

So, You Want to Write an OER? Three Authors Share Triumphs, Pitfalls, and Options

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Abstract: Open Educational Resources (OERs) offer a free, viable alternative to costly textbooks. The authors share their experience and advice on finding and writing online content, creating an online platform for the content, finding videos and other resources, and working with an appropriate free online homework system to match the written content. In addition, the implementation and suggestions for practitioners are discussed. At the end of the article, the bibliography contains two OERs freely available under an open commons license, one for Intermediate Algebra, the other for Mathematics for Elementary Education.

Keywords: Open educational resources, curriculum development, intermediate algebra, mathematics for elementary education, homework platform for mathematics

INTRODUCTION

Community Colleges in the United States serve the unique role of providing open access to many students seeking higher education. Community colleges educate a significantly high percentage of underrepresented students, which include low-income people, first-generation college students, and ethnic minorities (Berkner & Choy, 2008). Purchasing textbooks can present a challenge to many of these students. Open Educational Resources, or OER, offer a free, viable alternative.

OERs are educational materials that may include textbooks, modules, streaming videos, and software (Hilton, 2016). Hilton (2016), synthesized the results of sixteen studies across different disciplines at the post-secondary institutions to show that students generally achieve comparable learning outcomes when using OER vis-a-vis commercial textbooks. Two recent studies conducted at Scottsdale Community College and Mercy College showed that students enrolled in mathematics courses performed similarly on the uniform final examination whether they used a commercial textbook or OER (Fischer et al., 2013; Pawlyshyn et al., 2013). From our own experiences in the community college setting, we believe that students can do even *better* when an OER is available, because students are able to review the material and start their math homework immediately during the crucial first weeks of class, rather than waiting for financial aid or a used textbook.

The Borough of Manhattan Community College (BMCC), where all three of us teach, is one of twenty-four institutions comprising the City University of New York and serves over 23,000 students. Over 90% of the student population is comprised of minorities and groups from historically underrepresented populations. About 65% of students at BMCC receive needs-based financial assistance. Each year about 72% of BMCC'S new entering students are placed into a developmental mathematics class based on their performance on the placement math proficiency test. (BMCC Fact Sheet, 2019). Our mathematics department is one of the largest departments at BMCC. Comprised of over 70 full-time and over 200 part-time faculty members, BMCC offers more than 400 sections of courses ranging from basic pre-algebra to advanced calculus. There are three levels of developmental proficiency -- prealgebra, elementary algebra and intermediate algebra -- which a student must successfully complete in order to enroll in precalculus, the first credit-bearing mathematics courses for STEM majors. We also offer many co-requisite courses, most of which at present do not have a single textbook suitable to tackle both the developmental and credit-level content.

For our OER project, we chose to focus on Intermediate Algebra with Trigonometry, a developmental course that offers no credits and meets six hours a week. On average, thirty sections of this course are offered at BMCC each semester. The development of OER materials and professional development workshops were made possible by a New York State OER Scale UP Initiative that awarded CUNY a \$4 million grant to establish new or support ongoing OER initiatives across CUNY (<https://www2.cuny.edu/libraries/open-educational-resources/nys-oer-scale-up-initiative/>). The award allowed us summer stipends, which gave us the time we needed to complete the work.

In addition to having the time for the project, the three authors of this article have, collectively, many years' experience teaching mathematics courses and developing materials for mathematics classes that informed our OER work. One of us (Offenholley), had previously created an OER for Mathematics for Elementary Education, a credit level liberal arts math class for students who wish to become PreK or elementary school teachers. We also have prior experience writing content (Hirsch, for online courses) and creating online question sets (Millman, for our Quantitative Literacy and Reasoning course for Non-STEM majors).

As the focus of this article, we will focus on the Intermediate Algebra and Trigonometry OER, our most recent project. Our work involved three main tasks: finding and writing online content, creating an online platform for the content, videos and other resources, and finding an appropriate online homework system that matched the written content. We share our experience in each of these areas, in the belief that what we learned will help others who wish to create OERs.

Written Content

For our textbook selection, we had three options. We had to decide upon (1) using an OER course that was pre-developed and published, (2) using a text that was written by our faculty, or (3) a blend of both.

For (1), a search for an appropriate textbook for this course began at OpenStax.org. OpenStax is a nonprofit educational initiative which publishes peer-reviewed, openly licensed college textbooks. These textbooks are free for electronic version and have a nominal cost at the printed level. The mathematics texts found on OpenStax represent a variety of subjects, beginning at the primary level, terminating at the higher-level undergraduate mathematics class. Faculty can download a pdf of the textbook and upload it to their own website, with their own videos and notes, or can choose to have students access the text on the OpenStax website. In addition, libretxts.org, an open textbook initiative from the University of California, is a new source for OERs.

However, because the Intermediate Algebra and trigonometry class at BMCC is a 0-credit class, logarithms and trigonometry are taught from a perspective that does not include functions, so we found it difficult to find an appropriate free open-source text. Similarly, in a previous OER project for Math for Elementary Education, we were unable to find a single existing OER that had both enough mathematics and enough education content, so we had to write our own content. Since the development of those two courses, however, OpenStax has improved platforms to mix and match and modularize sections of its texts, using the CNX platform, so it is quite possible that you will be able to find the right mix for your own OER at one of these two places.

For our Intermediate Algebra and Trigonometry OER, we agreed that one author should be used to present the entire textbook to assure a pedagogy that was consistent throughout the book. Therefore, a blend of both a pre-published OER text and one that we wrote would not be acceptable. Thus, we went with option (2). An unpublished e-book for this course was available, written by a member of BMCC's mathematics department (Hirsch), and initially intended to be used for a hybrid version of the course. Permission was received to modify and edit the textbook and use the e-book version for the course that was being built. This was ultimately the text that was adopted for the Intermediate Algebra and Trigonometry OER course.

Online Platform, Videos and Games

Once we decided on our text, we wanted to have a way to present the material so that our students could easily access it, without additional cost. We also wanted to have videos available, because many of our students have a difficult time creating meaning from only reading. For our platform, we used WordPress, which is a free open-source platform and hosting service. The one issue with hosting the service with WordPress is that the students will see advertisements. Some college systems have hosting available, so that an ad-free version of WordPress can be used; within the CUNY system, the CUNY Academic Commons is beginning to be such a place (<https://commons.gc.cuny.edu>). In addition, www.pressbooks.com has a WordPress-based book-creation platform that has a free and for-pay model, both without ads. With any of those sites, students can access the content on their smartphones with adaptable pages that shrink to fit the smaller screens. (Remember that if you decide to go with an OpenStax text, you might not need a separate website.)

One of the things we liked about creating our own site was that we could use the excellent videos from www.mathispower4u.com, a website with thousands of videos for all levels of mathematics, from basic mathematics to Calculus. These videos have the advantage of being closed captioned

and ADA compliant, and there are no ads. We placed the videos separately from the text – with the text in pdf form – but in hindsight we suggest embedding the videos within the text, so that students are more likely to read *and* watch. To see the differences between the two approaches, see the two OERs links above the references section.

In addition, we were able to add links to several conceptual algebra games created through an NSF grant on which one of us (Offenholley) was the Principle Investigator. These games, like the videos and our textbook, are all available for free through Open-Commons licensing.

Homework Platform

Modern textbooks often come prepackaged with access to an online homework platform such as WebAssign, MyLab, ALEKS and HAWKES Learning (<http://www.webassign.net/>; <https://www.pearsonmylabandmastering.com/northamerica/mymathlab/>; <https://www.aleks.com/>; <http://www.hawkeslearning.com/>). These systems have become widespread particularly in developmental, introductory courses and gateway courses. The 2009 AMS survey found that 43% of bachelor's degree-granting mathematics departments were using online homework (Kehoe, 2010). Since 2009 the use of online homework platform has been required at BMCC in all pre-algebra and elementary algebra courses.

For our project, we chose MyOpenMath (MOM), an open-source homework system developed by David Lippman (<https://www.myopenmath.com/info/aboutus.php>) in 2006 at Pierce College. The first version of the platform was built on Google's OpenClass system and released as an IMathAS (Internet Mathematics Assessment System). IMathAS was one of the Learning Management Systems that was specifically designed to have capabilities of working with various algorithms used in mathematics. Initially, the system had to be installed and managed using local servers which made it more difficult to adopt. In 2011, the IMathAS evolved into MOM, which has capabilities of a cloud environment. This allows individual instructors to offer courses that use MOM without the need to locally host the system. However, the maintenance of the platform requires sponsors who offer the institutions an option to provide instructor and student support for a fee. Even though MOM does not provide direct support, it remains free and offers a large community-based support. MOM can also be integrated into Blackboard and Canvas platforms.

MOM offers a large database of automatically graded questions from basic arithmetic to calculus and beyond. MOM has various learning management features, including a fully featured gradebook. Faculty can monitor student online engagement and modify or adopt homework questions with no extensive programming knowledge. For this project, homework sets were created by selecting questions from the database that closely match examples presented in the textbook. The questions were sorted based on the number of times they were used in the past; the average time students have spent answering them, and the availability of embedded videos that demonstrated similar examples. Using already available questions in the database proved easier than modifying the already available set of questions from the template courses. One of the defining premises of the MOM platform is sharing of the resources created by the community. The

materials developed for this project are available to be accessed through MOM directly by any instructor using the system.

In developing this OER authors worked together to establish cohesiveness between the written curriculum, the online platform, and the supporting resources. The written lessons were proofread and piloted prior to wider implementation. The content of video resources was checked for accuracy and consistency with the written materials. One of the authors had a prior experience in adopting MOM in the quantitative literacy course offered at BMCC. This experience facilitated the creation of the shell for this project. In addition, this author had been granted administrative rights by David Lippman to create and manage instructor accounts on MOM. Considering the system had been successfully implemented at BMCC in other courses, it was decided that instructor support would be provided by instructors who had previously used the system.

Implementation

The policy at Borough of Manhattan Community College before adopting any new textbook for a course is to first pilot the textbook for a couple of semesters. Therefore, the faculty could facilitate constructive feedback from like-minded peers, and then to bring the text back to the department for a well-informed discussion and vote. The textbook, online homework system and videos were piloted for two semesters before the authors sought departmental permission to adopt their text.

Motivated by the zero-cost textbook, a handful of instructors piloted the text, offering suggestions about the order of the text content, editing, and pointing out glitches in the online homework system. The authors were able to polish the text, homework, and videos to a sheen before presenting them to the department for a vote.

After being presented as a possible alternative free text for our Intermediate Algebra with Trigonometry class, the department voted unanimously to offer the text as a free alternative to the already approved textbook, with the stipulation that one of us would be available for training.

Because of the funding from the New York State OER Scale UP Initiative, we were able to provide paid training to twelve instructors who wanted to adopt our OER. Two workshops were held in the summer for instructors who were teaching the class in the fall or spring of the up-coming semester. Furthermore, we were able to provide funding for the person who lead the workshops, one of the authors of this paper.

Student feedback

We received positive feedback from students who were enrolled in sections that used our OER. Students found it easy to navigate between the online textbook, homework assignments and support videos. The features provided by the online homework platform such as ability to try problems more than once, constant feedback and videos that tied to specific problems were among the common responses that we received. Students also appreciated that the materials were provided free of charge. One student wrote: *“The homework encouraged you to understand how to solve the problems and the option to have 7 chances forced me to want to get the problem. Everything [OER materials] was accessible and it was a major bonus that it was free to use”*.

Conclusion

We believe that our combined technical and teaching expertise were immensely helpful in creating our OER. We urge anyone who is considering creating an OER who does not have a technical background to team up with people who do, and anyone who is a beginning teacher to team up with people who have taught for longer. Successful implementation requires collaboration and technical expertise. Professional development is needed to introduce instructors to new online systems. Large scale implementation can require support by mathematics faculty and administration. Creating OER materials and providing professional development might require grants and/or release time. Community Colleges in the United States were founded with the premise of open access (Bragg, 2016). Developing OER materials by the experts in the field can provide high quality learning resources free to students who would otherwise not be able to afford them (Hilton, 2016). This study suggested that students benefited from OER materials.

OUR OERs

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