

STRATEGIES FOR DEVELOPING COST-EFFECTIVE AND POWERFUL INTERACTIVE MULTIMEDIA EDUCATIONAL MATERIALS

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ABSTRACT

Interactive multimedia (IMM) will only become a mainstream educational method if IMM titles:

- result in clearly better educational outcomes (are educationally powerful); and
- can be developed within reasonable resource constraints.

Without achieving both of goals, university developed IMM will be relegated to the margins of educational materials development and even brilliant projects will burn brightly for a short time before sinking below the surface without a trace.

This paper examines reasons for universities to create IMM titles and some of the barriers to doing so. It then examines some strategies we are using at the University of Southern Queensland (USQ) [1] to develop affordable and powerful IMM environments and thus mainstream IMM as a core flexible delivery technology. In discussing these strategies I use examples of strategic planning for the Educational Multimedia Group at USQ and the university at a whole, and also examples from development of the Hathaway CD-ROM which was a major component of my work at Deakin University in 1995.

The Hathaway CD-ROM contains over 600 items of information made up of text, video, audio, images and drawings. In traditional media the CD-ROM contains more than 1 hour of video, 1 hour of audio, 400 pages of text, and many hundreds of photos and scanned documents (samples of children's work, architectural drawings, news paper articles, policy documents, etc.). Additional information on Hathaway can be found in Evans [2] and Hathaway [3].

KEYWORDS:

interactive multimedia, development, planning, cost-effective, tools

IMPETUS AND BARRIERS FOR MULTIMEDIA DEVELOPMENT

Most universities and other education and training providers are increasingly using flexible delivery technologies. Interactive multimedia (IMM) technologies (broadly defined as digital tools used to represent, process and transmit textual, graphic, audio and video information) are major components of these flexible delivery technologies. Increased focus on flexible delivery is a result of both the changing nature of students (mobile, part-time, more diverse) and a desire to make educational products more marketable to a wider range of people at a time, place and pace that is defined by the user.

However, IMM materials have much longer developmental times than paper based materials which are typically developed and produced within 6 months. Developmental is a very complex process involving many different groups of people working together to produce a single product.

Also, if IMM proponents are correct and IMM systems are qualitatively different to traditional educational media (paper, video, audio) then academics must totally rethink the educational process and content they are working with. If this is not done, why produce an IMM title?

Ironically the speed of technology development can also be a barrier to the development of IMM. We all know a technoluster who is forever reading press releases, trying beta releases and has a hard disk full of software which is not actually used for any **real** task. In the world of almost unlimited possibilities enabled by technology, it is important to carefully think about what we want to do and then work towards achieving this.

While these problems apply in all contexts there are also problems which more often occur in universities. Perhaps the most common is that of "paralysis through analysis" where people endlessly think and debate the "perfect" way of doing something to such an extent that nothing is achieved. Academics are also notoriously loathe to use a resource which they themselves have not developed.

STRATEGIES FOR AFFORDABLE IMM DEVELOPMENT AND USE

The remainder of this paper will examine strategies to decrease the development and delivery cost of powerful IMM titles. Some strategies may be implemented at the institutional level, while others are more applicable at

the levels of the IMM development group or the individual project team. Each section will include an example of the strategy as it has been applied within the Educational Multimedia Unit of the Distance Education Centre at USQ or as it was applied in the development of the Hathaway CD-ROM.

This paper does not attempt to quantify, in absolute terms, the development and delivery costs. I suspect that costs, productivity and expectations are changing so fast that absolute quantification would be of little use for predicting future costs.

Many of the strategies discussed in this paper are based on the ratio between development time and the time the package is used. Thus, either increasing the number of users, the time the package is used, or spreading developmental overheads over a number of projects will result in lower developmental costs.

Focus on our core objectives

IMM technologies will impact on all university activities—teaching and learning, research, administration and community service. Within teaching and learning, IMM may be used in several different ways emphasising different aspects of the teaching-learning episode and different educational models. Some applications include:

- Computer Assisted Learning (CAL) focusing on presentation of carefully structured teaching sequences;
- Computer Managed Learning (CML) focusing on assessing learning and managing learner access to materials;
- Computer Mediated Communication (CMC) focusing on interactions between people (students and teachers);
- Simulations, modeling and virtual reality, focusing on representations of different situations and environments; and
- Interactive Multimedia learning resources focusing on providing students with finger tip access to educational resources.

While, features of these applications are converging it is critical that IMM development groups focus on one or two styles in order to develop affordable products.

At USQ we are focusing on the development of IMM learning resources for several reasons. IMM learning resources may be used in a number of units and are generally used for significant amounts of time compared to traditional CAL materials. Greater usage options justify the developmental cost. The flexible structure of IMM learning resources also allows the inclusion of CAL, CML and CMC facets when appropriate to the needs of the users, the tasks at hand and the features of the content.

A further advantage of focusing on IMM learning resources is that it allows us to capitalise on the vast amounts of print based information which most universities already own. I am not suggesting that existing paper based study materials should be simply reformatted for screen presentation (shovelware), but rather that this information should be integrated into the IMM environment in a way which adds value for the user. For example, a current USQ project involves a CD-ROM based database of images and animations. While the majority of students will read the text of the unit on paper, this text will be also included on the CD-ROM, allowing the student to more easily find, understand and use the media resources.

Theories from psychology, education, information science and human-computer interaction can also be used to focus the implementation of individual projects. Without such guidelines it is difficult to focus on clear goals and the plethora of possibilities offered by IMM is one way of overspending development budgets. One such principle is that the IMM environments should reduce the cost for a person to find, understand and use a piece of information, as well as increase the value of that information. However, it should be remembered that the value of an IMM environment depends on a complex set of interactions between the features of the content, the users, the tasks they are set, and the tools that are provided [4].

Collaborative work between people and groups

IMM development requires co-operative input from people with different expertise (content, video, graphic, textual, programming, project management, legal etc). Often these people have never worked together and there may be long standing impediments to their collaboration. If a university is to develop useful IMM, then it is necessary to foster a strong coalition between these different groups. Strategies which offer individuals and groups opportunities to best utilise their strengths and participate in a "win-win" collaborative effort, are more likely to be effective than "brute force" strategies (e.g. restructuring).

Within USQ both top-down and bottom-up strategies are used to foster cross-sector collaborative groups. The Flexible Delivery Committee [5] consisting primarily of Deans and the Deputy VC sets policy and broad parameters for the direction and pace of the use of Flexible Delivery technologies. I have also established the "multimedia@USQ" [6] user group to support people who are using IMM. This group provides a forum for practitioners to showcase their work, and share experiences and expertise.

Collaborative work is also fostered at the level of the unit team which at USQ consists of content experts and an instructional designer. When a unit team decides to develop an IMM title, an IMM expert is involved with the entire unit team to ensure that the possibilities and potentials the project offers are fully exploited.

Strategic planning and staged development

Deployment of IMM educational materials requires faculties and the university as a whole to set long term plans if costly mistakes and delays are to be avoided. Long lead-times are also necessary to ensure that the infrastructure is available for the IMM to be effectively delivered to students. Many faculties within USQ are currently moving towards requiring students to have access to a certain level of computer at a specified time in the future. This means that core educational materials may be distributed electronically without the added cost of a dual development and delivery system. In return for their investment in computers, students will be assured that they will use the computer in the majority of units over the duration of their course.

Each faculty within USQ has prepared a rolling 3 year plan for the introduction of flexible delivery technologies into their teaching.

Deliverable products vs. ongoing expertise and infrastructure

Another way of reducing developmental costs is to ensure that each IMM project is conceptualised as both a deliverable product **and** also as an opportunity to develop infrastructure, expertise and models which will be used in future projects. The mix between these aspects is different for each project and it is important not to overly force the aspirations of individual projects into the "grand plan" for the group. While most projects broadly support this developmental principle, each is periodically examined to ensure that it is contributing to the expertise and skills of the group.

The "retained" part of each project may take several forms:

- content structuring and markup;
- tool functionality and interfaces; and
- algorithms and code.

Content structuring and markup: A major asset of any university is the intellectual property of its staff and the expression of this in teaching materials. While paper based renderings of content will be used into the future, it is clear that content should be organised and maintained so that it can be moved from one presentation format to another—"author once and play anywhere". For example, the one source document could be used as the basis for documents distributed on paper, CD-ROM or perhaps the WWW. This is one of the reasons why markup languages such as SGML are becoming increasingly common as a way of enabling content to be "future proofed".

Functional tools and interfaces: Projects in different faculties will emphasise different tool sets and different representational media e.g., calculators and scientific simulations would be more common in a unit taught in the Faculty of Engineering and Surveying than an Art or Education unit.

However, there is also a core of functionality and media types which are consistent across all disciplines. For example, all IMM learning resources should allow the user to follow thematic links between information. It is imperative from a cost effectiveness point of view to ensure that the tools used to create these links, the underlying data structures, and the way in which students use them are developed once to avoid "reinventing the wheel". Tools such as context sensitive online help, word search and indexes should also be reusable in a variety of titles. A complete functional specification of the Hathaway CD-ROM can be found in Hathaway [3].

Underlying code: While true cross-platform development and delivery is still problematic, developmental costs can be reduced significantly by implementing functionality in ways that are robust, generalisable and maintainable. The code should also be written in a way which isolates key functionality from the underlying hardware and software. For example, tools are being produced that facilitate translation of content between systems such as HyperCard, SuperCard, TookBook and Director.

Project management

IMM projects, like other projects involving many people, benefit from close project management in which roles, responsibilities, and demonstrable mile-stones are clearly specified. This does not mean that all members must attend long minutely minuted meetings. Generally project goals are not achieved in meetings—the meeting establishes the potential to achieve goals but the goals are achieved through work in between the meetings. We have found it useful to have short weekly meetings after which actions and decisions are minuted and attached to a single name for action.

DEVELOPMENT PROCESSES

Software platforms

Numerous authoring systems claim to increase the productivity of multimedia programmers--some even claim to replace the programmer. All environments have strengths and weaknesses and this paper is not the place for a platform war in favour of a particular environment. However, it is important to carefully match the skills of the

programmer with the design specification of the project and the features of the tools which are used. For example, the Hathaway CD-ROM was developed using a general purpose scripting language because it allowed us the freedom to create the tools which were required.

Development tools

The development of the Hathaway CD-ROM involved creating numerous tools which will be used in future projects. For example, link creation involves selecting the start anchor (a phrase of text, a visible button or a region) and then selecting the end anchor. The link is then automatically created, stored in the link database and the anchors visually highlighted. Once created these links can be verified, sorted, or processed using other tools.

Hand-coded "button" multimedia versus "tool" multimedia

Some multimedia products are entirely hand-coded and all functionality has been created on a "one-off" basis. Often these products are created by content experts who have recently been visited by someone selling the "ultimate" authoring tool. This process is not only very labour intensive during its creation but also almost impossible to maintain. In the case of IMM learning resources, it would be impossible for one person to think of all the possible links and relationships among the nodes. This is a common reason why initial breathless enthusiasm is often replaced by the sobering realisation of the limits on the depth or amount of information many IMM environments contain.

In contrast, the goal of the developer should be to create IMM titles which provide tools for both the developer and the end-user. For example, attaching several index terms to each node and providing a flexible way to navigate these index terms provides the user with an opportunity to investigate thematic issues which might not have been considered by the developer. Moreover, the value of these index terms increases with the number of nodes rather than collapsing under their own weight as they are apt to do in many hand crafted systems.

Figure 1 shows the hierarchical index term pop-up menu on an article which only has the index term "nocean". The hypertext contains six index terms the user has just selected to view an article indexed with the term "hypertext".

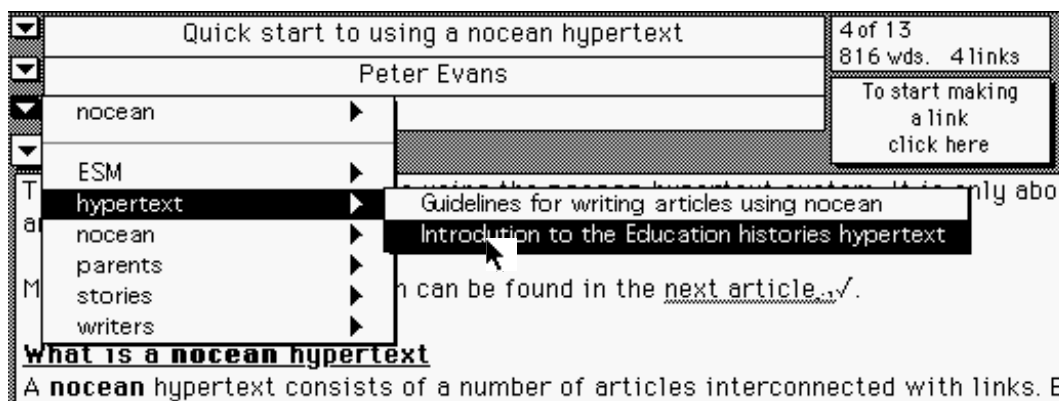


Figure 1: Hierarchical menu of index terms and all articles indexed by that term.

Rapid prototyping

Some models break the software development process into a sequence of steps such as requirements analysis, specification, implementation and testing. In my experience such models have not been very useful in IMM development, partially because people and the project are in a continual state of evolution and development. A more useful approach has been rapid prototyping in which a prototype (either a sketch on paper or a computer implementation) of a small part of the project is constructed and then placed "on the table" for examination by the project group.

TOOLS FOR THE USER

The Hathaway CD-ROM contains tools to help the user to navigate, to find information, to understand information and to use information. These are all general purpose tools and will be used in future projects.

Tools for finding information

Broadly speaking electronic environments provide two different styles of tools for people to find information—query based searching and browsing. The Hathaway CD-ROM provides both methods and allows the user to select the one that is most relevant to them and the task at hand. Figure 2 shows the "Query based Word search" window allowing the user either to enter a search term or select it from a list and which returns a list of all nodes containing that term. While indexing the database is very slow (over 8 hours on a mid range PowerPC based machine) retrieval is very fast (less than 10 seconds for most searches). The effort involved in writing this indexing and retrieval tool is justified through multiple reuse.

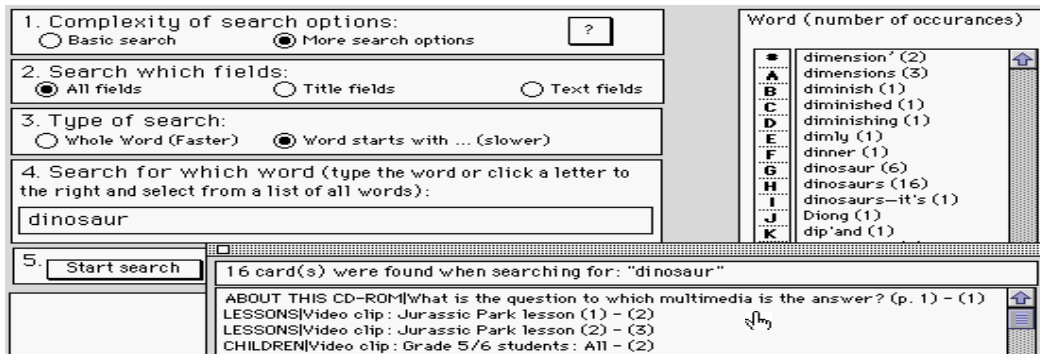


Figure 2: Query based search window and of "hits" returned when searching for words beginning with "dinosaur".

Recognising and understanding information

Once information is displayed, the user has to understand it and recognise its relevance before it can be used. Electronic environments can provide many tools for helping the user to understand information including:

- using multiple interlinked representations of information;
- highlighting relevant parts of the data;
- providing links to related information; and
- providing interpretations of the information.

The Hathaway CD-ROM provides all of these tools and presents information using a range of interlinked symbol systems (text, images, video and sound). For example, the video based interviews are linked to a synchronised text transcript. The synchronised nature of the text and video means that students can browse through either to find the corresponding part of the other. Additionally it means that we were able to use tools traditionally applied to text to also work with video and other time based media (e.g. animations moving around a school building). For example, we can create hypertext links between specific segments of video or use word search to search for any video were a particular person is speaking. Figure 3 shows a segment of video of a lesson where the teacher is guiding a student through a worksheet. Links in the text allow the user to synchronise the video, see glossary entries for the speakers or follow hypertext links (clicking on "Make a list ..." displays a scanned image of the worksheet on the desk) to related information.

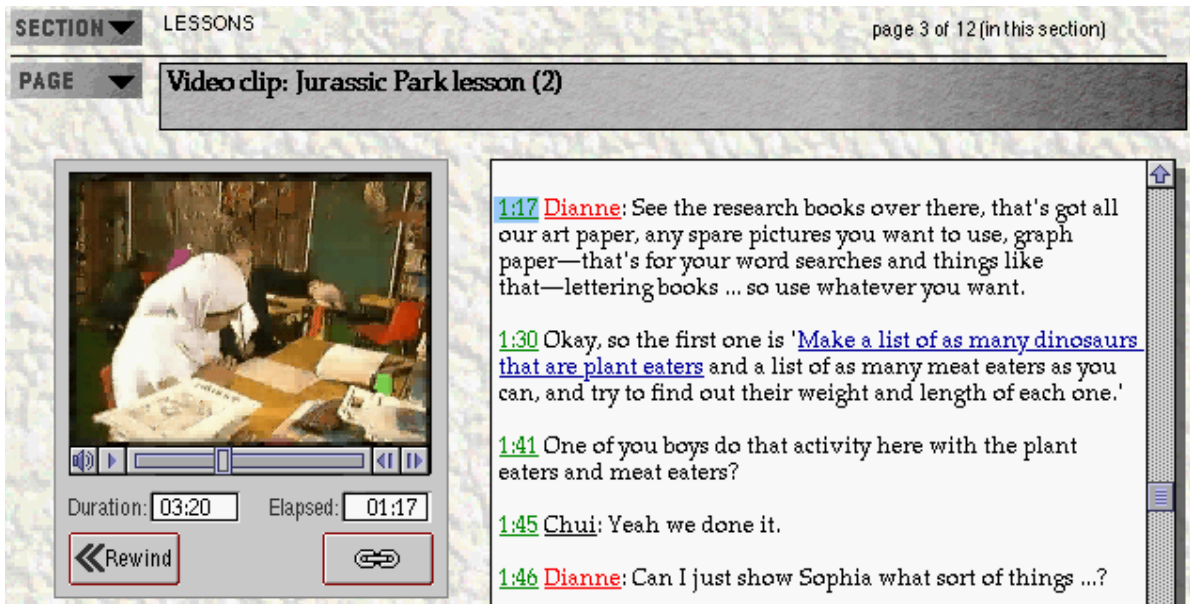


Figure 3: Synchronised video and text showing hypertext links in the text (coloured text is underlined in this screen snapshot).

Because we have developed general tools to enable this synchronisation of text and time based media to be easily created we are able implement this at numerous places in the package at little cost.

Tools for collecting, using and understanding information

If hypermedia technologies are powerful tools for presenting and organising information then **end-users as well as developers** must have access to tools that enable them to use, link, and organise relevant information. General purpose tools for collecting information in the Hathaway CD-ROM include automatic histories, annotated bookmarks, and research notes. Figure 4 shows a list of nodes which have been visited in the current session allowing the user to return to a recent location by selecting it from the pop-up menu.

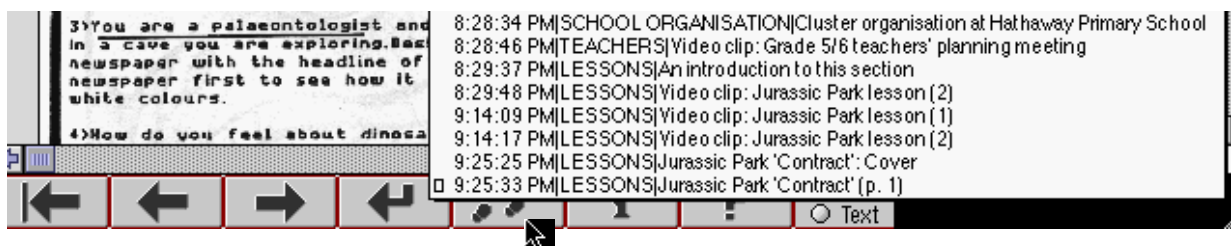


Figure 4: Clicking on the "footsteps in the wet sand" displays a history of visited locations.

Users of the Hathaway CD-ROM can create links and record notes in commentary file stored on their own floppy or hard disk. Figure 5 shows such a commentary file and commentaries will also be used to submit assignments either via floppy disk or email. When an embedded link (shown as the underlined number) is clicked the appropriate part of the case record is displayed and the students interpretations could be verified by looking at the surrounding information.

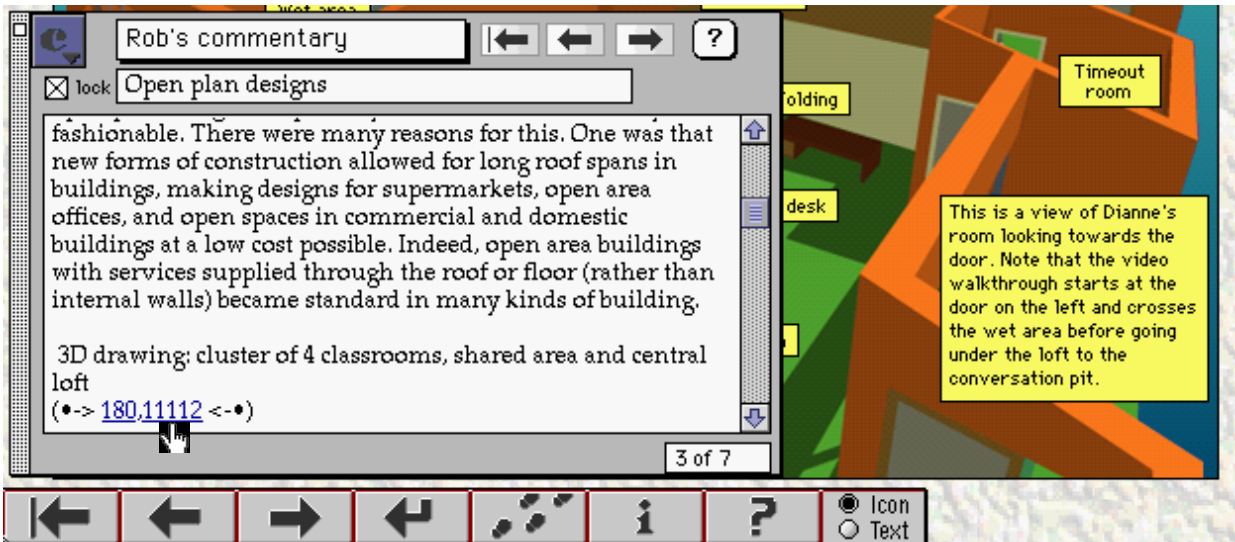


Figure 5: Student prepared commentary file which is stored on a floppy disk and contains links (underlined numbers) pointing to nodes on the CDROM.

SUMMARY

This paper has examined some strategies we are using to reduce the cost of developing IMM titles at USQ. These strategies range from institutional development, to project management to the development of tools and techniques which may be reused in many IMM titles.

While the power of a multimedia title it not necessarily directly proportional to the cost of its development, the process of multimedia development is a continual process of balancing cost and power. If products are not powerful and thus don't justify their existence, then the use of IMM for university teaching and research will be significantly slowed. On the other hand, even the most brilliant IMM project will not be successful in the longer term if it can't be developed within a reasonable budget.

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