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PUBLISHING

Going digital

Creating electronic textbooks requires ingenuity, teamwork and multimedia savvy.

BY ROBERTA KWOK

Douglas Emlen is hard at work on an evolution textbook. But this is not just a print book. Creating an iPad app with images, audio and video clips, and interactive graphics and exercises has meant collaborating with designers, programmers and an artist on a digital version of the book.

Emlen, an evolutionary biologist at the University of Montana in Missoula — who is co-writing the book with Carl Zimmer, a science writer based in Guilford, Connecticut — is part of an emerging group of scientists navigating the world of digital textbooks. The idea of electronic instructional materials is not new: texts in e-book form, as well as online supplements, teaching tools and homework systems have been available for years. But as tablets and e-books become more popular, publishers are increasingly placing equal or greater importance on the digital product rather than considering it as an add-on to the printed book. Some publishers are moving towards electronic-only textbooks. A survey released in March by the Pearson Foundation in Mill Valley, California, which promotes literacy and education, showed that the proportion of university students who own tablets grew from 7% in 2011 to 25% in 2012. More than two-thirds of university students have used a digital textbook, the survey says, and more than half prefer the digital format to print. The increasing popularity means that authors must consider the digital vision of the book when coming up with an idea and work with diverse teams to weave together text, multimedia and interactive exercises and quizzes.

"The role of an author in the past was, 'Let me write a big manuscript and mail it in to you,'" says Kurt Strand, senior vice-president and chief product officer at McGraw-Hill Higher Education in Dubuque, Iowa. Now, the author provides the vision for the complete learning experience, he says.

Authors must consider the most effective use of multimedia, adapt to the changing structure of textbooks and be flexible in response to feedback from user-testing. Although the financial reward of such projects remains uncertain, some digital-textbook authors have found satisfaction in exploring alternative ways to teach concepts and potentially improve their connections with students.

The first electronic textbooks were little more than replicas of the print versions. But, with the release of the iPad, greater Internet bandwidth in schools and a growing popularity with students, textbooks with more interactive features are emerging. In January, Apple announced the release of its iBooks 2, an app with improved support for digital textbooks, and announced that three major publishers would sell their textbooks through its online shop. Inkling, a start-up company in San Francisco, California, now has more than 100 digital textbooks available through its iPad app and will soon make them available through web browsers. And in February, the US Federal Communications Commission in Washington DC urged schools and companies to supply all primary and secondary education students in the United States with at least one digital textbook within five years.

The shift from print to digital textbooks is happening very quickly, says Morgan Ryan, project director of *E.O. Wilson's Life on Earth*, a digital-only biology textbook being developed by the E.O. Wilson Biodiversity Foundation in Chapel Hill, North Carolina. "There's this feeling that it's finally arrived," he says.

Sceptics warn that students may become lost among, or distracted by, some of the ▶

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electronic bells and whistles. Nevertheless, publishers are taking the plunge, and they are expecting authors to have an active role in shaping the product.

A DIGITAL VISION

Even as textbooks shift to a different medium, publishers say that authors still need to understand the challenge that they have taken on, and to have an effective, classroom-tested approach to teaching. "I have had authors come forward and say, 'My distinguishing feature will be that this book will be digital'," says Kaye Pace, a vice-president and executive publisher in the global education group at John Wiley & Sons in Hoboken, New Jersey. "I don't think that works. You have to start with, 'What is the issue that you're trying to resolve?'"

Proposals to publishers should include ideas for multimedia and interactivity. Although publishers generally don't expect authors to provide app prototypes or refined illustrations, they do want specific concepts that can be executed by the publishing team. Storyboards are often sufficient. Authors may not ever learn all the ins and outs of three-dimensional graphics and programming, but they do have to think about how the medium is going to be used, notes Ryan.

Some authors are planning graphics and interactive elements up front, instead of writing the text first and deciding which multimedia to add later. "The digital product becomes much more of a teaching tool than a way of illustrating in some visual form what the words are saying," says Eric Schulz, a mathematics instructor at Walla

Inkling founder Matt MacInnis says authors need to think of new ways to communicate with learners.

Walla Community College in Washington, who created roughly 650 interactive figures for a calculus textbook (published in 2010 by Pearson).

But authors also need to be aware that multimedia and interactive elements are expensive to produce. The amount of money available will depend, in part, on the size of the potential market: an introductory economics textbook, for example, will probably have a larger budget than a niche upper-level textbook about community ecology. Nonetheless, some publishers encourage authors to start with a grand vision. "I'd rather start there than get something that's less exciting," says Ben Roberts from Roberts and

Company Publishers in Greenwood Village, Colorado, which is publishing Emlen and Zimmer's book. Elements can be discarded later if need be.

RECONCEIVING THE TEXTBOOK

Cost and time considerations are not the only reasons to use multimedia judiciously. "Students aren't going to learn more just because you throw a whole bunch of videos in there," says Emlen. Instead, authors should carefully consider which method would be most appropriate for achieving their instructional goal. For example, David Johnston, a marine biologist at Duke University Marine Laboratory in Beaufort, North Carolina, and project leader of *Cachalot*, a self-published digital textbook about marine megafauna (see 'Self-publishing'), says that it makes sense to use a picture to show the features of a penguin's tongue and an audio clip to demonstrate the noises in echolocation, but to illustrate the rate of sea-ice decline, a two-dimensional graph could suffice. And complex material, such as a set of equations, may be difficult to learn if it is presented only in a transient format, such as animation.

Opinions differ on how large a role the text should have compared with graphics, animations and interactive features. "I often see too heavy a reliance on expository text," says Matt MacInnis, founder and chief executive of Inkling, noting that Inkling's data suggest that learners skim, search and refer to text instead of reading it. "Find ways to be brief and multimodal rather than expository and textual." For example, the next iteration of WileyPLUS, Wiley's online teaching and

SELF-PUBLISHING
A time-intensive project that may not be for everyone

With the release of Apple's iBooks Author e-book authoring app and the ability to distribute mobile apps easily, obstacles to self-publishing a textbook continue to fall. But is it a good idea? It may be, for those who have the time to invest in an intensive project and to oversee everything from art to marketing.

Self-publishing proved to be a satisfying option for David Johnston, a marine biologist at the Duke University Marine Laboratory in Beaufort, North Carolina. Publishers turned down Johnston's proposal for a digital textbook about marine megafauna. So he got a grant from the Duke Center for Instructional Technology, recruited computer science students to write an app, solicited text from about 30 experts and assembled multimedia from scientists, National Geographic's Crittercam and the Woods Hole Oceanographic Institution. Within a year, his team had released an iPad app, *Cachalot*, which offers multimedia-enriched entries about marine animals, open-access articles and teaching modules. "If you're a creative individual and you have time, then it's a great way for you to get across the ideas that you want," says Johnston.

Cachalot has been downloaded more than 3,500 times, and three universities have expressed interest in using it. The app is free, so the project has certainly not made Johnston rich, but he says it has allowed him to connect with other experts in the field through

their contribution to the project, brought him recognition within his department and prompted the marine lab to consider buying iPads for students to use.

But self-publishing authors take on a heavy burden. They must fill in services that publishers would provide, such as editing, art, design, programming, marketing, sales and customer service, says Morgan Ryan, project director of the digital textbook *E.O. Wilson's Life on Earth,* which is being developed by the E.O. Wilson Biodiversity Foundation in Chapel Hill, North Carolina. The amount of time and money needed depends on the scope of the project. An author who writes the text and uses free multimedia could publish a textbook using iBooks Author essentially for free. Johnston, who focuses on a very specific topic and gets help from students and colleagues, says that he spends about five hours a week on *Cachalot* and so far has been awarded US$15,000 in grants. Hiring professional contractors could run into the tens or hundreds of thousands of dollars.

The decision may boil down to whether an author is willing to be a manager and publisher. "You're going to have to put on a hat that you're probably not used to," says online-teaching tool developer Dan Johnson, a senior biology lecturer at Wake Forest University in Winston-Salem, North Carolina. **R. K.**

learning system, will 'chunk' material into concept modules and avoid long passages of unbroken text. But that doesn't mean all writing must be condensed into Twitter-sized bites. "It's going to come down to the writing, regardless of whether it's in electronic format or on paper," says Emlen.

The structure of textbooks is also in flux. Digital textbooks are becoming increasingly modular, as many publishers are selling individual chapters and allowing teachers to build customized versions. Some textbook producers are also migrating towards more open-ended navigation in which students can skip to topics rather than follow the linear ordering used in print. "Think about it as building a big website as opposed to building a book," says MacInnis. This approach may not work for every subject; trigonometry, for example, requires some linear progression.

Once a publisher has accepted the concept, the author needs to guide the publishing team that will execute the idea. Authors have to be at the centre of the creative process, says Roberts. "There will be animators, developers and instructional designers all trying to get their calling orders from the author." Authors must clearly communicate their vision and be prepared to iterate it as elements such as artwork and simulations are developed. And, because publishers are still working on the best approach to digital textbooks, authors also need to adjust their vision in response to feedback from testing with potential users. Compared with print textbooks, the authors have to be much more flexible and more attentive to the learner, says Strand.

Aspiring authors should use existing science apps and digital textbooks. They can get their feet wet by being a reviewer for one or authoring a component of a digital textbook or online learning system, such as a module, simulation, case study or assessment questions. For example, about 40 authors and reviewers worked on the digital *Principles of Biology* textbook from Nature Education, a division of Nature Publishing Group, which publishes *Nature*. And authors should consider teaming up with a multimedia-savvy partner, especially if the person is also an expert in their subject area. Graduate students may already have those skills, says Ryan.

In the end, authors should not get distracted from the core task of trying and validating better teaching methods. What makes a great author has not changed, says Susan Winslow, a publisher for life sciences at WH Freeman in New York (WH Freeman is owned by Macmillan, which also publishes *Nature*). "They're capable, in any medium, of connecting the dots for a novice." ■

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TURNING POINT
Mark Lawrence

Atmospheric scientist Mark Lawrence was named scientific director of the Institute for Advanced Sustainability Studies in Potsdam, Germany, last October, after a 19-year research stint at the Max Planck Institute for Chemistry in Mainz.

What drew you to Earth and atmospheric sciences?
I intended to study medicine at university, but after learning about the realities of being a doctor, I decided to move into basic physics. Towards the end of my undergraduate studies at the Georgia Institute of Technology in Atlanta, I spent a couple of semesters at the tyre manufacturer Michelin working on cutting edge car-suspension systems and ways to analyse how roads affect car tyres. However, I realized it was important to me that my work had a societal impact, so I switched to Earth and atmospheric sciences, which gave me the chance to combine broad aspects of physics as well as chemistry, and even some topics related to biology. It was an intellectually challenging science.

How did you end up in Germany and why have you stayed?
I wanted to see the world, and Germany seemed to be a good place because my now-wife was heading back to Germany to finish her studies. I had a US National Science Foundation graduate fellowship, so I contacted the then-director of the Max Planck Institute for Chemistry, atmospheric chemist Paul Crutzen, who agreed to supervise my thesis. I had planned to return to the United States after my PhD, but Paul jointly won the Nobel Prize in Chemistry in 1995 for his part in work on the ozone layer, and he persuaded me to stay at the institute for a postdoc, studying atmospheric models and the pollution outflow to the Indian Ocean — preparation for the 'Indian Ocean Experiment'. At the same time, qualifications started to take priority in German academia, and it became easier for young researchers to progress. In 2000, I won a grant from the German Federal Ministry of Education and Research to lead a junior research group — a five-year funding opportunity for young scientists seeking to establish themselves in the field — focused mainly on large-scale atmospheric pollution in the tropics, especially Asia.

How did you get your new post?
Through Paul, I met Klaus Töpfer, founding director of the Institute for Advanced Sustainability Studies. I gave him some of my climate papers to read, and he later invited me to Potsdam. The research collaboration grew from there. When the institute started looking for a scientific director, I was fortunate enough to be the right person in the right place at the right time.

My group is focusing on how humans are modifying the composition of the atmosphere and how this affects human life — for example; how ozone, methane and soot modify the composition of the atmosphere. We hope to find ways to make our modern lifestyles more sustainable by reducing pollution.

What is your secret for success?
I have a passion — I want to make a contribution to society through science. My job is more of a calling than a career. Honest self-analysis is important for professional success. We are very good at analysing our environment, but we should also look at ourselves and ask, 'What are our personal strengths and preferences, and where can we make a difference?'. Students should figure out what they can really do well that will make a positive contribution.

How do you juggle your work and personal life?
I spend weekends with my wife and children in Mainz, but my weekdays are concentrated on work. To focus, I usually get up early, meditate, go jogging and take a cold shower. Then I work until midnight. I find it is sustainable — the magic word — only if I keep my focus on my scientific contributions rather than on my career accomplishments, such as publication and citation numbers. ■

INTERVIEW BY ALEXANDRA BELL