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Opening the Online Homework System: Toward Cooperation and Collaboration

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Abstract

One of the core tensions in open educational practice in current mathematics and physical science coursework is the use of online homework systems. Many such tools are from commercial providers and have profit to that provider as a motive. Open resources are pursued by those who, for reasons of cost or of pedagogy, seek to resist the tools of commercial providers. This pursuit is frequently made outside of the context of discussions of open educational practices; indeed, the first author of this presentation describes one such effort that started before he was even aware of open education as a discipline. It is important to ask how those faculty, particularly in the mathematics and physical science disciplines at non-elite institutions, assign homework in ways that encourage practice and skill-building, and more broadly, how such content can be shared more robustly and completely among faculty at different institutions.

Keywords: online homework, open educational resources, STEM education

Introduction

Courses in mathematics and physical science disciplines frequently use networked tools to serve students homework problems and other means of skill-building and problem-solving practice. When implemented effectively, these online homework systems provide a great deal of convenience to the instructor in exchange for at least equivalent learning effectiveness on the students' part (Allain & Williams, 2006; Bonham et al., 2001; Ziemer, 2004). However, many online homework tools are from commercial providers, have profit to that provider as a motive, and are not necessarily responsive to the end user in their construction or long-term implementation. Kersey (2019) dubs these tools closed educational resources (CER) (e.g., providing limited to zero prospect of sharing and editing to afford greater flexibility), standing in contrast to open educational resources (OER) that provide the capacity to share resources freely for the benefit of instructor and student.

Open solutions are becoming increasingly available to those who, for reasons of pedagogy or cost, want to resist those tools provided by commercial providers. While many such tools are on platforms that encourage sharing beyond the single institution (Kersey, 2019), other tools are developed on unique platforms that require more intention for the sharing of materials (LeBlond et al., 2019).

Cooperative and Collaborative Potential of Open Online Homework Systems

The first author has worked steadily on one online homework solution for physics, mounted on the open-source learning management system (LMS) Moodle since 2007, and has extensions for that solution appropriate for general chemistry as well. The system was inspired equally by Doignon and Falmagne (1985)'s proprietary solutions for online problem-solving in its practical application via the proprietary software ALEKS and locally implemented solutions for student practice (DeLorenzo (n.d.), personal communication). The second author has been developing open resources for his general chemistry students since the onset of his academic career in 2009 and began using OpenStax resources in general chemistry in 2015, receiving a state-level grant in 2016 designed to promote the production of free and open resources for students and instructors. Development of supporting materials ensued, in the form of YouTube videos covering core concepts and LibGuides providing lecture notes and homework problems through his institutional library.

In various forms, both authors have steadily worked on problem banks for their LMSs over the course of their careers, outside of awareness that this work could be received as scholarship in its own right or even aware of open education as an academic discipline. The authors' work is representative of the efforts of many other such instructors around the world. The first scholarship along these lines was published in 2009 (Martín-Blas and Serrano-Fernández) and has been cited over 200 times (e.g., Chandra & Watters, 2012; López et al., 2016; Shurygin and Sabirova, 2017). Many more instructors simply work out their own solutions in the name of serving their pedagogical needs, in a decentralized context, without the pursuit of scholarly credit or informative sharing. Indeed, the DeLorenzo inspiration referred to above was another such independent effort.

Identified Gaps in Current Practice and Research

One investigation into the use of OER in a university algebra-based physics course (Hendricks et al., 2017) points out how the authors coded their homework into an edX course website for reasons of cost and efficiency of administration. The specific nature of the homework solution is not addressed and may simply be best suited to the university's needs; however, the lack of a clear model for sharing all of the resources generated as a part of the project without opportunity for collaboration with like-minded peers seems to undermine the open promise of the solution, and gives the reader interested in wider solutions cause to ask if there is a more efficient way to share the resources created. It also bears mentioning that the solution cited in Hendricks et al. (2017) utilizes quizzing within the context of OER reading materials, which doesn't neatly fall into the online homework system model.

The development of projects like LibreTexts, formerly known as ChemWiki (Allen et al., 2015), which provides platforms for sharing of all kinds of course materials linked with popular textbook shells, makes it less reasonable for instructors to maintain their own independent solutions and more reasonable to encourage widespread sharing of homework resources in ways that can benefit faculty who currently work independently, reinventing the wheel in many ways. The increasing robustness of the WeBWork platform (Kersey, 2019; Ziemer, 2004) provides additional opportunity for creative sharing; however, the costs associated with utilizing the WeBWorK platform, either monetary or in terms of computational resources required at the institution, provide a barrier to immediate access for the interested potential adopter.

Conclusion

The major questions going forward are twofold: first, how can sharing of resources that encourage practice and skill-building build bridges between those instructors who, removed from the dialogues that the connectedness of the open education community affords, simply have worked out their own solutions for the specific learning problems in their coursework? Second, are those resources best utilized by instructors in delocalized contexts where the sharing of those resources requires more investment in human and computational resources, or is the sharing of those resources best done in a single centralized context where all computational resources and data collected reside in the same institutional location?

Author's Contributions

DCP and AE cooperated equally on the writing of the manuscript.

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Ethics Statement

An ethics review was not applicable for the work described in this paper. The authors utilized no data that could have led to ethical concerns.

Conflict of Interest

The authors do not declare any conflict of interest.

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