Multimedia technology in the future of education is a theme that dominates the recent literature of education and information technology. Higher education has not so far demonstrated a high degree of enthusiasm for multimedia, but this does not necessarily mean that multimedia has little to offer in this sector. To advance the use of multimedia technology, post-secondary teachers must be convinced of its relevance and practicality. Arguments, evidence, training, and facilities for multimedia instruction must be presented in forums that are accessible and convenient for the unconvinced.

INTRODUCTION

Multimedia technology in the future of education is a theme that dominates the recent literature of education and information technology. Title after title heralds multimedia as the educational resource of the twenty-first century. Certainly multimedia resources are increasingly embraced in elementary and secondary education. In that sector both the range of products and applications for the technology is expanding rapidly. By contrast, higher education has not demonstrated equal enthusiasm for multimedia, but this does not necessarily mean that multimedia has little to offer.

The slower acceptance of the new technology in the post-secondary sphere has less to do with its inherent limitations than with the culture of higher education and the circumstances of multimedia's introduction into that specialised environment. Articles in praise of multimedia appear in such publications as EDUCOM Review, Change, or THE Journal. Accordingly they reach an audience of converted faculty and administrators, while, as DeSieno (1995) points out, “less than five percent of college and university faculty use computing to aid classroom instruction or enrich student learning [and] many faculty view digital technology as the latest collection of gadgets unable to deliver the educational merit promised by proponents.” To advance the use of multimedia technology, post-secondary teachers must be convinced of its relevance and practicality. Furthermore, arguments, evidence, training, and facilities for multimedia instruction must be presented in forums that are accessible and convenient for the unconvinced.

BACKGROUND LITERATURE

In any field of study that is characterized by rapid technological change, identifying relevant literature is like taking a frame from a movie. The progress of events quickly overtakes the action of a single moment. The best that one can do is to be aware of those sources which both keep pace with change and interpret it in a useful way. Naturally, books are of limited utility, since the content is dated almost before it reaches the audience. Periodicals which maintain a general approach to education and technology, such as EDUCOM Review, CD-ROM Professional or Change, tend to be the most useful for introductory purposes and for acquiring information about building connections to exploit a range of experience and expertise.

Frequently, introductory articles recount the experience of the author(s) at a given institution, using a particular product. It is important, when referring to such articles, to keep in mind that experiences vary...
considerably depending on the circumstances of an institution and the desired application of the technology. Some items in the literature, frequently opinion pieces, may be interesting but of no practical use. In the worst cases, articles may appear to offer advice in professional development while really they are thinly disguised advertisements. Those who require more depth of treatment in technical aspects of multimedia production may look to journals such as Online or PC Magazine. There are also journals dedicated to using computer technology in specific disciplines, but these serve a very specialized and usually technologically sophisticated readership.

THE VALUE OF MULTIMEDIA IN INSTRUCTION

As a starting point, faculty ought to understand the ways in which multimedia technology may enhance, if not revolutionize, their instructional practice. "Literally, multimedia is the integration of two or more communications media. It is the use of text and sounds, plus still and moving pictures to convey ideas...it is built around the premise that anything words can do, words with sounds and pictures can do better" (Kalmbach, 1994, p. 29). For higher education, these features, in reference works or interactive courseware, can supplement course content and activities in innovative ways (for example, see Liou, 1994, p. 66). The pedagogical basis for augmenting instruction in this fashion is sound. Research in educational psychology suggests that "student learning is affected positively by presenting text and illustrations together...furthermore, computer-generated animation offers a potentially powerful medium for presenting visually based information to learners" (Mayer & Sims, 1994, pp. 389-401).

This theory is supported by anecdotal evidence from the post-secondary field. Advocates of the multimedia social sciences curriculum at Medgar Evers College report that "multimedia courseware holds students' interest better than typical college course materials do. Students who were interviewed said they enjoyed the feeling of being proactively involved in the material" (Fitzgerald & Olsen, 1993, p. 41). Furthermore, it seems that students not only enjoy but benefit from exposure to multimedia instruction. The use of this technology may promote engagement, collaboration, and creativity among learners (Green & Gilbert, 1995, pp. 13-14; Barron & Orwig, 1995, pp. 4-5). Although there may well be problems or obstacles in using multimedia in higher education, there does not appear to be a pedagogical foundation for faculty resistance to the technology.

In fact, the contrary is true. Some students may be better able to learn from multimedia than from any other format. The possibilities of this medium for students with aural or visual learning style preferences are unprecedented. Reynolds and Anderson (1992) describe the relevance of multimedia to three objectives of learning:

- **Cognitive objectives.** Used to teach recognition or discrimination of applicable visual stimuli and audio stimuli.
- **Psychomotor objectives.** An excellent tool to recreate real world conditions.
- **Affective objectives.** Interactive multimedia is very useful in the affective domain. The strength of detailed portrayal of situations and interactive participation of the learner increases its usefulness for affective domain objectives. (p. 201)

Soloway (1993) describes a situation in which, with the help of multimedia, a visually oriented student was able to use images from art to illustrate abstract concepts in physics (pp. 26-27). Livergood (1994) concludes in his research study that while "the addition of multimedia content and methodology to traditional instructional material does not invariably improve test scores of undergraduate students...presenting material in a modified multimedia intelligent tutoring system can significantly improve test scores" (p. 342).

For students with learning difficulties requiring remediation, multimedia may also produce dramatic effects. At Medgar Evers College it has been found that students who are "enrolled in remedial and/or
developmental precollege courses to improve reading and writing skills...often assimilate course material more quickly in an image-rich environment that offers alternatives to traditional, text-based learning” (Fitzgerald & Olsen, 1993, p. 39).

**FACULTY RELUCTANCE TO USE MULTIMEDIA**

On the strength of its pedagogical merit, one might expect a more lively interest among faculty in using multimedia to enhance their programs of instruction. Unfortunately, there are several inhibiting factors which act on post-secondary teachers. First, there is a reputation for conservatism in academic culture which, in many institutions, may be combined with an emphasis on research over instruction. In these circumstances, Taylor (1994) points out that “the process of teaching [is] taken more or less for granted...there has been no significant qualitative change in approaches to teaching in conventional higher education institutions for at least the past 100 years” (p. 179).

Further, some consequences of adopting multimedia technology can be construed as counter to faculty interests in the long term. For example, the application of multimedia to distance education has been welcomed by educational administrators as a means of making resources more widely available without escalating costs. Some faculty have reacted with apprehension, perceiving that if multimedia can be shown to save costs in distance education there may be a general challenge to the value of live faculty instruction. According to DeSieno (1995), there is a fear that “reducing costs with the aid of digital technology translates into reducing the number of faculty and increasing student-faculty ratios”. While it may seem surreal that faculty could be replaced by technology, the perceptions of both faculty and administration are crucial in this matter. Administrators, under pressure of diminishing budgets, may be eager to see multimedia as a solution that will allow them to do more with less. Self-professed computer geek Hunt (1995a) writes that “this is the caustic fallout of the information explosion...the best tool for education is a good teacher, not a good teaching machine” (p. 34). Nevertheless, as long as faculty believe that ‘more with less’ will happen at their expense, and to the detriment of quality instruction, pedagogical arguments in favour of multimedia use will be overshadowed.

Green and Gilbert (1995) address issues of cost at some length, suggesting that multimedia is “productive” in the sense that it enhances learning among individuals who are exposed to it. However, they go on to argue that “calculating productivity gains for any broader universe — even at the level of the individual course — will not show such gains...development costs are quite large if spread over only a few hundred or even a few thousand students” (p. 13). Thus, administrators should not count on cost-saving through development of multimedia instructional resources. Cost recovery depends on developing products that can be sold or leased to other institutions, or products for courses with large ongoing enrollments, (Ekman & Quandt, 1995, pp. 41-2) which may defeat the purpose of local multimedia development.

Even in the case of a successful multimedia product faculty have little cause for worry, according to Green and Gilbert. These authors refer to the A.D.A.M. anatomy software, stating that while it is a useful product for students, and may even recover the costs of its development, “the number of students taught in these courses has not increased; tuition has not increased; nor have the number, kinds, and combination of faculty teaching these courses” (Green & Gilbert, 1995, p. 14). Whatever administrators may like to think, “students will continue to need faculty to provide the conceptual framework and motivation that enable them to seek and integrate new information” (p. 17). If the future holds change for student-faculty ratios, it will be due to other factors, although multimedia technology may be perceived as responsible.

Even if faculty can be assured that multimedia does not threaten them with obsolescence, there remains another line of resistance. Until very recently, it could be fairly maintained that multimedia technology “delivers only what the marketplace provides, and too often those provisions do not meet the local curricular
needs of the faculty and students” (DeSieno, 1995). Writing for *Corel Magazine*, Hunt (1995a) asserts that “virtual reality and multimedia are the ‘dumbing-down’ of communication...where is the content? What are the tangible rewards?” (p. 34).

On a more positive tack, an experienced user of multimedia in instruction argues that “to be really successful, technology has to be adaptable to specific teaching situations, and it has to be personalized for what the instructor wants to do” (“A little classroom magic”, 1994, p. 45). With commercially-produced multimedia, the extent to which such personalization can take place has been very limited. This has meant that the most successful products have been those with the most general applications. Reference works, such as A.D.A.M. or Microsoft’s *Musical Instruments*, are useful at the post-secondary level, offering advantages unique to the multimedia format.

In some cases, the multimedia format adds value to a standard work, giving it new applications for the classroom. This is the case with Voyager’s *MacBeth*, which offers video clips and interactive karaoke. Instructors who are interested in commercial multimedia with good quality content and production should peruse review sources such as *CD-ROM Professional, Library Journal*, or *MacWorld*. Increasingly, too, the catalogues of academic publishers and distributors, such as Harper Collins and Films for the Humanities, are advertising CD-ROM products which may include multimedia. However, the problem remains that most commercial products have relatively little application in classroom instruction.

**FACULTY CONTROL OF THE MULTIMEDIA PRODUCT**

Only in the last few years has it become possible for multimedia to offer the flexibility that faculty require to integrate this technology into the classroom. One instructor who has made use of commercially available multimedia says that he is inclined to “pick this and that and put it together in ways that correspond with what I want to do...I don’t think I would ever really be satisfied with a product right off the shelf” (“A little classroom magic”, 1994, p. 44). The mass availability of multimedia authoring software has had the potentially revolutionary effect of giving control over the production of multimedia instructional resources (courseware) to the very people who may use it to teach. A motivated instructor who decides in favour of the multimedia format can now convert course material without having to learn a programming language [see appendix A for considerations in choosing multimedia as an instruction format]. This is not to say that it is easy to do: even with innovations in multimedia authoring, “faculty must learn to operate sophisticated hardware and software while they sustain mastery of the central issues and pedagogy of their courses” (DeSieno, 1995).

If faculty do become acquainted with the pertinent hardware and software, the time commitment demanded for integration of multimedia may be cause for hesitation. An average estimate for converting one course to multimedia is 150 to 200 hours (Sammons, 1994). Furthermore, those who undertake multimedia development projects are faced with complex legal issues: “all of the audiovisual elements used in a multimedia application—including illustrations, text, movies, video clips, documentaries, music, and software—are protected by copyright. Whenever a multimedia work is published, whether on a CD-ROM, a diskette, or the information superhighway, the developer must obtain the right to use every object in it” (Hofstetter, 1994, p. 28).

Understandably, many instructors feel defeated before they begin when confronted with these considerations. If faculty venture into the realm of multimedia without adequate facilities and support, the apprehension that they initially feel may harden into disillusionment. Sammons (1994) identifies some essential factors in motivating post-secondary teachers to experiment with the new technology: “make equipment available, provide time for faculty to develop material, provide support, and provide easy-to-use hardware and software.” In addition, although the product must be able to reflect the unique requirements of the instructor and course, the production should not be conducted as a one-person show. This notion may be foreign to many faculty, particularly in the humanities where so much emphasis is placed on the product of
the solitary scholar. Yet, in the case of multimedia, the instructional tool frequently may be used without
direct mediation by the teacher. Therefore, emphasis should be placed on coherence and production values,
which are best assured through collaborative effort and skilled use of technology. In multimedia, as in
anything else, “there is nothing more useless than a product that alienates, or worse, annoys its audience”
(Hunt, 1995b, p. 19).

HARDWARE AND SOFTWARE FOR MULTIMEDIA PRODUCTION

It is difficult to make recommendations for hardware for multimedia development that are both spe-
cific and meaningful for longer than a few months. However, two general principles apply in acquiring
hardware for multimedia production: value for cost, and quality in construction and service. To date, mul-
timedia development has posed challenges to memory and processing speed such that it is not really possible
to have too much of either. Accordingly, it is generally wise to invest in as fast a computer, with as much
memory, as the project budget will allow. This consideration should be tempered with that of quality: budget
constraints should not be permitted to compromise the reliability of the equipment, and consequently the
timeline of the project. Hardware should also be selected with reference to the specific requirements of the
development tool.

Choosing the multimedia development tool is one of the most important project decisions. Faculty
should be aware of some key considerations: “development time, distribution, uniqueness of features, tech-
nical resources, and target hardware” (Strauss, 1995, p. 54). At the outset, the prospective multimedia author
should identify who will be using the tool and how much time they have to learn it, what specialized features
the tool should support, what level of support is offered by the vendor, and who will be using the product
and with what equipment. In most cases, faculty will be satisfied with some variety of authoring software.
Typically, authoring software “not only enables the creation of multimedia-based [materials], but it provides
a system to manage the delivery” (Barron & Orwig, 1995, p. 144). These programs are useful for “situations
where one does not envision distributing many copies of the program or a long lifespan for the product”
(Strauss, 1995, p. 55). Authoring systems offer the advantage of being available in a range of complexity and
cost. Generally, more complex and expensive programs such as Macromedia’s Director require a greater
investment in learning the program. At the other end of the range, Microsoft’s PowerPoint or Apple’s
HyperCard allow the user to create multimedia presentations more easily and affordably, but with less
flexibility. The alternative to authoring software is to use a programming language. This is more appropriate
“for applications that will be sold off the shelf, or require some special new features or capabilities” (p. 55).
Before any choice is made, the purpose of the project must be clear: “many projects have gotten into trouble
midway through, when the development tool, originally selected for its ease-of-use, proves inadequate to
accommodate the final design” (p. 55).

Experienced multimedia developers among faculty make diverse recommendations about authoring
systems. For example, multimedia experiments reported from Medgar Evers and City University of New
York in 1993 relied on the IBM-ACIS Advanced Academic software (Fitzgerald & Olsen, 1993). This system
is Windows-based and may be configured with other Windows applications such as CorelDraw and Toolbook.
The users of this system seemed satisfied both with the level of support offered by the vendor and with the
product, which was described as “friendly and responsive” (Wagner & Picciano, 1993, p. 35). Developers at
the University of Southern California, who used the Macintosh-based HyperCard to create a writing skills
program, reported that “the relative ease of programming and the short development time for the courseware
far surpassed everyone’s expectation” (Kalmbach, 1994, p. 30). This software, available since the mid 1980s,
relies on the metaphor of a card stack that can be “bundled in a variety of ways, allowing the user to conduct
information searches hierarchically (as in traditional databases), intuitively, and by association” (p. 30). At the
University of Michigan another Macintosh product, MediaText, has been used to “enable students to
read and write a new class of documents...it provides a set of multimedia components out of which students
construct documents” (Soloway, 1993, pp. 26, 29). Although it is interesting to learn of the diverse applications
of various programs, such reports tend to represent successes and minimize obstacles. While one may look for guidance to the reported experience of other developers, it is important that a project's unique needs together with local conditions weigh most heavily in the selection of a system. It is also wise to consider the future needs of the institution and issues related to compatibility, perhaps setting a standard for university-wide use (Kalmbach, 1994, p. 32).

TEAM BUILDING FOR MULTIMEDIA PRODUCTION

The benefits of collaboration are widely reported by many who write about multimedia production. The University of Toledo established a multimedia development staff to support faculty development of multimedia materials. This multi-talented team consists of the director of Audio-Visual Services, a graphic artist, a photographer, and a support person from Computer Services (Kalmbach, 1994, p. 32). The University of British Columbia's (UBC) Media Resources Network (MRN) allows faculty access to “staff whose expertise in visual and human-computer interface design form the cornerstone for effective and attractive multimedia learning materials.” MRN also undertakes the following objectives:

- enabling UBC to continue moving forward in the combined use of communications and multimedia technology to promote learning
- providing faculty members with training opportunities which will increase the impact of their teaching
- facilitating and coordinating multi-media projects through peer networking
- providing the basis for planning coherent, long-term projects involving most or all faculties
- providing leadership in expanding the high-speed campus network using appropriate technologies such as ATM. (Media Resources Network Homepage, 1995)

Elsewhere, teams have been formed of faculty and/or students from various disciplines who share an interest in multimedia development. At Medgar Evers this “proved to be a great asset...[in] creating unique multimedia modules for use in teaching social sciences and fine arts” (Fitzgerald & Olsen, 1993, p. 38). Faculty who are involved in this sort of collaborative effort can later become valuable resource people. For example, at City University of New York, the Multimedia Courseware Development Program prompted a “faculty software-authoring community to emerge...across disciplines, across eighteen campus affiliations, and throughout the University” (Wagner & Picciano, 1993, p. 33).

The volume of work associated with producing multimedia instructional tools can be overwhelming, especially given the initial investment in learning the technology. Making development practical requires a reconsideration of the solitary way in which many faculty have worked in the past: “We cannot expect greater productivity by asking already over-burdened faculty to work harder. The most effective way to achieve greater results will be through teamwork and imaginative new ways to link faculty (and other academic professionals) into a system of shared effort” (Plater, 1995, p. 29). To exploit multimedia technology effectively requires building and maintaining collegial relations not only among faculty but between faculty and information and systems specialists.

INSTITUTIONAL SUPPORT FOR MULTIMEDIA PRODUCTION

Faculty may come to embrace multimedia for teaching, they may learn to assess and use development technology, and they may join in collaborative approaches to projects. Yet, ultimately, the fate of multimedia development may rest with the adequacy of production facilities, the budget, and the time which the developers are able to commit to it. Unless multimedia developers receive external grants with which to buy
equipment and release time, they depend on the benevolence of their institutions for the success of their projects. Unfortunately, “thus far, personnel committees, curriculum committees, and college administrators have responded minimally...and the result is faculty, particularly junior faculty, are understandably reluctant to experiment with digital technology in the curriculum” (DeSieno, 1995).

Many administrators hope that technology will solve perceived problems of inefficiency in the delivery of instruction. Paradoxically, “the current technology infrastructure at most institutions is so taxed and underfunded that campuses are stretched thin just to support the ‘early adopters’” (Green & Gilbert, 1995, p. 11). M RN at the University of British Columbia “is an initiative of the Deans to advance the use of information technology in teaching, learning and research.” However, it relies on external funding; $2.67 million (Canadian) from the British Columbia government’s Skills Now! Innovation Fund was provided to fund some 30 projects in the first year of operation (Media Resources Network Homepage, 1995). If institutions expect to see local multimedia development initiatives sustained, they must put up or arrange for adequate resources. Sammons (1994) states that “faculty believe it is important to have a strong sense of administrative support for their work.” DeSieno (1995) agrees, advising that this support extends beyond funding:

[C]olleges should support formation of local faculty communities that share experience and provide assistance for mastering challenges of technology and pedagogy. Colleges should encourage educational uses of digital technology that can be assessed for their effectiveness, and that testify, at promotion and tenure time, to one valued aspect of a faculty member’s work...colleges must challenge existing patterns of work and specialization on campuses. They must ask faculty who use digital technology to work with other faculty...colleges must support this cooperation by supplying essential digital resources and expect tangible curricular results.

Green and Gilbert (1995) suggest that, as a foundation, “each college and university engage in an institution-wide planning initiative that looks carefully at the ways information technology can be used most effectively to improve teaching and learning” (p. 17). This is entirely in keeping with DeSieno’s (1995) assertion that digital technology is “too important a resource to be left to accidental development.” The responsibility of “restructuring” for the use of instructional multimedia lies with the leaders and managers of higher education institutions (Taylor, 1994, p. 188).

THE FUTURE OF MULTIMEDIA IN HIGHER EDUCATION

Predictions for the future of multimedia in post-secondary teaching range from the utopian to the dystopian. Some writers anticipate that multimedia will contribute to a revolution in post-secondary education, heralding a collaborative approach to learning: “If we are willing to reconceive the basic learning product, the course, we can also reconceive the faculty role as that of facilitator and guide” (Plater, 1995, p. 28). Perhaps there is little alternative to such a reevaluation, given the present and coming audience for post-secondary instruction. Green and Gilbert (1995) point out that “the computers students have at home...will be newer and more powerful than the systems available to them on campus” (p. 12). Consequently, students increasingly “will have expectations for production quality that are beyond the present capacity of most institutions and [will have] low tolerance for instructional deficiencies” (Plater, 1995, p. 27).

Based on a survey of student assessment information at Wright University, Sammons (1995) finds that “students overwhelmingly supported continued use of the computer in the classroom” (p. 69). This does not at all mean that students will dispense with faculty in the future, for it is already evident that “some students go online with little desire or incentive to study systematically” (Kilian, 1994, p. 18).

While student demand may be an indicator of the need to integrate multimedia technology into higher education, it cannot be the driving factor. Rather, “faculty are key, for they are the people who fuse the substance of their disciplines with the skills and techniques that make digital technology serve the curriculum in depth” (DeSieno, 1995). Once faculty are convinced of the value of multimedia in their teaching, their development initiatives must meet with institutional backing so that they are able to generate products
which are appropriate to local needs. On the side of caution, developers and their institutions should note Hunt’s (1995a) warning that “as more and more people embrace the technology...there will be an artificial need to produce and promote multimedia in a sort of ‘keeping up with the Joneses’ mentality” (p. 34). However, the very reticence of faculty to take up multimedia militates against this eventuality. Their respect for their subject matter is likely to correct any rash enthusiasm on the part of educational planners for a new format. Once convinced of the advantages of multimedia, faculty are well-situated to make exciting use of this educational technology because they are precisely the people to keep “communications goals in sight, using multimedia as a useful tool, and not just a novel diversion. The content is the primary concern, not just the presentation” (p. 34).
APPENDIX A
CHECKLIST OF CONSIDERATIONS FOR SELECTING AND USING INTERACTIVE MULTIMEDIA*

CONSIDER THESE GENERAL ISSUES:

Are qualified instructors for the content hard to find?
Are staff members available with enough skill to program the lessons?
Are students sufficiently motivated to benefit from the planned multimedia application?
Does necessary equipment exist?
Does this approach meet organizational instructional goals?
Is standardized training important?

CONSIDER THESE SUBJECT MATTER-RELATED ISSUES:

Are there considerable variations in student background and experience?
Do topics lend themselves to access as desired by the learner?
Is interactive multimedia necessary to serve most of your curriculum needs?
Is the subject matter proprietary?
Is the subject matter reasonably stable?
Must large numbers of students be trained in a limited time?
Will large numbers of people be trained eventually?

CONSIDER THESE LOCATION-RELATED ISSUES:

Does the organization have limited money for travel and accommodations?
Is decentralized training important?
Is the student population geographically dispersed?

APPENDIX B

CONSIDERATIONS IN CHOOSING MULTIMEDIA AUTHORING SOFTWARE
(from Livingston, 1994)

1. Requirements Analysis. Features and price should not be considered in isolation from such issues as what you are trying to achieve.

2. Lifecycle Costs. It is possible that an authoring system which is initially more expensive than its competitors may yield reduced costs in other segments of the product lifecycle.

3. Product Evaluation. Test how a system deals with the full range of the authoring cycle.

4. Cross-platform Capability. Make sure that the authoring software you pick generates applications that perform well on — and can be easily ported among — the computer and consumer electronics systems that will run them.

5. Program Performance. Authoring systems should be open to new features or extensions added by customers.

6. Developers’ Skills. Have a good idea of who will actually work on the system you select. An authoring system must be appropriate to the skills of its users.

7. Vendor Support. Training, consulting, technical support and other services provided by the vendor are important considerations in picking a system.
REFERENCES


ADDITIONAL READING


