Delivering the new goods—CD-ROMs

Six years ago, when BioScience addressed changes in biology publishing (39:180-183), the word CD-ROM appeared nowhere in the article. Today, the word is on the lips of most scholarly and commercial publishers. There is a tremendous eagerness to have a CD-ROM in hand to either sell or give to science instructors at all levels. Nobody wants to get left in the dust in the race to produce CD-ROMs—even though many in the industry consider them a transitional technology and a financially risky proposition. As Patrick Shriner, supplements editor for W. H. Freeman in New York, puts it, "We're all trying to deal with the technology without going broke."

Estimates on the cost of manufacturing a CD-ROM vary wildly—figures from $200,000 to $4 million have been tossed around. But Denise Schanck, publisher for science in the College Division at McGraw-Hill in New York, says development of a good CD-ROM realistically could cost $700,000 to $1 million. Given that publishers have traditionally used the model of "give things to professors and sell things to students," Schanck says it is unlikely that publishers will make a return on their investment until they have a student market.

"Right now, there is more hype than reality in CD-ROMs," says Stephen King, vice president and director of electronic media for W. W. Norton in New York. "There are fewer CD-ROM drives out there than we'd hoped for, so it remains to be seen whether we can make money."

Even though CD-ROM drives are not commonplace now, publishers are banking their future sales on the growing demand for personal computers—in 1994, more personal computers were sold than televisions—and the presence of CD-ROM drives in most new equipment. Last year, Dataquest Incorporated, a market research firm in San Jose, California, predicted that on a worldwide basis 36.6% of all desktop computers would be connected to a CD-ROM drive by 1996. In 1993, there were an estimated 8.8 million CD-ROM drives installed; next year the figure is expected to be 57.1 million.

How these figures translate into CD-ROM drives at educational institutions is unclear. No one interviewed said he or she had a sense of how many were available at colleges and universities. While some institutions do have lecture halls with the finest multimedia projection systems, it cannot be taken for granted that most large institutions are equipped for CD-ROMs. For instance, at the University of Wisconsin-Madison, where 1500 students per semester take introductory biology, there are no CD-ROM drives for either faculty or student use, says Warren Porter, chairman of the Zoology Department there. "Most campuses are in dire straits financially, and the overhead money is just not available to buy teaching equipment," says Porter. "There are high schools with multimedia labs that make us envious."

Forbes, meanwhile, in its 17 July issue, painted a gloomy picture for elementary and secondary schools when it reported that there is, on average, less than one CD-ROM per school in the United States. It estimated a cost of $31.5 billion to buy computers and software and to train teachers nationwide.

Whatever the real picture, publishers perceive that the instructors in lower grades, particularly high school, are better equipped to use the technology. Money may be tight at all levels of education, but the funding criteria for public school education is leaning toward technology, so schools do have grant-application options, says Randal Merriman, vice president of multimedia for Holt, Rinehart and Winston, Inc. (Austin, Texas), which publishes a CD-ROM for high school teachers.

Publishers also say that teachers in lower grades are more comfortable with using an array of technology in teaching. As one publisher says, "They are not locked into the 'sage on stage' mentality."

Attitudes more than money sometimes provide roadblocks, says Andrew Sinauer of Sinauer Associates in Sunderland, Massachusetts. People in colleges and universities say they are interested in CD-ROM technology, but few individuals want to expend the time and energy it takes to learn how to use them effectively in lecture presentations. "One has to be passionate to teach using this kind of technology. The huge courses with a need for the technol-
ogy are team taught. Generally, no individual in the team has a great enough stake in the course to learn how to use them,” Sinuier says.

According to Tommy Humfrey, manager of Education Interactive Imaging, a CD-ROM company in the United Kingdom, the United States is lagging behind Europe in the introduction of CD-ROM systems. By the end of 1995, it was the UK government’s intention to have a CD-ROM system in every school, he says. Not every school may have one by year’s end, “but the user base is so large that the few not having systems are negligible.”

Like education watchers in the United States, Humfrey says schools at the lower levels are better equipped in terms of multimedia than is higher education. With educational funding changes, “we should see UK higher education catching up,” he says.

Along with the increased availability of drives, there has been a proliferation of CD-ROMs. The Software Publishers Association reported that sales of computer software programs on compact disk reached $648 million in 1994 on sales of 22.8 million CD-ROMs. Sales of content products—encyclopedias and references—accounted for $156 million, while home education CD-ROMs earned $106.6 million.

As with hardware, there is no breakdown available describing the CD-ROM-buying patterns of educational institutions. For those interested in biology content, there are scholarly journals, reference materials, and what is called edutainment in CD-ROM format available. Only a few college textbook companies have a CD-ROM available, but many have at least one in planning or development.

Despite the hoopla about electronic media, publishers have no intention of consigning textbooks to the refuse heap. The immediate accessibility and portability of the printed page is still attractive and familiar. There is also a consensus among the publishers interviewed that, if text works for conveying certain kinds of information, why mess with a good thing?

Educational publishers should not be turning themselves into multimedia companies for the sake of doing it, says Robin Heyden, executive producer at Benjamin/Cummings Publishing in Redwood, California. “The art in the publishing business comes from deciding what medium works best for conveying particular kinds of information.”

So, why the fuss?

What is so special about CD-ROMs? They are not linear, say their producers. Unlike textbooks, where one fact marches sensibly behind its predecessor, CD-ROMs offer more opportunity to poke around in different formats. Along with text, one CD-ROM might contain graphics, animations, simulations, sound, and video clips. This true multimedia approach gives publishers a chance to create an experience completely different from what you can get from books, says Joe Fuller, director of marketing at A.D.A.M. Software in Atlanta, Georgia.

Instead of rendering three or four static images in a book and having instructors contort themselves into human pretzels in front of a class to explain a process, publishers say multimedia allows a student or teacher to use a learning tool appropriate to the material. Students can interact with the CD-ROM, altering parameters in simulations of biological events, for instance, to see how different variables might alter outcomes. Animation might better explain a complicated subcellular action like transcription. Students could self-test themselves. Not only can a student fiddle with the CD-ROM individually, instructors can use CD-ROMs on a network, hooking in students who may be at different stages academically.

For James Gould, who teaches in the Department of Ecology and Evolution at Princeton University in New Jersey, “CD-ROMs are a way to make my teaching easier.” In collaboration with his son Grant, a student at the Massachusetts Institute of Technology, Gould developed a CD-ROM to accompany the sixth edition of his textbook *Biological Science*. The disk should be available in January from W. W. Norton. “My students get assaulted with it this fall,” says Gould.

However easy the CD-ROM might make teaching, it was not easy to produce, particularly the simulations of processes, Gould explains. “It is always a problem trying to illustrate something dynamically, but Grant’s view was that ‘if we can imagine it, we can program it.’”

Because a CD-ROM can store 700 or so megabytes, it is a highly portable way to carry around a lot of visual and sound presentations. “Five minutes before going to class, I can completely change the visuals for a lecture,” says Gould. Using the technology also strikes a chord with students “who are far more visually oriented than the students I started with 21 years ago.”

The other use of CD-ROMs is as a mass storage vehicle for huge amounts of text and numbers. Encyclopedias, dictionaries, databases, and other references are ideally stored on them. McGraw-Hill’s CD-ROM *Science Navigator 3.0*, a combination encyclopedia and dictionary of science, is among the products that have been well received for use by the general public. Springer-Verlag and Academic Press likewise are producing, respectively, a biodiversity database and *Methods in Enzymology*, the massive workhorse reference for biochemists, in CD-ROM format. This sum-
An innovative, information-filled CD-ROM called Find It! Science—designed for a young audience—is scheduled for distribution later this year. It contains a database on 3000 children's science books—including descriptions of the books' contents, authors, length, and reading level; summaries of critics' reviews of each book; and pictures of the book jackets. With appealing graphics, the database can be easily accessed by children. It was developed with National Science Foundation funding by educator Wendy Saul at the University of Maryland-Baltimore County.

One corporate approach to multimedia

"The struggle with textbooks always is showing how things change over time," says Heyden. "So when Benjamin/Cummings decided three years ago to shift from being a publisher of textbooks to becoming a publisher of educational information, it decided to query students and teachers to discover what posed learning problems. There was surprising unanimity among them about which processes in physiology were hard to teach and to learn."

To deliver physiology in a way that focused on visualizing processes like cardiac output and the regulation of blood pressure, Benjamin/Cummings hooked up with A.D.A.M. Software, recognizing that the traditional textbook publisher did not then have the capability in-house to produce electronic media. (Addison-Wesley Publishing Co., Benjamin/Cummings's parent company, owns a stake in A.D.A.M.) "As the publishing industry transforms itself, companies will have to form strategic alliances," says Heyden.

A.D.A.M., which stands for Animated Dissection of Anatomy for Medicine, is an outgrowth of a medical illustration company that serviced lawyers who needed graphics in court. When A.D.A.M. formed in 1990, the company decided to render the human body on computer, and it made dissection the core of its education program, says Fuller.

"Remember the transparencies of the body you used to look at as a kid. Each one you turned showed different layers of the body. Well, we're taking transparencies to the nth degree," says Fuller. A team of medical illustrators spent three and a half years drawing the layers of a male and a female human body that would be turned into software. The company's idea was that users of an A.D.A.M. CD-ROM would point, click, and be able to peel back 40 or so digitalized tissue layers.

Depending on the level of complexity desired, an instructor can opt for multimedia software that includes up to 20,000 structures in the body. This level is currently used by medical schools to teach anatomy, says Fuller, who adds that 80% of the nation's medical schools have A.D.A.M. software.

For the allied health market, A.D.A.M. and Benjamin/Cummings together are creating Interactive Physiology with Elaine N. Marieb of Holyoke Community College in Massachusetts and Marvin Bronstrom of Cananda College, Redwood City, California. Marieb, who is the author of Benjamin/Cummings major anatomy and physiology textbook, Human Anatomy and Physiology, 3rd edition, shows up at various points on-screen in the modules already developed—cardiovascular and muscle—to get students through difficult parts.

Besides its ties to Benjamin/Cummings, A.D.A.M. works with other companies, including Churchill Livingstone, the London publisher of Gray's Anatomy. "The value in hooking up with a publishing house is they know where to market educational materials, and they provide a check on content," says Fuller, who believes a product without strong content is not worth selling.

The reviews in the popular press of A.D.A.M. products aimed at the general public have lauded the company for its attention to content. When PC World reviewed the CD-ROM A.D.A.M.: The Inside Story last November, it described it as an "entertaining, interactive production that gets you interested in the workings of the human body" while remaining scientifically accurate. Adam and Eve, the thoroughly modern couple depicted on the CD-ROM, go through their lives dealing with physical problems and curiosities that have a biological basis. The user can search the body systems of the two characters to answer their own questions.

Developing content for a nonacademic audience is sometimes tricky because of the breadth it must encompass, says Fuller. For instance, in their family product Nine Month Miracle, a CD-ROM on pregnancy, there is a spot where a young child could fiddle with exaggerated traits on the on-screen mommy and daddy to get a sense of what the new baby coming into a family might look like. The mother in the family could explore the physical changes she is likely to go through each trimester.

"This sort of thing also poses a lot of potential hot buttons that we pay attention to in focus groups" that try out the program, says Fuller. The company, he says, stuck to medical facts, avoided abortion issues, and provided options that limit access to certain sections such as conception. Fig leaves cover genitalia on the male and female bodies, "a practice that some professors laugh at us for," says Fuller. "If parents want to remove the discretion locks
and leaves, it’s up to them.”

When putting the content for a particular subject together on a CD-ROM, concepts of pedagogy cannot be ignored, says Fuller. People assume that interactive media are completely random, but they cannot be, because people do not learn in a completely random way. Material has to have some organization. In the case of Nine Month Miracle, information was organized roughly by month.

Developers of CD-ROMs also have to be sensitive to people’s paradigms for getting information. For instance, because a traditional book index is something people are familiar with using, A.D.A.M. included one in Nine Month Miracle, says Fuller.

A shortage of material

Despite all the buzz, Shriner says, “At the college level, there is a real dearth of good electronic teaching material.” He thinks the greater availability of such media in grades K through 12 is something that should worry science educators at higher levels. This viewpoint is shared by Susan Veccia, editor of MultiMedia Schools.

“More and more students are coming through who are attuned to using electronic media,” Veccia says. For some students, interactive media may be an ideal way to learn. According to Veccia, there are some anecdotal studies that indicate that younger students who are not superachievers academically can get quite motivated by electronic media, but “we don’t yet know how older students do with it.”

“CD-ROMs are about as good as it gets for storing a lot of images for interactive use,” says Tom Terry, an associate professor of molecular and cell biology at the University of Connecticut in Storrs. He, like some other academics interviewed, is comfortable with using multimedia and electronic communications in teaching. But he does not use CD-ROMs yet because he has not found one appropriate for his teaching. Instead of CD-ROMs, he says, his department is experimenting with using the World Wide Web for a microbiology class. Other departments, including non-science ones, at the university also have “virtual classrooms,” he added. “The great advantage of the Web is that information can be changed everyday.”

A number of publishing executives are carefully following what kinds of educational material academics are putting on the Web. King, for instance, says, he “looks for talent there.”

Like many in the publishing field, Michael Jensen, who is in charge of electronic media for the University of Nebraska Press in Lincoln, views CD-ROMs as an important transitional technology that will eventually be superseded by on-line access. “The press has put a lot of eggs in an on-line basket, but for at least the next five or six years it will continue to do CD-ROMS,” says Jensen.

“To switch to an on-line method of information delivery where you charge for access instead of ownership [of an object] is going to be a major change in philosophy,” says Jensen. He believes “publishers have glommed onto CD-ROMs because they are objects that can be sold. They fit the publishers model that ‘we have x number of items in the warehouse to be sold.’”

“The method of the future is on-line delivery,” says Heyden, who notes that already all of the support materials for Benjamin/Cummings computer science books are available on-line. Other companies like Academic Press do the same for certain products.

Just how much the Internet could interfere with the viability of CD-ROMS is unclear. Those who predict that the Net will be the end of CD-ROMS sometimes forget that most Net connections are limited by bandwidth, says Robert Hall, vice president of the educational division at Videodiscovery, Inc., in Seattle, Washington. For now at least, as a teaching tool, downloading visuals takes too long on the Net to hold people’s attention.

It may turn out that publishers in the future will not have to choose between CD-ROMs and the Web. Companies like America Online are forming partnerships with their information providers to create hybrid CD-ROMs that would combine multimedia content with on-line connections.

Upping the ante

Publishing experts say part of what is leading publishers in the CD-ROM direction is the competitive game of providing a “complete package” to one-up the competition when marketing new textbooks. Now companies provide professors with free software, worksheets, testing materials, and other ancillaries completely separate from the textbook. Already, developing a big introductory biology textbook may cost more than $1 million, with ancillaries representing sometimes a quarter or a third of costs. To break even, a company may have to sell 25,000 to 30,000 copies of the book to students.

If a company decides to make a CD-ROM to accompany a book, it may have some of the content, but it still has to pay for the design of animations and simulations, and sometimes an additional set of permissions. The cost of royalties for authoring tools, the software that helps CD-ROM creators link all the pieces together after the text, visuals, and sound have been put in digital format, can also be costly, says Jensen. The development costs are also unlikely to decline over time as people continue to expect fancier CD-ROMs.

“What if you decide to develop a book and a CD-ROM, and they have to share the same market? The plant costs for the two may be greater than their combined profit,” says Bill Lindsay, assistant director and chief financial office of Harvard University Press.

Industry watchers say it is unclear whether increased production costs could be recouped without a student market, which already is paying out huge amounts of money for books each semester. Professors’ expectations will have to change if CD-ROMs are to be profitable in the short-term while the student market is developing, publishers say. “Publishing companies have built their own beast. We’ve run ourselves ragged by raising the stakes by continuing to give away so much for free. We are going to have to draw a
Recipe for CD-ROM success

To make it from development to commercial success, companies aiming at educational and general markets are going to have to do certain things. First, they must make only products that are novel, content-rich, and easy to use. “Shovelware—products that put text and clips together roughly—is just not going to make it,” says Fuller. “The ‘Book-on-CD’ Approach will also fail,” speculates Merriman.

Second, they must change their product marketing and selling strategies. Some companies are accomplishing this task by marketing to large bookstore chains as well as computer stores. They believe materials based on content have a better chance of sales in bookstores, because the competition for shelf space is much fiercer in computer stores. “We also need to find the professors who are most likely to use technology in teaching,” says Sinauer. This task is no easy feat, adds Heyden, who says textbook sales at the university level are made “going door to door, one professor at a time.”

Third, companies must watch the timing of market entry. For educational publishers, timing CD-ROMs to coincide with the textbook adoption cycle is critical, explains Merriman. For companies that market to general consumers, proper timing means getting into the stores in the months just before the holiday rush, says Hall, who notes that even good products may only last on computer store shelves for 6 to 18 months. Science Sleuth, Videodiscovery’s CD-ROM that requires users to use the tools of a scientist to solve biology-based mysteries, was not ideally timed, he says. (The product came out after the holidays.) This fall, Videodiscovery is releasing Jake’s Attic, a physical science CD-ROM for youngsters, based on a Fox Television character.

Fourth, traditional companies should not underestimate the stiff competition education will provide. Hall, who taught for ten years and worked for two major publishers before going to Videodiscovery (which was formed by an expert in curriculum development), explains, “Companies like Microsoft and Disney are out there in the field.” As more school districts make more decisions at the local level, and there is less of a central authority in determining curriculum, he sees more teachers moving away from the traditional textbook. “They’re looking for other resources. More site-based management might mean schools want more innovation in what they use,” he explains.

Fifth, focusing on what is educationally necessary and doing as much as possible in-house are critical, says Humfrey, whose company concentrates on photomicrographs on CD-ROM. Because animations and simulations, for instance, are not needed to illustrate the material, they are not used. Education Interactive Imaging already has products in 3% of British schools. Unlike most CD-ROM producers, the UK company is profitable.

“There are a few production groups like ourselves that are in fact doing well,” says Humfrey. “The secret is simple; keep production overheads low, make sure of your product’s target market—this most basic of principles seems to have been forgotten by the CD-ROM industry—and keep distribution simple.”

Acknowledgment

I thank the many book publishers and consultants who talked with me about publication of CD-ROMs.