

In the digital age, physics students and professors prefer paper textbooks

Whether electronic textbooks become more popular may depend on making them more interactive and user-friendly.

Physics departments in the US have generally been early adopters of classroom technologies, including interactive online simulations and multiple-choice clickers that let students answer questions in real time. So it may come as a surprise that electronic textbooks are not gaining much traction in the discipline. Most students and faculty prefer to stick with print textbooks, for reasons that range from design problems with the current generation of e-textbooks to greater familiarity with paper books. If publishers want their e-textbooks to compete, they may need to rethink their approach to copyright protection and integrate innovative features that give electronic books clear advantages.

With e-textbooks, readers can—at least in theory—easily enlarge or shrink the text, use built-in dictionaries, and access the book from any electronic device. The price is also right: Most e-textbooks sell for roughly one-third to one-half the cost of a new hardcover print textbook. For example, the popular introductory textbook *Physics for Scientists and Engineers with Modern Physics* by Douglas Giancoli (Pearson, 4th edition, 2008) has a list price of \$326.00; the e-textbook version lists for \$115.95.

And e-textbooks are more portable than their physical counterparts. Giancoli's tome weighs in at more than 1300 pages and nearly six and a half pounds. Saad Najmi, a physics major at the University of Texas at Austin, chooses e-textbooks for that reason. "I like to have nothing but my laptop in my backpack, and not having to carry large physics textbooks is a big plus."

But most physics students prefer print. Among them are Josh Tawabutr, a 2017 Harvey Mudd College graduate who double majored in physics and math. "I like to annotate when I read," he



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says. "Annotating is most convenient to me on paper."

Peter Shawhan of the University of Maryland, College Park, uses Giancoli's book when he teaches introductory physics. He incorporates several electronic tools into his course, including interactive simulations supplied by the textbook's publisher and clickers. Still, Shawhan advises his students to buy the physical textbook; previous classes have found the electronic version difficult to navigate. "A real book is high resolution, and you can flip through it easily," he explains, while electronic textbooks often require readers to wait for the next page to load.

Why print is still king

Caroline Myrberg, an electronic resources librarian at the Karolinska Institute in Stockholm, says that physical textbooks maintain certain advantages over electronic ones. "Books have a static layout. Something that you read at the top on the left-hand side will always be at the top on the left-hand side, and that aids the memory."

Training and familiarity may be another key to people's reading preferences. The latest research, Myrberg says, has shown that readers who routinely use e-books retain information just as well as when they read print books. But most students are still taught using print books. "As long as reading on paper is the default for schools, it will be the default for students."

Data on e-textbook use can be hard to come by. PHYSICS TODAY contacted a handful of academic publishers for this article; all declined to share information about their physical versus electronic sales. But there do seem to be differences among disciplines. A 2014 survey by the University of Kansas found that the physics and astronomy department had one of the lowest rates of e-textbook adoption at the school. More than 80% of physics students and faculty members surveyed said they prefer physical textbooks to electronic ones.

That was a notable contrast with mechanical engineering and molecular biology, where only half of students pre-

ferred print, and the university's pharmacy school, where fewer than 30% of students chose print. Courses in the pharmacy school regularly assign textbooks that are only available electronically, which likely increases students' comfort with the format.

Myrberg says that the desire for correct, readable equations may be another reason why e-books are unpopular in physics departments. Although physicists have for years relied on websites like arXiv.org to circulate electronic preprints, she says, "their experience has been that equations aren't necessarily accurate" when a book or journal article designed for print is turned into an electronic document.

Access woes for readers

Another obstacle to e-textbook use has been the digital-rights management systems that publishers use to prevent e-books from being copied and distributed for free. Many e-textbooks can be downloaded only once and cannot be copied to a second device, even by someone who has legally purchased the e-book. Some academic publishers require students to download proprietary software or apps to use their e-books. Others do not allow downloads at all; instead, they ask students to create an account on a website and read the e-textbook in a browser window while connected to the internet.

Such restrictions are often inconvenient for students and faculty members. Najmi expresses frustration with e-textbooks that can't be downloaded to his laptop. Shawhan finds the electronic version of his introductory course's textbook cumbersome; it has to be viewed in a Web browser and does not allow students to view full pages in high resolution, so the equations are difficult to read.

Kate Hill, the electronic resources librarian at the University of North Carolina at Greensboro, says that requiring specific software to use a book makes e-books unappealing to readers. "That's so many steps. A lot of users, especially undergrads, will say, 'I'll go find an alternate book to use.'" Requiring a login or an internet connection can also be annoying for readers, she says. Students may forget passwords or find themselves locked out of their textbook's account, "and therefore turn away from the

use of e-books because they consider them unpredictable."

A brighter future for e-textbooks?

The route to success for physics e-books may be to incorporate interactive simulations that allow students to conduct virtual experiments immediately after reading about a new concept. Such features, however, are expensive to create. The popular PhET Interactive Simulations developed at the University of Colorado Boulder, for example, cost more than \$2 million per year to design and maintain, according to director Katherine Perkins.

Publishers may be able to overcome the cost barrier by partnering with companies that specialize in simulation programming, rather than trying to build their own interactive features from scratch. "We are creating an enhanced version of PhET that allows companies to customize the simulations," says Perkins. As coding becomes more flexible and stable, and as students become more familiar with e-reading, "we see a lot of opportunity for integrating simulations" into electronic texts.

Myrberg says that rotatable three-dimensional images and other interactive features have made digital anatomy databases popular among medical students at her university. "The databases do the same thing as print books, but in a better way," she says. "But we don't call it a book because it's so different from a print book."

Despite existing barriers, Myrberg says, "I'm really hopeful that e-books will be a lot better in the future, with more benefits for the reader."

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