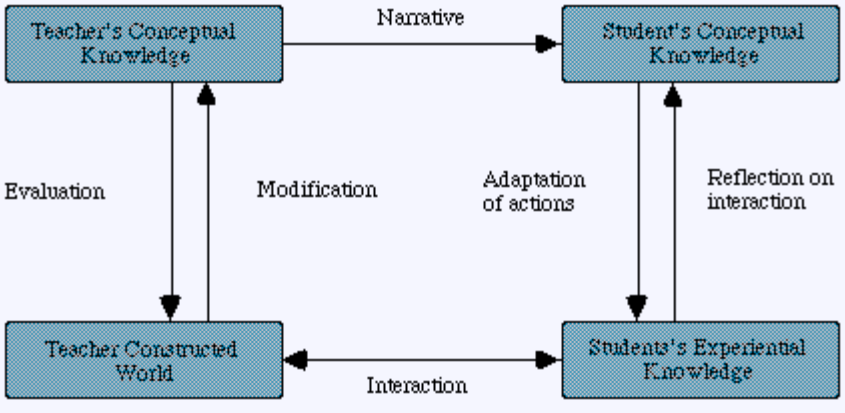

Figure 4: The attributes of the carbohydrates program in Laurillard's scheme

Laurillard would classify the Carbohydrates program as Discovery Learning. She makes the following point about Discovery Learning:

> The paradox of interactive media is that while in a user control medium the user expects to have and has to be given control, a learner is not in a position to know enough to be left in full control (Laurillard, 1994).

In other words, the CBL needs to be supplemented by extra support to give the feedback which is missing. With the addition of a support environment and mechanisms for students to initiate discussion, then the CBL becomes a Guided Discovery Learning environment, which encompasses all aspects of the teaching-learning process.

Guided discovery learning

What functionality can be added to a CBL program to achieve Guided Discovery Learning? We need to be able to give students a feeling of context, for example, by providing a map and glossary. We should also attempt to give students a feeling of ownership/ belonging by letting them record their own notes for themselves and comments for others. Perhaps their comments could be available to other students or as direct feedback to the teacher. When we give the student more functionality, such as a map, glossary, notes and comments, we are giving them what David Jonassen calls Cognitive Tools.

> [Cognitive tools] empower the learners to think more meaningfully and to assume ownership of their knowledge, rather than reproducing the teacher's (Jonassen, 1994).

While cognitive tools give the student more power, they complicate the user interface. The Carbohydrates program uses a direct, intuitive interface with minimal buttons. How can you implement a map or glossary without a button? If you do add buttons, then the interface is no longer simple, and you need extra functions to explain the interface, making it yet more complex. The strength of the Carbohydrates program is that has avoided the narrative style and has an intuitive interface. The weakness is that it doesn't give enough context and empowerment to the learner. The dilemma here is to empower the user while keeping the interface simple.

Part 3: The new networked hypermedia: Solutions to ownership, distribution and maintenance?

Geoff Rehn
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A question of terminology

It is difficult to come up with a term that adequately captures the impact that the changes of recent years in communications and information technology have had on digital media and its distribution. For some time now, we have been hearing of the 'convergence of the communications and information technologies' and the synergy that has thereby been engendered. Perhaps the greatest impact has been that brought about by the increased networking of computers and in particular by the exponential expansion of that global network of networks called the Internet.

In the same way that the term 'computer conferencing' has given way to the more comprehensive term 'computer mediated communication' that encompasses a variety of media forms and modalities, it is now time that the term 'interactive multimedia' be taken to include the distribution of media by means other than a direct interaction with a stand-alone computer's central processing unit. This broadening of the definition of interactive multimedia will incorporate what one might refer to as 'telemedia', which refers to the range of media formats that can be transmitted by networks, such as ISDN (Integrated Services Digital Network), broadband ISDN, high speed ethernet, analogue full-bandwidth television broadcast and even PSTN (Public Switched Telephone Network). Indeed, this is the line being pursued by Australia Telecom (Telecom Australia, 1993) in the promotion of their recent developments in global interoperability and collaborative communication, including their Conferlink Multimedia, which enables real time video, voice, text, and still images to be transmitted over PSTN, in a shared working space environment.

Let us then take as a base definition for interactive multimedia the requirements that the delivery mechanism incorporates a variety of media, that the user can select the type of resource that they wish to investigate and that they control the rate of progress and the direction of the investigation. I would then propose that the new networked hypermedia, as exemplified on the Internet by the World Wide Web, should be considered as interactive multimedia, especially as network bandwidth capacity increases, thus making the oft mentioned Global Information Super Highway that much closer to being a reality. The developers of interactive multimedia will need to keep their vision focussed somewhat on these developments; networked hypermedia is not a final solution or paradigm but a pointer to what this

future will bring. The following words capture this sense of potential and, indeed, concern:

> Some people believe that long-distance interactive multimedia will change human interactions as dramatically as they were changed by electronic mail. Meeting the performance requirements for such applications, while simultaneously scaling the Internet to include more hosts (by several orders of magnitude), is going to be an interesting challenge (Lynch & Rose, 1993).

What is networked hypermedia and the World Wide Web?

Tim Berners-Lee (of the World Wide Web project) describes the Web this way:

> The WWW project merges the techniques of information retrieval and hypertext to make an easy but powerful global information system... The Web contains documents in many formats. Those documents which are hypertext, (real or virtual) contain links to other documents, or places within documents... All documents, whether real, virtual or indexes, look similar to the reader and are contained within the same addressing scheme. To follow a link, a reader clicks with a mouse (or types in a number if he or she has no mouse). To search an index, a reader gives keywords (or other search criteria). These are the only operations necessary to access the entire world of data.

The World-Wide Web has been described as a 'wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents'. It was invented at the European Centre of Particle Physics (CERN), Switzerland. Basically WWW and Gopher are similar: both systems allow the user to browse information across the Internet without the necessity to login. However, WWW is much more powerful and flexible than Gopher. Whereas a Gopher menu is a list of items, WWW appears to the user as a text document and can take - provided that the user runs a graphical interfaces such as NCSA Mosaic - full advantage of text formatting. WWW documents are written in hypertext. Selecting certain words within a WWW document via mouse or keyboard causes other documents to be opened, no matter where on the Internet these documents are. In addition, WWW documents can contain links not only to other text, but also to images, sounds and movies.

It is the thesis of this brief paper that the World Wide Web and networked hypermedia provide solutions in the domains of ownership, distribution and maintenance.

Ownership

With the recent release on to the Internet of public domain soft ware tools for Unix, Windows (and DOS) and Macintosh platforms, that enable the academic, researcher or information provider to both readily develop hypertext/hypermedia documents suitable for retrieval via the WWW, as well as easily set up their own networked desktop workstation as a WWW server, there is now an unprecedented capacity for the developer to pretty much 'go it alone', both with respect to producing interactive materials and their publishing and dissemination.

Of course this 'bottom up' approach will have implications for network usage and bandwidth considerations, as well as the release onto the Net of poorly designed materials. But it is early days yet, as this new medium establishes itself. We can all recall ugly examples of interactive multimedia and computer assisted learning, in the rush to release materials.

Tony Barry, from the Australian National University, a well known figure on the Australian AARNet/Internet scene, posted the following recently to the RESODLAA listserv, in response to an ongoing discussion on instructional design and hypertext:

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>Return-Path: <resodlaa%usq.edu.au@zeus.usq.edu.au>
>Date: Sat, 1 Oct 94 22:39:37 EST
>Originator: resodlaa@usq.edu.au
>From: Tony Barry <tony@info.anu.edu.au>
>Subject: Re: ID and hypertext

> On Sat, 1 Oct 1994, Ameigh wrote:
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> > In reply to Peter Donnan re: <ID and hypertext> it is important to
> > note that hypertext is not an instructional paradigm, but rather a
> > scheme for organizing information (text, graphics, pix, audio).
>
>I couldn't agree more.
>
> > Hypertext is a tool that has the potential to speed up the learning
> > process and make that process more accessible and less
> > instructor-directed. Its challenge to instructional design stems from
> > the shifts in instructional technique it might spawn.
>
> As hypertext in the form of World Wide Web can now be inn from PCs or
> Macs and requires about two hours tuition to start authoring material (I
> give courses) it's up to the instructional designers to start using it as
> they are freed from the dictates of the techos and can go it alone.
>
> Tony

> Tony Barry - http: //snazzy.anu.edu.au/People/TonyB.html
> CNIP - Centre for Networked Information and Publishing
> and
> Centre for Networked Access to Scholarly Information fone + 61 6 249 4632
> Australian National University Library phax +61 6 279 8120
> Canberra A.C.T. 0200, AUSTRALIA tony@info.anu.edu.au

Distribution

The nature of 'electronic publishing' on the Internet is markedly different from the distribution of digital media designed for 'stand alone' operations. Materials made available for anonymous FTP (File Transfer Protocol), Gopher or the WWW can be accessed by anyone, anywhere, and at any time, providing they have Internet access. This fact is to be seen on a global scale. Thus, materials I develop and put on the local host cleo.murdoch.edu.au can be accessed by a student on the Murdoch campus, a person operating from a rural telecentre and a colleague in Great Britain, perhaps all at the same time. Thus, hypermedia and the WWW is very much in keeping with 'open learning', however this be defined.

With the increasing availability of network information retrieval tools with a graphical user interface, such access is very user friendly and quite seamless (Rehn, 1994a). Indeed, I might argue that the increased involvement of the user in using such tools and associated 'viewers' (such as a GIF or JPEG image viewer) increases the 'interactivity' and gives the user a sense of control and participation that is not present in the same way in the usual interactive multimedia. This is not to say that becoming proficient in the use of fairly sophisticated network information retrieval tools is a trivial matter; but experience in getting new users up and running using such tools, done by electronic mail and subscription to a new user listserv (ie., eff_one@cleo.murdoch.edu.au) would indicate that this process is a dynamic and intensely stimulating one.

Thus, networked hypermedia, the WWW and associated network information retrieval tools allow the ready and very broad (indeed, world-wide) distribution of developed materials in a manner free of the costs and constraints of traditional distribution forms such as CD-ROM. With the increased availability of Internet access and the development of user friendly dialup tools (Rehn, 1994b), as well as the increasing ease of developing hypermedia materials for electronic publication, and the increasing independence from network administrators in making such material available over the Internet, we have a mechanism for immediate distribution and publication that is unprecedented.

Maintenance

The question of maintenance of hypermedia documents is not separate from the issue of development, publication and distribution. The author of a hypermedia document can of course use the same tools to update, change, modify or completely rewrite materials, with tools no more complex than one's usual favourite word processing application.

While such ease of use will (and does) lead to the premature release of materials, there is no longer the reliance on the 'technocrats' or authoring specialists to undertake revision and improvement. Thus, the development of interactive multimedia, in the form of hypermedia on the WWW, will give rise not necessarily to final products that have undergone extensive testing and trialing, but to works that are open and in the process of development, improvement

and refinement, as new materials or insights come to light. For me, this humanises the overall process, increasing the sense of ownership and also the sense of who is the master of this new technology.

Conclusion

We are in early days yet - the World Wide Web browser NCSA Mosaic was released just late last year - and networked hypermedia needs to be seen as an emerging medium; hypertext and the hypertext markup language (HTML) are still in prototype development. There are immense challenges ahead, both in questions of instructional design and network considerations, that will need to be met. The WWW and hypermedia information retrieval will not displace more established forms of interactive multimedia but they have a place in the family of modalities and media forms that are to be considered interactive multimedia. They offer solutions to problems of multimedia ownership, distribution and publication, as well as maintenance, and will increasingly empower the ordinary desktop user.

> Note: Geoff Rehn's contribution to this paper is also published electronically and can be obtained from the following sources: Rehn, G. (1994). The new networked hypermedia: solutions to ownership, distribution and maintenance? WAIER IMM seminar. Edith Cowan University. Oct 18 1994.
>
> ftp: //ftp://cleo.murdoch.edu.au/pub/Res-and-Dev/rehn-WAIER_IMM.txt
> URL http://134.115.224.48/WAIER/waier.html
> The HTML document for this resource is also available by anon ftp.
> ftp://cleo.murdoch.edu.au/pub/Res-and-Dev/rehn_WAIER_IMM.html

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Part 4: Interactive multimedia: problems, solutions and opportunities

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Introduction

The question posed at the head of this paper is capable of several layers of interpretation. It correctly implies that multimedia programs should be created for sound educational reasons rather than for their own sake, but introduces dilemmas of definition and research reliability. Multimedia is an imprecise term. It may successfully convey the integration of different forms of information, but it is applied to a rapidly shifting technology and is therefore not a stable concept.

> Researchers often discuss computer technology as if it were one monolithic system that could readily be transferred from one setting to another and could reasonably be expected to obtain the same results (Krendl & Broihier, 1992, 216).

Furthermore, 'interactive multimedia' is frequently used alongside the term 'hypermedia', and much confusion surrounds the two. In this paper, 'multimedia' and 'hypermedia' are used interchangeably and describe computer- based software that integrates many forms of information (graphical, textual, audio, etc,) and which are not confined to a linear form.

In the broader sense, there is unlikely to be any grand educational 'problem' to which interactive multimedia (IMM) is the solution. However, there may be a range of sub-problems that IMM might help solve. The points raised below draw upon a study (the 'PES study') carried out by the author into the utilisation of computer-based learning courseware by a physical education teacher and class of secondary school boys (Dickinson, 1993).

Learning, teaching and IMM

Individualised, self-paced instruction has long been difficult to achieve in the classroom, but IMM applications appear

to improve the possibility of practical individual instruction. Appropriately designed IMM can create a rich learning environment which actively engages the students, and that this heightened engagement may enhance learning.

IMM programs may appeal to a wider range of learning styles than narrower forms of delivery. Dede (1987) and Jonassen (1985) have suggested that 'hypermedia-based instruction' could amplify various cognitive learning principles and these ideas remain largely unexplored.

> Investigation of the interaction of various learner traits with aspects of the emerging instructional designs has typically lagged far behind the development of the computer technology (Repman, Rooze, & Weller, 1991, 31).

In an article on empowering environments, futurist Christopher Dede (1987) referred to hypermedia as one of the new cognitive enhancers in which the "complementary cognitive strengths of a person and an information technology can be used in partnership" (Dede, cited in Repman, Rooze & Weller, 1991, 30). IMM should offer a multi-channel experience to the learner, and exploit the multi-sensory nature of learning. There are reasons to hope that IMM programs hold a key to some future improvements in learning efficiency.

IMM applications are capable of a high level of interactivity and learner control. Kinzie et al. (1992) indicated that when students feel in control of a learning activity, it develops meaning for them, and increases their motivation for the task. But little is known of the degree to which the benefits transfer to other applications, or how long such positive effects last.

The PES study highlighted the potential for guided discovery, through the use of multiple media, using worksheets. The idea that the path should not be left completely to the learner's discretion proved to be an effective instructional strategy. The students appeared to study most effectively when the learning was guided by support materials. Megarry points out that 'hypermedia require quality support materials that structure learners' exploration and allow them to create fresh combinations and links for themselves' (Megarry, 1992, 2).

We need to know much more about the effects of using IMM materials with varying degrees of learner control.

> Although learner control, self-regulated learning, and discovery learning may be facilitated by hypermedia environments, it appears that even mature learners may experience disorientation and cognitive overload when learning concepts presented in [hypermedia-based instruction] (Repman, Rooze, & Weller, 1991, 3o)

The success of hypermedia courseware will depend heavily upon the structuring of the information and the way in which a student is able to interact with it. In the PES study, many students expressed a preference for more depth of content. The finding may merit research into the capacity of students to absorb more complex information when presented through the medium of IMM. A motivating environment may well encourage students to rise to greater learning challenges.

Research is needed to identify appropriate techniques of message organisation and processes of instructional delivery through technology and to determine more clearly what 'appropriate depth' is for different students, for different learning styles, and in different circumstances. IMM applications can be designed to adapt the depth of the information presented on the basis of feedback received from the user, an approach with rich educational possibilities.

IMM offers users control over dynamic events. Feedback in the PES study on the appeal of animated sequences and simulations was very positive, but far more needs to be known about the instructional effectiveness of simulations and animations.

Research shows that trying to introduce computer-based learning into a teacher-centred classroom often engenders resistance, or rejection. IMM may offer an opportunity to change this situation. When teachers are provided with the opportunities to do things with computers that cannot be done conveniently and cost-effectively any other way, then computers and their software will begin to carve niches in the school curricula.

Computer applications deviate widely in type and application, in their scope, their cognitive demands, their

attractiveness, their purpose and their impact upon users. Future comparative studies will need to focus more closely upon programs with similar purpose and scope. Past researchers have been looking for 'computer effects' rather than isolating the effects of particular uses of computer technology.

Clark (1983) pointed out that the groceries - not the delivery vehicle - are responsible for improvements in nutrition, and many research efforts have since focused upon applications - their interfaces, their structure, their content, and their interaction with the learner. There is clearly significant variation between different 'flavours' of IMM software, and there is little evidence yet to suggest that studies of the impact of one program can be extrapolated to another. We know all-too-little about the effects of different levels of user control, the perceived need for organisers and cognitive maps, how students use different IMM environments, the extent to which such environments may encourage discover-based learning, and the changing roles of teachers and students using IMM materials. In the mean time, whilst exposure to IMM applications remain an unusual experience, students will probably continue to find them motivational.

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