



Collaborating with Students to Find and Evaluate Open Educational Resources in Engineering

Sarah E. Evelyn and John Kromer*

Librarians are experts at finding resources, but often need the input of subject matter experts to identify “good” study materials. Librarians worked with faculty and students in Introduction to Engineering, an entry-level course, to identify open educational resources to supplement the existing textbook in the course. Described in this paper is the process we undertook to find, collect, evaluate, and deploy OER in the course, along with takeaways and lessons that we learned. The evaluation and tailoring of materials to a particular course and the topics covered therein create a model that can be reproduced in other courses.

Introduction

Librarians, course instructors, and students each bring a unique set of perspectives and strengths which contribute to the overall success of open educational resources in the classroom. The work the library community has done to develop the open movement, and in particular open access, positions libraries as vital to the adoption of open educational resources (OER) in teaching and learning in higher education. When confronted with the rising cost of textbooks, students often choose not to purchase the required text. Some share textbooks with a friend, others use a library copy, some find a pirated copy online, and some opt not to use it at all. Regardless of whether they use the textbook, students often seek materials online to supplement or entirely replace the assigned course materials. These online materials often vary in quality. We set out to gather these materials and evaluate them for quality to ensure that students receive the information they need to be successful in their coursework, specifically in the context of an engineering course.

Students come to the university with varying levels of experience with the content in STEM fields. Because introductory STEM courses are often large, lecture-based courses, it is difficult to evaluate prior knowledge. The challenge this poses to instructors impacts the type of content they present, the depth of explanation they provide, the assumptions they make about student ability, and ultimately their expectations of student success. Students have widely varying academic backgrounds, from college preparatory schools, international baccalaureate or advanced placement programs, to public high schools with limited advanced course opportunities. Additionally, students bring different levels of interest to introductory STEM courses. Some are curious about the topic, while others are beginning a sequence of required courses toward their desired major.

All of these issues presented themselves in *Introduction to Engineering*, a first-year course required for all engineering majors but open to non-majors as well, and it is this course around which we focused our project.

* Sarah E. Evelyn, Director of Academic Engagement for the Humanities and Social Sciences, Brown University Library, sarah_e_evelyn@brown.edu. John Kromer, Head, STEM Division, Arizona State University Library

The course is described in the course catalog as:

An introduction to various engineering disciplines, thought processes, and issues. Topics include computing in engineering, engineering design, optimization, and estimation. Case studies in engineering are used to illustrate engineering fields and scientific principles, including in-depth studies of statics. Laboratories and design projects are included. Prerequisite: coursework in Applied Math or Calculus.

The instructors for the course were aware that the students used additional materials through the open web and other sources. The instructors questioned the quality of those resources and also how successful students were in finding them. Their concerns are well-founded: up to two thirds of undergraduates are unsure how to approach the task of evaluating search results.¹ Even in cases where students were successful in finding materials, the instructors were concerned that the resources were not appropriately aligned with the content in the course, or in some cases that the resources were just wrong.

This project was designed to evaluate the availability and quality of OER. As experts in information literacy, librarians are well-positioned to work with instructors and students to identify and evaluate open educational resources. Libraries have a history in the open movement ranging from significant efforts to promote open access publications and policies, to the programs and infrastructure to address open access research mandates, and more recently in supporting open education. OER can vary in quality, i.e. some are not evaluated, validated, authoritative, etc.² Perceptions that OER might be created with lower levels of authority and accuracy, or that they would be too focused on a single campus or specific course, were real and understandable concerns. *Introduction to Engineering* was an ideal case for collaboration between the library and instructors to explore the role of open educational resources to support student success and the role of the library in that effort. Evaluating and tailoring materials to a particular course and the topics covered therein creates a model that can be reproduced in other courses.

Background

There are numerous interpretations of “open educational resources.” The *Forum on the Impact of Open Courseware for Higher Education in Developing Countries* report defines OER as “the open provision of educational resources enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes.”³ The Hewlett Foundation similarly defines OER 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 repurposing by others. OER include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge.”⁴ The definition of OER has also been described as “educational materials which use a Creative Commons license or which exist in the public domain and are free of copyright restrictions.”⁵

Licensing of OER has largely been through variations of the Creative Commons licenses. These licenses consist of four components which can be assembled into a license based on the preferences of the creator or publisher of content. These components are Attribution (BY), Share-Alike (SA), Noncommercial (NC), and No Derivatives (ND). A sample Creative Commons license might be Attribution-NonCommercial (CC BY-NC) which permits others to use a work with attribution for non-commercial application. The omission of the No Derivatives clause means that remixing is permissible.⁶ Both focus on free access which is unrestricted by copyright.⁷

The 5Rs have emerged as a framework to define OER, and like the definition and trappings of OER, have evolved over time. The framework was initially defined in terms of 4Rs: reuse, revise, remix, redistribute.⁸ Later,

an additional consideration was added, retain, to address concerns of “disappearing ink,” or the difficulty in finding persistently available OER.⁹ Retention is a valid concern, one which we encountered numerous times during this project.

The complexities of licensing necessitates careful attention to copyright, and this applies to OER as well as non-open content.¹⁰ Applying Creative Commons licenses to educational resources is the primary way in which they become “open” educational resources. Taking the example given earlier, a resource with a CC BY-NC license allows you to retain the resource by downloading it to your own computer or by uploading it to a repository; to reuse it in any way you see fit (aside from selling it); to revise it; to remix it; or to redistribute it. The only restriction given is that you credit the creator of the resource and you don’t profit from it. This freedom of use is what defines it as open.

Described below is the process we undertook to find, collect, evaluate, and deploy OER in the *Introduction to Engineering* course, along with takeaways and lessons that we learned along the way.

Framing the Search

Before we began collecting materials, we had to define the scope of materials that we intended to collect as well as the topics for which we wanted to find resources. The second question, which topics we wanted to cover, was easier to answer. Using a copy of the syllabus, we identified the major topics and themes covered in the course. These topics [vectors, force equilibrium in two and three dimensions, trusses, friction, center of mass, and content on SolidWorks® (design software that was used in the course)] provided a well-defined starting point for collecting materials, but we still needed to define what types of materials we would collect.

One of the goals for our project was to find materials in as many different formats as possible, so as to accommodate a diversity of learning styles. Problem sets, online tutorials, text, videos, podcasts, or anything else that presented relevant information was acceptable for the purposes of this project. It is worth noting that we were looking only at online materials, partly because of our desire for open materials and partly because we wanted the materials to be easily accessible to the students without having to physically visit the library.

From the onset, we placed an emphasis on fully open resources, as defined by the 5Rs. Following the 5R criteria restricted us in the materials available, which made us suspect that we were missing some of the best materials. Many resources we found were partially open, or implied free and open use but with restrictions that made them not technically “open”.

After initial attempts at searching for explicitly open resources, we realized that our insistence on fully open materials was at odds with the motivations of this project: to provide additional materials to the students taking the course to help them better understand the course content. Even if the content could not be remixed or revised, it often would not limit the helpfulness of the resource. Many freely available online resources are already designed to be short, focused tutorials or to cover a very small topic. These were exactly what we needed to provide for our students, so the ability to revise them was really not necessary. Considering we plan to house all these materials in the course management system, a password-protected system only available to students enrolled in the course, we considered ourselves to be protected under fair use for the redistribution of these resources. With this new scope in mind, we took a fresh look at the materials available online and greatly expanded our list of support materials.

We were, however, still mindful of copyright. Even though we were aware that many textbooks are illegally available online (including the textbook assigned for this course), we were careful not to include any of these resources.

Takeaways

- Carefully consider your needs. If you don't plan to remix or redistribute the resources, you may be able to use resources owned or licensed by your library, rather than limiting yourself to openly licensed or Creative Commons materials.
- Look for resources in a variety of formats. Student learning preferences, environment, and content needs vary, so provide different levels and media when possible.

Finding Materials

Using broad search terms and targeting specific locations were the most valuable strategies we employed to locate resources for this project. Resources available in the Open Textbook Network, LibreTexts Physics, and the OER Commons, were particularly valuable. Additional resources were found in repositories at public universities in states that have policies on open education. These repositories provided us with problem sets and course notes, both of which were lacking in the materials we had collected to this point. For videos, we specifically looked at Khan Academy and YouTube and searched for relevant materials, using both broad terms like physics, statics, and engineering, and more focused terms like those in the course syllabus.¹¹

Takeaways

- This project was necessary because there was no central repository for quality resources on this topic. Searching through well-established repositories like the Open Textbook Network, LibreText, OER Commons, and academic institutional repositories is a good way to start.
- Materials available on the web are not guaranteed to always be there. If possible, and the license allows, download the resource or make a duplicate in your own repository.
- Keep a list of the terms you search, as well as other terms you gather along the way that may help you in further searches.
- Document everything: search strategies, where you had success (or no success) finding resources, license restrictions, etc.

Evaluating Materials

The goal was to make sure that the resources we provided to the course instructors were of high quality and cover a broad range of formats and presentation styles, so we needed to determine what criteria we would use to evaluate the resources. Although we did a cursory evaluation of materials as they were gathered, we nevertheless collected all resources unless they were completely unusable or wrong.

We created an initial list of criteria that would be important for evaluating the collected resources, and we supplemented our list with other existing rubrics for evaluating open educational resources. Several rubrics provided good examples of criteria, but most of them were focused on aligning resources with information literacy standards. While we certainly value the standards, they are not the focus of our project. We were interested in providing the best resources to the students in order to help them to better understand the topics in the course. Drawing on OER rubric examples, created a set of criteria for evaluating OER that included production quality, choice of format, helpfulness, accuracy, engaging, originality/novelty, relevance to course topics, and anything the resource lacked that would have made it better.¹² We also provided space for evaluators' general comments,

TABLE 1					
Introduction to Engineering Resources Evaluation Rubric					
Resource Being Evaluated (Name/Title)					
Resource Being Evaluated (URL)					
Categories	5	4	3	2	1
Production Quality: Consider font, audio quality, video quality, visually pleasant.					
Format Choice: Was the choice of presentation medium (e.g., video, problem set, text, etc.) a good choice?					
Helpfulness: Does it explain the material in a way that will help you to better understand it?					
Accuracy: Is the information presented correct?					
Engaging: Is the resource interesting?					
Originality/Novelty: Is the material presented differently than you've seen it before?					
Relevance: Is the resource relevant to the topics covered in the course?					
What Is Missing/What Would Make This Better?					
Additional Comments					
Overall Rating					

and a question for the “overall rating” of the resource. See Table 1 for our final rubric and additional information about what we meant by each criterion.

We created a Google Form to collect responses. Google Forms gave us the ability to better tailor our 1-5 ratings to the particular question being asked, such as “Format Choice” ranging from “Poor” (1) to “Excellent” (5) or “Accuracy” ranging from “This Is All Wrong” (1) to “Everything Is Correct” (5). Thus we were able to provide context to the students while making data collection simple.

With our rubric established, we were ready to have students evaluate the resources. We reached out to students who had taken the course as well as teaching assistants to ask them to help us “improve *Introduction to Engineering*”, specifically avoiding any mention of evaluating resources. We saw the evaluation sessions as an opportunity not only to evaluate the resources we had collected, but also to explore the students’ and teaching assistants’ understanding of information literacy concepts.

FIGURE 1	
Interview Question Protocol	
Preliminary Questions	
<ul style="list-style-type: none"> • If you were looking for materials to supplement classroom instruction and the textbook, where would you go? • How would you decide if the materials you find are trustworthy? • You find out that someone has uploaded a copy of your textbook to the internet. Do you see any issues with using that textbook? Would you use it personally? • Tell us about <i>Introduction to Engineering</i>. Did you struggle? Did you feel prepared for the course? 	
Final Questions	
<ul style="list-style-type: none"> • What were some of your general thoughts on the resources you looked at today? • Think about the best resource you looked at today. What made it the best? • Now think about one of the resources you decided wasn't good. What made you decide to cut it? • Did the source of the materials impact your evaluation of their effectiveness? • Is there anything else you wanted to share with us? 	

The questions that we posed (see Figure 1) were divided into two sets: those we asked the evaluators before we introduced the project, and those that we asked after we had explained the project and they had taken time to evaluate resources. The preliminary questions were intended to align with some of the ACRL Information Literacy Standards for Science and Engineering/Technology, with a particular focus on the ethics of using information found online and the ability of the students to find and evaluate information to supplement their classroom learning. Overall, the students and teaching assistants provided very similar answers to our questions. While they were aware of the legalities of using information that has been loaded to the web, they were not concerned with the ramifications of using this information. Wikipedia was the favorite website for gathering background information on a topic, and they frequented the same websites over and over when looking for other kinds of information. The only criterion they typically employed for evaluating information they found online was whether or not it could answer the question they were asking.

Takeaways

- Teaching assistant feedback can be just as valuable as undergraduate feedback.
- Be prepared to deal with students' busy schedules. Consider making yourself available during evening or weekend hours, or consider if the evaluation is something that students can do on their own time.
- Exploit any contacts you have to reach out to students. Faculty members and instructors, department undergraduate groups, teaching assistants, etc.. Any one of them may be able to put you in contact with students who can help.

Evaluating Success

We exceeded the goals we set when we began this project. Initially we simply wanted to supplement the existing course textbook, but the instructor was so pleased with the outcome of this project that she decided to go textbook-free in future semesters.

With all of the work that went into gathering and evaluating resources and preparing course modules, it is important to evaluate the value of the project. First and foremost, we must evaluate student success. We intend to employ a multi-pronged approach to student success, evaluating both quantitative and qualitative aspects. Quantitatively, we plan to compare the grades of previous semesters' students, who did not have access to these curated resources, with those of the students in the coming semester who will receive the intervention.

Qualitatively, we would like to conduct interviews with a random selection of students in the course at the beginning of the semester to gauge their preparedness and expectations for the course, as well as to evaluate their information literacy skills. Throughout the semester, we will be doing check-ins to see how much they are using the additional resources we are providing, and how valuable they think they are. At the conclusion of the semester, we will conduct a more comprehensive interview to get their impressions of the course and the supplementary resources, and to evaluate whether their information literacy skills have changed or improved.

Conclusion

Creating a collection of open educational resources is not easy, but with well-defined collection and evaluation strategies it becomes much more manageable. Be sure to document searches and identify license restrictions of resource as you find them. How you plan to adopt OER dictates the decisions you make about which resources are collected. Beware of resources that are too course- or university-specific to be useful. Seek resources in a

variety of formats to ensure support for diverse learning preferences. There are a number of central repositories for OER as well as scattered smaller collections and individual OER which reside on individual websites or servers. Retention of materials may be an issue, since materials available on the web are not guaranteed to always be there. Finally, draw on the resources available to you, including course instructors, students, and other librarians.

Endnotes

1. Head and Eisenberg, "Truth Be Told," 26.
2. Shank, *Interactive Open Educational Resources a Guide to Finding, Choosing, and Using What's out There to Transform College Teaching*, 120.
3. UNESCO, "Forum on the Impact of Open Courseware for Higher Education in Developing Countries: Final Report," 24.
4. The William and Flora Hewlett Foundation, "Open Educational Resources," 1.
5. Wiley, Bliss, and McEwen, "Open Educational Resources," 781.
6. Creative Commons, "The Power of Open."
7. Wiley, "Openness as Catalyst for an Educational Reformation."
8. Wiley.
9. Wiley, "The Access Compromise and the 5th R."
10. DeVries, "Evaluating Open Educational Resources," 58.
11. Evelyn and Kromer, "OER Evaluation as a Means of Teaching Information Literacy in Individual and Small Group Settings."
12. Yuan and Recker, "Not All Rubrics Are Equal."

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