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Scott Bell, Heather M. Ross, Jordan Epp and Kelsey Bates

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Scott Bell[1]
Heather M. Ross[2]
Jordan Epp[3]
Kelsey Bates[1]

[1]Geography and Planning, University of Saskatchewan, Saskatoon, SK
[2]Gwenna Moss Centre for Teaching Effectivenes, University of Saskatchewan, Saskatoon, SK
[3]Distance Edcuation Unit (DEU), University of Saskatchewan, Saskatoon, SK

Abstract

Geomatics is uniquely suited to the development, publication, and use of open textbooks. Here the concept of open textbooks will be introduced and the suitability of Geomatics will be examined, particularly with respect to OpenData movements, open software, and the historical association between government involvement in spatial data, GIS, and cognate domains. Geomatics is not unique in the extent to which it lends itlself to open textbooks, but the current state of geomatics (software, data, theory, etc.) has benefited from a variety of centralized activities (Census, military, space programs, planning, land and resource managements, etc.). This history and the dependence of modern geomatics on both national interests and the open movemnt means that the knowledge associated with teaching geomatics and related disciplines in primarily in the public domain and authors have relinquished restrictions related to copyright, intellectual property rules and laws, or other aspects of its use.

Background and Relevance

Open textbooks are books for teaching and learning that are published under an open copyright license (BCcampus, 2016). Currently, most open textbooks are authored by instructors and for the most part these instructors are motivated by our personal instructional experience. Open textbooks are one kind of open educational resources (OER), which are defined by the Hewlett Foundation as "...teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge." (http://www.hewlett.org/strategy/open-educational-resources/) Like other textbooks, they represent relevant material, new and pre-existing, compiled to support teaching at all levels (most likely higher education, but also K-12). Similar to traditional textbooks open textbooks exist in a publishing environment that provides guidance, resources, and support. In particular, open textbooks are published with specific licenses associated with how the material in the textbook can be used and reused. These range from restrictive (using and sharing a book in full with complete attribution) to only attribution (material can be used, shared, edited, and combined with other material, commercial or not, also known as Creative Commons Attribution, or CC-BY) (see more at:

https://opentextbc.ca/opentextbook/chapter/creative-commons-licenses-2/). Open textbooks are free and are normally available in a variety of electronic formats (EPUB, Mobi, pdf, html, etc.) as well as print-on-demand.

Geomatics and cognate disciplines (GIS, cartography, geodesy, and remote sensing) are increasingly important and popular areas of study in Canadian universities. These disciplines are also reliant on copious freely available knowledge, information, software, and data, making them suitable to the use of open textbooks. In the sections that follow the various aspects of open textbooks that lend themselves to teaching and learning in geomatics will be elucidated, as will the unique nature of geomatics knowledge for teaching and learning. Relationships to other Science, Technology, Engineering, and Math (STEM) disciplines will also be considered.

The Suitability of Geomatics to Open Textbooks

The history of geomatics is closely coupled with concepts we now associate with what is called the open movement (data, government, software, etc.) (see open.gov or http://opendatahandbook.org/glossary/en/terms/open-movement/ for more information). Needless to say, geography, geodesy, and other predecessors of geomatics have a long history in humanity's constant development (settlement, navigation, scholarship, military action, mapping, surveying, census, urban planning, etc.) and the earliest stages of software, data collection, and related activities were centralized and or led by academic institutions (Chrisman, 1998; Cooke, 1998; Thomlinson, 1998). This history means that the foundational knowledge upon which our contemporary classes in the cognate fields of geomatics are mostly based on freely accessible material, knowledge, and facts. It could be argued that the current landscape of academic GIS training has tendrils back to the software's origins in academia (Harvard Graphics Lab) and government (Canada GIS). Perhaps it is those origins that create the current software licensing arrangements that seem to provide academic institutions favorable terms.

Many, if not all, of the topics germane to geomatics are publicly available and supported. Related geomatics topics (remote sensing, geodesy, cartography, etc.) are not only part of the public domain, but are well supported by many federal agencies associated with or part of developed countries, many with space, military, and scientific programs. Space exploration, military requirements, centralized scientific programs, and resource allocation, development, and exploitation all require vast and accurate geomatic knowledge and information. As a result, government-developed and supported websites contain a plethora of material that can be leveraged for textbooks ranging from introductory to advanced topics. My own textbook leverages material from Natural Resources Canada, Canadian Space Agency, NASA, USGS, etc. as well a limited text from similarly licensed open material.

The Current State of Geomatics Open Textbooks

Campbell and Shin (2016) developed one of the first (and perhaps only) open textbooks for Geographic Information Systems. This book (Geographic Information Systems

Basics) was published under a CC-BY-NC-SA license (Attribution, Non-commercial, Share Alike) which means that material can be used non-commercially, can be remixed, added to, and altered, as long at the new material has the same license applied to it. A current work in progress (Bell, 2017) has adopted chapters from this publication (Data models); such opportunities make the development of books in similar, but not identical, areas of teaching straightforward (and literally a pleasure). In exploring the book and its provenance, it was clear that publishing an open textbook can be as challenging as publishing in the traditional commercial environment, but for different reasons. That book has since transitioned to a multi-format (epub, pdf, print-on-demand) for-profit publisher, Flat World Knowledge, using an online textbook that operates outside the traditional commercial publication environment (producing hard copies of books).

There are a variety of potential challenges to the development, proliferation, and adoption of open textbooks. Unlike commercial publications, resources or support from the entity that will eventually publish the book are not always, or necessarily, provided. In Canada, BCcampus (bccampus.ca) is the largest open textbook repository in Canada and supports the publication and availability and distribution of open textbooks. BCcampus brings together the active development of open textbooks, but also archives textbooks from a variety of sources (as of December 2016 it is the only online source for Geographic Information Systems Basics). In Saskatchewan, the provincial government is providing targeted funding to higher education institutions to support the adoption and development of open textbooks in an effort to reduce the financial burden of higher education on students. For authors this funding provides a landscape more in keeping with traditional publishing; funds and resources provide authors support related to image (figure) development and procurement, book layout, editing (copy and design), and taking care of the more nuanced elements of the publication process. An aspect that is not well understood is the extent to which ongoing support is necessary, available, or desirable. In commercial publishing authors are encouraged to produce serial editions, the goals of which can be beneficial to both students and revenue generation.

The implications of these challenges are evident in the practice of open textbook publication. The only existing GIS textbook (see above) is still available on BCcampus, but the original authors have migrated the most current (and updated) version to a less open, but still online platform. The only freely available open versions are archival and have not been updated by the current authors. The most inexpensive student option for the new and updated version is $24; the most expensive version is $139. With this version, depending on the format purchased, there are supplemental materials (test bank, image bank, etc.). Such accoutrements can be developed for any open textbook, but are often considered separate publications and require additional work by the author/developer. There is no doubt that open textbook publishing will be dwarfed by commercial textbook publishing for many years. But there are ancillary benefits that cannot be ignored.

Conclusions

Students benefit from open textbooks. Currently, BCcampus attributes a $100 savings to every student enrolled in a class that adopts an open textbook. Authors, departments, colleges, universities, and government can use these figures to attribute financial benefit to the adoption, development, and promotion of open textbooks. In my own class, 155 students have adopted two open textbook products (a notetaking guide for lectures and the open textbook), saving students $31,000, collectively (this savings is greater than the funding received to develop the textbook). Currently at the University of Saskatchewan (2016/17) 2500 student equivalents are enrolled in classes using open textbooks (this figure includes double-counting students who enroll in more than one such class). Additionally, textbook development allows authors to work collaboratively with colleagues and students on a collective activity. In my own development process, I have been able to support two undergraduate students and a sessional instructor. The latter position was used as a "shadow" instructor, attending lectures and making notes that we subsequently used to develop, edit, and augment text material. The spirit of open textbooks being free extends to the remuneration of authors; authors receive no direct compensation for developing books in Saskatchewan, nor for their continuing or extended adoption (at other institutions). However, direct and in-kind (fulltime support staff) funding can be used to hire student assistants, editors, designers, or other support staff, any of which could include a professional development or training of highly qualified personnel (HQP).

The future of open textbooks will depend on many things: interested authors, dedicated support staff, available resources, and a welcoming educational landscape are all essential to meeting the textbook needs in higher education. The textbook industry is enormous, with popular individual textbooks generating millions of dollars of revenue annually. The complexity of the publication process will continue to favour commercial publishers. Such outlets will be the primary competition for open textbooks. What is evident is that the open textbook process is primarily bottom up, authors fill a need they identify locally, adoption by a wider audience comes later. Commercial publication is a top-down model; when a demand/opportunity is identified, the resources assigned to that demand is commensurate with the perceived revenue that the textbook could generate. The majority of resources are assigned to the most profitable opportunities, often a well-established textbook in a high-enrolment subject. There are few opportunities for marginal, fringe, or interdisciplinary topics.

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