

Paper presented at the SaGES 2015 Conference

Re-imagining Textbooks for Surveying and Geomatics Education

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Abstract

Rapidly rising costs in post-secondary education, while at the same time society is requiring greater credentialing for jobs and professional registration (it has been estimated that nearly 30% of US workers need a license to perform their job), adds to the growing cost of higher education. Textbooks are part of that spiraling increase in costs. Modern technology has allowed publishers to make the release rate of new editions faster, while printing costs have dropped. But the price of textbooks continues to increase, while the lifetime of textbooks shortens. Most textbooks seem to operate on a 3-year edition cycle.

A comparison of textbook prices to regular books of comparable size and complexity suggests an inequity. Relatively little of a textbook's retail price makes it to the authors; most remains with the publishers and distributors. Printing has become more automated and efficient, and so its margins are being squeezed. Yet the price of textbooks has risen faster than inflation for several decades, adding to the financial pressure on the wider community. Unsold textbooks have to be returned to the distributor, and the cost of this is added to the initial cost of the book.

Students buy textbooks now more as a burden to be endured than as an addition to their professional library. The book is bought at top dollar, even if used, then sold back at a substantial loss at the end of the course. For example, a new fluid mechanics textbook may cost \$172 and a used one \$114. Either sold back to the college bookstore will give the student perhaps \$15-20. The used copy is marked up dramatically (back to \$114) and sold again next semester (a few weeks later), unless a new edition has come out, in which case the book is worthless and may well be discarded. To try to reduce the cost a little, textbooks can be rented for the semester, at between \$35 and \$70, somewhat less than if a new book had been purchased and sold back. All these factors work against students using the book as a repository of core knowledge for their professional development over many years.

There is a need for a centralized repository of information on many specific topics to support higher education. Educating students to become professionals means, in part, conveying to them the body of knowledge associated with their field, and this can be contained in something like a book.

The authors propose using more modern technologies to change how we think about and work with textbooks. These changes will reduce the cost of textbooks dramatically, encourage long-term ownership and use of textbooks, and make the books more relevant to their primary users: students and working professionals.

Introduction: What are the Problems?

Textbook prices have been increasing at a rate faster than inflation for many years, despite advances in printing technology reducing that part of the cost of books. New editions appear regularly, often with few significant changes, but this usually means that new books are required for the courses that use them. New production and printing technologies have been used to create planned obsolescence in textbooks, rather than reduce the cost of disseminating knowledge. Meanwhile, the older editions are devalued, despite still containing a large body of relevant and useful knowledge. If we were to look at textbooks from 20 years ago, what they are missing is the latest technology; but they have the foundational material that is necessary to understand the latest technology. The latest technology may not be appropriate for introductory textbooks, but it is important to provide some mention of it in order to link to foundation material.

The textbook market has become less competitive, with several consolidations of publishers and textbooks. This has allowed prices to rise in the absence of realistic competition. Many textbooks are hardcover, despite the greater cost, even though publishers realize that they will be made obsolete in a matter of two years (or less) with new editions.

Publishers and distributors collect the lion's share of the amount the student pays for the textbook, after the retail outlet has made its percentage. Where these two entities are combined, such as in amazon.com, they can charge rather more, in amazon's case 55% of the purchase price.

Used textbook sales are a way for the retailer to gain additional income with a short-lived product. As the current edition may be useful for no more than two years, there is a strong incentive to earn as much as possible from each book. So students are encouraged to sell textbooks back to the retailer for a substantial loss. The retailer then marks the book up substantially for sale as 'Used,' and on subsequent re-purchases makes the same sum again each time, almost regardless of the book's condition. A textbook can therefore generate its purchase price several times for the retailer during its lifetime.

For example, the \$172 fluid mechanics textbook will last for 3 years before the next edition is released. During that time, the book can be sold for \$172, then re-sold used for \$114 in each of the following five semesters. It is bought back for \$20 at the end of each semester (assuming no summer courses). The bookstore receives \$762 for this book, paying out \$100 in re-purchase costs. The profit from these local transactions, \$662, is far more than the bookstore's wholesale cost to buy the book (about \$135). None of this money flows back to the authors, and none of the six students who bought the book retain it. (These figures were obtained by looking at the local college bookstore prices.)

The person who pays for all of this is the student. The student is often in a bind because they need to have the textbook, yet are often not in a financial condition to afford it. Loan moneys are often used for textbook purchases, and the textbook is sold back to the retailer at the end of the semester at a substantial loss so that there are some funds on hand for the next semester's textbooks. So this circus is paid for by the students, who usually have no choice but to obtain the required textbook.

Because of the need to limit the amount of capital tied up in textbooks, students tend not to retain them. This is unfortunate because they should be the foundation of the student's professional library. Yet the textbook system works against this desirable outcome in its efforts to maximize the amount of profit per student. With the rapid release of new editions, often with little of substance changed, textbooks are made to appear obsolete, like an old cellphone. It is not in the bookstore's interest, nor the publishers', for students to think about retaining books. Yet it is fundamental to professional development.

Students tend to take notes much less than they did in the past. Reduced funding in colleges means that printing notes for students gets curtailed, but even if notes are available on-line, students may not retain them, possibly because of the idea that the course is over. Students tend not to keep as many physical or electronic records of their professional development, compared to the past when information was more scarce, which action works against their long-term professional development. So students pay more, but generally get less.

In many disciplines, technology, techniques and theory are changing very quickly, and textbooks therefore get out of date quickly. The only way to get the book updated is to buy a new edition, but this simply adds to the problem. Further, the production process for a book is sufficiently slow that if the discipline is changing rapidly, it takes a significant amount of time to get the updated edition into the bookstores.

With the rapid expansion of technology, techniques and theory, the amount that a student needs to learn has increased. Not only does a student need to learn the new material, they also need a foundation in the old material, because that explains how we got to this point. Much of the 'old material' includes critical theoretical content that is necessary to understand things like error models, even with the latest technology. This content is important to understanding 'why,' in addition to knowing how to push the right buttons. This is not to suggest that we include large amounts of history in our programs, but without a context, it is harder to understand how the new and old fit together. Trying to manage this in textbooks is difficult. What do we add and what do we leave out? When is something ready to be dropped? To give one example, 'south azimuths' were dropped by NGS many, many years ago, but they remained on the FLS exams for a great many years after that.

When the cost of a textbook is compared with a similar non-textbook, the price differences are instructive. Regular books, even with similar sales figures, seem to be profitable at a fraction of the price of textbooks. This is despite the larger distribution problem caused by having many more retail outlets to cover than is the case for college textbooks. The only college textbooks that are comparably priced to equivalent non-textbooks seem to be literature classics that are widely available through regular retail outlets.

Using figures based on data from the Census Bureau and the Bureau of Labor Statistics, while the Consumer Price Index has risen 250% from 1978 to 2013, new home prices rose by 325%, medical services rose by 575%, and educational books rose by 812%. Tuition rose by 559% over the same period (Kingkade, 2013). While it could be argued that tuition and medical costs should be counted as part of the 'Transformative' sector of the economy (Pine and Gilmore, 2011), and be expected to be rising rapidly, textbooks should be part of the 'Information' sector of the economy (Jones, 1990), and so changing price at a rate much closer to the CPI changes.

Today, most students have at least one device like a smartphone, tablet or laptop computer. There has been a strong move towards people obtaining information through these devices, rather than through books. While we work to connect students with the books in the college library, the

libraries are introducing more on-line and digital information, for many of the reasons given above, especially cost.

With these problems with textbooks, students are losing the idea of building a body of material as the core of their professional development over time. Traditionally, professionals would create a collection of important works that allowed them to review material and re-connect to their formal education. But without encouragement to create this collection, students cannot make a start with their educational materials to nearly the same extent. There is not yet a trusted set of materials in electronic form. Wikipedia has some issues, although it can direct readers to source materials. Many of the textbooks available electronically are just PDFs of the paper book, and so subject to the same cycle of editions, and similar prices. The 'open educational resources' people are working to provide pieces of the solution, but they are providing pieces, not complete solutions, yet. There is a gap here, which has not yet been filled.

In summary, there is a *series* of problems here. Almost everyone recognizes that textbooks are a means of ripping-off students, who are a captive market, and the books themselves are becoming a major financial burden on the students, at a time when student loan debt is over \$1 trillion. Claims of 'competition' in the industry caused by amazon.com and others do not seem to be reducing the cost to the student, so the nature of the competition must be questioned. Students are not treating the books as repositories of knowledge, but as coursework materials that expire about one semester after purchase. The short-term gains from student textbook sales are dissuading students from buying textbooks when they are required to do so, and this mindset limits their professional growth in the decades after they graduate.

Discipline-Specific Problems

Within the Surveying and Geomatics education discipline, a new generation of faculty are joining programs. In most cases, these people have PhDs, simply in order to gain and retain academic positions. They commonly also have a good background in research, but often little background in practical surveying. This is simply a statement of a growing situation.

These new faculty are obliged to teach in an undergraduate program, as there are few graduate programs, where they have a more theoretical knowledge base than a practical knowledge base. While this is not yet a serious problem, there is a growing separation between the theoretical and practical foundations of the discipline.

Can a textbook help with the problem? Most textbooks tend to focus more on the theoretical aspects than the practical aspects of data collection, measurement and hands-on surveying. Can this be switched, to provide support for new faculty closer to where it is needed, and will be needed in the future?

Most programs in the US are chronically under-staffed, there are difficulties covering the full sweep of the geomatics discipline, funds are limited for equipment, recruitment is difficult and has limited success, and faculty rely on textbooks to provide much of the material for course support. How can we encourage students to become more involved with the larger body of knowledge in our discipline, when requiring textbooks clearly isn't working because of outside pressure?

The size of the surveying student population is quite small, as a proportion of population. Therefore there is less profit to be made and the discipline has a lower priority in publishing. Publishers also prefer to focus on just one textbook, to simplify their operations.

Steps Towards Some Solutions

The problems that have been identified with textbooks in the current situation are as follows:

- High cost, especially given the equivalent price of regular books;
- Delayed publishing schedules—currency of material;
- Disconnecting students from textbooks—risk of anti-book or non-book culture;
- Libraries are moving to more digital content;
- Need to support a growing body of knowledge;
- A small market for surveying material;
- Need to support practical measurement and operations; and
- Losing the idea of a traditional professional library.

There should be ways to reduce some of these problems, and provide a better focus on our students and our discipline. Fortunately, technological developments are not only affecting geomatics. There are major changes afoot in the publishing field.

The first possibility is self-publishing. Some time ago, the authors investigated the possibility of self-publishing a new edition of Moffitt and Bossler's *Surveying* textbook. For a print run of 5,000 copies, a full-color book of around 720 pages, with a full-color hard cover, and a full-color dust jacket, the cost was a little less than \$20 per copy. A paperback, even in full color, was significantly less than that.

There are extensive resources to support self-publishers, and not just the 'vanity press.' While most of these organizations support general self-publishers, rather than textbook self-publishers, they can provide extensive support services for editing, layout, and proofreading, as well as help with distribution and sales.

The second possibility is digital publishing, creating an eBook of some type. There are currently four primary eBook formats in use.

The first format is PDF, which is universal, but also the most limited of all the formats. It supports color and hyperlinks, but little else, and largely reproduces a paper book in an electronic format. PDF does not support re-flowing text to allow for different devices, as it holds each page in the original format. (Re-flowing is repagination of the text to allow for different devices and font sizes. It can also allow for graphics in and with the text.) In defense of PDF, it does exactly what it was designed to do, and does it very efficiently. But it wasn't designed for eBooks.

The second format is the format for Amazon's Kindle. There are actually two formats, but one (AZW3 (also known as KF8)) is superseding the earlier (AZW). They are both comparable to PDF in what they can do. They support re-flowing, and present an electronic equivalent of a paper book. The Kindle cannot directly read the ePub format, which needs to be converted before it can be presented to the reader.

The third format is the ePub format, which can be viewed on a large number of eBook readers and allows more capabilities than the PDF and Kindle formats. It is designed for re-flowing to allow any device to display a document in a form that suits that device. It has problems with

equations, and limited extensibility. It is still a work in progress and is at version 3, but has the advantage of being an open standard.

The fourth format is Apple's iBooks format. This is a proprietary development of the ePub format, but has a number of included widgets that allow the use of video and interactive elements. In addition, many widgets written in HTML5 can be included in a book and run inside the reader software. This adds considerable extensibility. Equations are supported, whether from MathType, or written directly in LaTeX or MathML. Apple has added a textbook eco-system to the iBook Store. The iBooks Author free software is available for the development of these books. Disadvantages of this format are that the reader application only runs on Apple devices, and the textbook option is not supported on the iPhone.

Because device-specific readers are used, the text is not truly re-flowing. This has advantages in a textbook, because page 123 will be page 123 on all devices. The book can be viewed in either landscape mode (the more traditional book view) or portrait mode, where the text is one large vertical block, while illustrations are thumbnails to the left, which will expand when tapped to full-screen. While the writer can constrain the book to just one orientation, both can also be allowed. Rotating the device changes the mode.

By self-publishing a textbook in the geomatics field, there is the potential to reduce the cost to the student. If the cost was sufficiently low, the idea of stealing or pirating the book would be irrelevant, and if the book was able to be updated easily, that would also encourage students to keep the book and place more value upon it. With a suitable electronic book format, video could be included, which would greatly assist in practical instruction. YouTube videos can do a certain amount, but they generally do not have a context within an instructional text, and if you don't have an internet connection, YouTube can be hard to access.

Many college libraries offer iPads or similar tablets to allow access to a wide range of on-line information, including some digital textbooks. These can be rented or lent by the library. A digital textbook could be offered to libraries at a suitable rate that would allow them to populate their tablets or similar devices, so that they could reduce their costs. Libraries also offer Mac computers, which could have the textbooks already loaded on them for student use. In this way, textbook use would be like having a large number of copies on Reserve, but the lower cost of a digital text would allow students to buy their own far more readily.

Wollindina Media

Wollindina Media was founded in 2006 to address issues with surveying and geomatics textbooks. Despite difficulties with traditional textbooks formats, a range of textbook materials were developed and tested. With the decision to explore more advanced presentation formats, several approaches were considered, various options tested and limitations assessed. After considerable study, it was decided to adopt the Apple iBooks Textbook approach, as it provided the foundation for solutions to several of the problems that have been raised.

While it certainly would have been easier to develop materials in a well-developed format like Adobe InDesign, which would allow direct export to PDF, Kindle and ePub formats, the limitations of these formats compared to what was possible within iBooks swayed the decision in that direction. This allows not only more advanced books to be developed now, but also the potential for some new developments with the incorporation of HTML5 code.

There are several critical features of the iBooks Textbook eco-system that are important to the direction that Wollindina Media wishes to develop. The first is that the price of iBooks textbooks is limited by Apple to a maximum of \$15 each. This allows a considerable reduction in price to the student. It would also allow a library to have multiple copies, rather than the single copy most libraries may be able to purchase (some choose not to carry current textbooks, to save money).

The second is that once the purchaser has bought the book, they can download it onto all their compatible devices. When the book is updated, they will be notified through the iBooks application and can download the updated version at no cost. This means that the book can remain current, and that incremental improvements can be made. The idea of editions no longer applies. Further, any bookmarks and notes that the user has added to their copy will remain and will attach to the equivalent places in the new version, as far as possible. This allows the book to become an on-going asset, part of their professional library, at no additional cost. There is no concern with being left with outdated material, and there are no subscription costs.

The third advantage is the inclusion of video. This allows practical methods to be included in the book and to travel with the book. As these books can run on an entry-level iPad Mini without problems, it is highly portable. Beyond video, these books can be extended using a wide range of other extensions, limited only by one's ability to write (or buy) HTML5 code.

The fourth advantage is the additional features that come with the platform. The iPad is a powerful computing platform that can run a wide range of software, including spreadsheets, word-processors, databases and presentation software. It has Bluetooth connectivity and can operate a very wide range of useful applications. It's not an eBook reader; it's a very capable computational platform that also allows easy reading of a book. With the accessibility options turned on, even the entry-level iPad Mini can read the text aloud to you.

There was one additional decision made concerning how textbooks would be offered. With the continual increase in the amount of knowledge that needed to be covered, there is a temptation to make a textbook progressively larger. While there are definite limits to how many pages can be in a physical book, there are no real limits to what can be put into an electronic book, apart from the available memory in the device. But at some point, it becomes unwieldy.

Therefore, it was decided to offer several textbooks that covered what would be in a single traditional textbook, but to allow for more depth, as appropriate for the level of the textbook. The divisions within the discipline for these books are flexible, and there will be considerable overlap, but the approach is to try to cover a narrower range, but in a more comprehensive and integrated manner. This also means that the size of each book will be variable.

A recent update to the iBooks format is the ability to add hyperlinks to other books. If a user has both books in their iBooks library, tapping a link in one will open the other book and take them to the target in that book. This will allow a series of books to inter-connect and provide cross-referenced material.

The Proposal

The authors propose generating a series of textbooks in the iBooks format, which will cover all the relevant material in Moffitt and Bossler's *Surveying* text. However, this is not to be a re-issue of that text—it will be a complete re-write of the material to suit not only current circumstances, but also the new format.

The books will be inter-connected, but will also be stand-alone books. They will be updated and expanded as circumstances change. New titles will extend the series, building on the foundations previously created.

Students and professionals with Mac computers or iPads can purchase and download books as they are released. Those without would need an iPad, which costs about as much as two to three current textbooks. However, an iPad will last at least five years. One was purchased by one of the authors on 3rd April, 2010, the initial iPad release date, and is only now starting to experience shortened battery life. However, this device still displays current books in the iBooks format. Having an iPad for five years would provide a textbook repository for most undergraduate careers, and if it is lost, all the textbooks can be downloaded to a replacement device at no cost. The iPad's ability to store textbooks is, effectively, infinite. Even if one is deleted, it can be downloaded again later. New devices can be added as they are acquired.

Where Would We Start?

Clearly, a series has to start with one book and build from there. As additional books are added to the series, cross-links can be added to the first book. The first book can be updated as changes occur, or as any errors are found.

Which topic should be dealt with first is less important than that a start is made. It is better if a more basic topic were to be tackled first, so perhaps leveling would be a useful topic. It has the advantage that there is a significant practical component, which would support using some video, and it provides many connections to other areas beyond traditional spirit leveling, such as physical geodesy, photogrammetry, LiDAR, IfSAR, UAVs and similar recent technologies.

Conclusions

The authors have discussed some of the problems with the current way that textbooks operate at the college level, in particular

- High cost, especially given the equivalent price of regular books;
- Delayed publishing schedules—currency of material;
- Disconnecting students from textbooks—risk of anti-book or non-book culture;
- Libraries are moving to more digital content;
- Need to support a growing body of knowledge;
- A small market for surveying material;
- Need to support practical measurement and operations; and
- Losing the idea of a traditional professional library.

In addition, there are some discipline-specific concerns in surveying and geomatics, not least being cost pressures.

We have proposed one possible solution: a series of digital textbooks that take advantage of what is currently the most advanced format for digital textbooks. The eco-system built around these textbooks allows them to be updated any time, and for those who have bought a book to download updated versions for free indefinitely. The same eco-system keeps costs for textbooks

down, both initially and over the full period of ownership, i.e., indefinitely. The books are able to be used on all the buyer's compatible devices, encouraging students to retain textbooks as important repositories of foundational knowledge throughout their professional careers.

All that remains is implementation.

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