

## A Reflection on Open Source

Cover Article

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My first encounter with open source was thirty short years ago. My, how time and technology-changes fly! As a typical financially-strapped undergraduate, I pieced together my very first personal computer, and was thrilled to have the option of using the open and (most importantly) FREE operating system, Linux.

This of course saved me money, but was also a valuable learning experience, as it required much focus and patience, through many coffee-fueled nights, accessing 'Usenet' for tips on configuring appropriate drivers etc. The community surrounding this open source stuff was amazing to me. Eventually, success! I was a firm convert to Linux, and the whole philosophy of free and open access to all that it offered. In those heady early days of the Internet, the idea of open and free access for all was a hot-button much-debated topic, as it still is to a perhaps lesser degree today.

However, once I had completed my studies and become gainfully employed, I quickly realized I was living in a Microsoft world. This was before Microsoft was broken up into smaller units/companies by U.S anti-trust laws, and before Apple had begun to compete with MS in any meaningful way.

As our campus system became more computer-based, moving beyond email and csv files to Active Directory, Learning Managements Systems (LMS), and Sharepoint etc., my administrative duties increased, and there was ever decreasing patience for non-MS files. I personally clung to a dual-boot system for some time, aiming to get back to Linux someday – but that day never came. Eventually, I installed LaTeX on Windows and left the dual-boot system behind.

To this day, I have lingering regret about this, as I viewed it as something of a 'sell-out. I'm certain millions of alternate system users felt the same way. Perhaps this is why I feel a sense of redemption whenever I am able to embrace Open Educational Resources (OER) in my job.

Open texts provide not only cost-savings to financially burdened students, but also gives Faculty the legal ability (by dint of the Creative Commons license) to supplement, re-write, rearrange, and delete content of the textbook to suit their specific course. Faculty may wish to make edits for a variety of reasons – from a desire to meet cultural, regional, or accessibility needs; to clarify or correct inaccuracies; to make examples more relevant to the class/discipline, or simply to bring text content into line with a long established lecture notes of a particular course. Of course, any such editing takes time, but for introductory courses in particular, there are many suitable options which are a perfect ready-fit for students, right out of the box.

With open texts, students have immediate access (even before classes start), and hard copies of many titles can be purchased for entirely reasonable rates. For example, the hard copy of the text I used for 'Calculus I' last term, can be home delivered for \$35.

I would add that many students are placed in a difficult moral position when asked to purchase a \$300 book when digital pirated copies are available online. Links to such resources are circulated freely, but often these files are accessed from malware-laced websites, and it is not uncommon for files to carry damaging and frustrating malicious content. There is also of course the (albeit slight) possibility that downloading these pirated materials could result in legal issues. This is perhaps not a real and serious concern for professors, but it does highlight the value of open source.

Textbook publishers have been evolving by developing software, interactive e-books, Multimedia and online homework systems to accompany their texts. Some commercial courseware-providers such as Lyryx, and WebAssign have partnered with OER. Open texts are increasingly designed to be interactive, and freely available. Graphing calculators such as Desmos.com, eMathHelp.net, and multiple mobile apps are easily linked with open texts, as are OER alternatives to mathematical software such as SAGE, Geogebra, and Scilab.

There is also OER software to support interactive homework assignments, some, such as WebWork are able to be integrated into most of the mainstream LMS such as Canvas, D2L, Moodle etc. I am by no means an OER aficionado, but I can speak to the merits of WebWork (WW), having

used it since 2012. WW has certainly come a long way since 2012, now boasting over 35,000 randomized questions in the (open) problem bank, covering a broad range of topics from pure/applied mathematics, statistics, engineering, and beyond.

I find that the immediate feedback students receive is an extremely valuable asset, making it an ideal accompaniment to hand-written assessments. It also allows for a significant reduction in the number of marking hours. The open problem-bank for example is an incredible resource, and the WW community forums provide excellent support for users, authors, and administrators alike.

I have also found WW to be a definite game-changer in my Discrete Math course, where we introduce mathematical proof. In the past, I would typically see a majority of poorly-written proofs on the first several assignments in that course.

I began supplementing the hand-written assignments with WW assignments, where students are able to drag and drop pre-written elements to create a proof (like a single column of blocks, but with extra blocks). The students were able to attempt these problems as many times as they like, with immediate feedback. The improvement in the hand-written proofs (on both assignments and tests) was frankly staggering. This made for a better experience for myself as a marker, but also for the students who did not lose marks while learning how to appropriately structure a proof for the first time. A very important win-win, and above all, an improvement in learning and understanding.

In the case that a WW question from the problem-library does not have a full solution, or perhaps the solution provided is not written to personal style, then one can be re-written in relatively short order and used, in many cases, in perpetuity.

In fact, a great way to engage interested undergraduate students who are working for a few weeks during summer work-terms, is to have them learn some Perl and LaTeX, while coding WW problems and solutions for new courses.

In our experience, students have actually had fun doing this, which elicits better work results and a more positive experience for the student and supervisor alike (especially if you hire multiple students). As an added bonus, these students are able to tag themselves as authors, and upload the problems for use by the world-wide WeBWork community! The tangible sense of accomplishment and recognition this may instill in students is quite valuable indeed.

In conclusion – even though I am composing this article on a Windows machine, I take some solace in that I am only a click or two away from a Putty terminal connected to our WW server, humming happily away on Ubuntu.

I believe that independent creative problem solving, and exploration of alternate user systems and solutions are backbones of learning.

For those that would like more information regarding some of the OER I mentioned in this article please see the embarrassingly incomplete list of links below.

- <https://openstax.org/subjects/math>
- <https://libretexts.org/>
- <https://open.bccampus.ca/>
- <https://webwork.maa.org/>