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## **AC 2011-561: FINDING YOUR WAY AROUND THE ENGINEERING LITERATURE: DEVELOPING AN ONLINE TUTORIAL SERIES FOR ENGINEERING STUDENTS**

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### **Abstract**

The typical graduate student in engineering or computer science excels at learning technical skills, but has had little exposure to library resources in his or her undergraduate program. Sometime in the first year of graduate school, most students are asked to do a literature search for a class, or are beginning to look at prior work as they decide on a focus for their thesis, dissertation, or Master's project. At that point, they realize that they will not be able to find everything they need with their current set of Web-searching tools and skills.

Engineering librarians are challenged to engage with these new students at just the right time. Properly marketed, online tutorials may provide part of the solution. This paper explores how the author used citation analysis and discussions with faculty, students, and colleagues to design a set of tutorials that teach graduate students both how to find what they need, and why they need it in the first place.

### **Introduction**

Unlike their counterparts in the liberal arts, engineering students rarely have the opportunity to read journal articles and conference papers in their field during their undergraduate years, much less synthesize and build on them to create new information. On their first day of graduate school, most students do not yet know to what extent they will need information found only through the library and its subscriptions. Science and engineering librarians generally agree that the only realistic goal of in-person orientation sessions is to let new students know they have a librarian, and that person is here to help them. They will need to know much more, but they most likely do not realize it yet.

Clearly, graduate students need ongoing instruction in what types of literature are available in their fields, why they might use items of each type, and how to find appropriate materials within those types. Online instruction provides a way to inform and guide students when they need it. Not only do graduate students prefer online instruction for its time efficiency<sup>1</sup>, but also a number of studies have shown that students learn just as much (and in some cases more) by completing an online module as attending in-person workshop<sup>2,3</sup>.

In October of 2009, the author participated in a month-long online ACRL training course, Instructional Design for Online Teaching and Learning. The outcome of that course was a design for the central module of a tutorial, produced using the ADDIE instructional design model (Analyze, Design, Develop, Implement, Evaluate).<sup>4</sup> The design was refined enough to begin talking to other librarians and faculty about it, but remained just an idea. In December 2010, a six-week professional development leave provided the time necessary to produce a working prototype and to develop the technical expertise necessary to complete the project.

### **Groundwork: What do students need to know?**

Every August, science and engineering librarians at the University of Minnesota are asked to give presentations at orientations for new graduate students in their assigned departments. Time given varies: Last August, one department allotted 20 minutes, another asked for one hour with

the subject librarian and another hour with the university's copyright librarian, and a third dropped library orientation from the schedule entirely. Providing new graduate students with a consistent introduction to all the library has to offer is, in short, difficult.

New graduate students typically have some familiarity with what a librarian might call *secondary literature*. Mildren<sup>5</sup> divides engineering literature into primary and secondary categories. Mildren's secondary literature list, proposed in 1976, includes:

- Handbooks and manuals
- Trade journals and catalogs
- Standards
- Abstracting and indexing journals
- Review articles

At a minimum, bachelor's degree-holding engineers will know about handbooks, trade journals, and standards. However, a new graduate student probably has only a limited understanding of the materials from which these are derived, the *primary literature* of the field. Using Mildren's list, primary literature might include:

- Technical reports
- Conferences
- Patents
- Theses and dissertations
- Scholarly journals

A 21<sup>st</sup> century audience could add to and subtract from these lists, but the categories remain a useful approach for explaining how engineering communication happens. Knowing that different types of literature exist, and understanding how to find and use those types, are key information literacy skills for engineers. Finding ways to teach students these skills when they need them and are ready to learn is in everyone's interest: the librarian, the faculty advisors (upon whom much responsibility for teaching these basics now falls), and the students themselves.

The need, then, is for instruction that:

- Provides both the "big picture" of engineering communication and practical skills.
- Can be consumed in short bursts to quickly get up to speed or review a topic.
- Is accessible whenever and wherever the student needs it.

Finally, the student must see a compelling reason to participate.

The online tutorial series presented here addresses each of these points through its content and the technologies used to create it, and by including faculty and their needs in the design process and marketing.

## Tutorial Design Overview

As one might expect, the tutorial series includes “how to” modules to teach students practical aspects of library use (e.g., how to connect to full text from a database). But the series is organized around a central “hub” (see Figure 1), designed to teach students when and why they might use a particular kind of literature. The hub introduces students to a range of engineering literature and provides an entry point to further instruction.

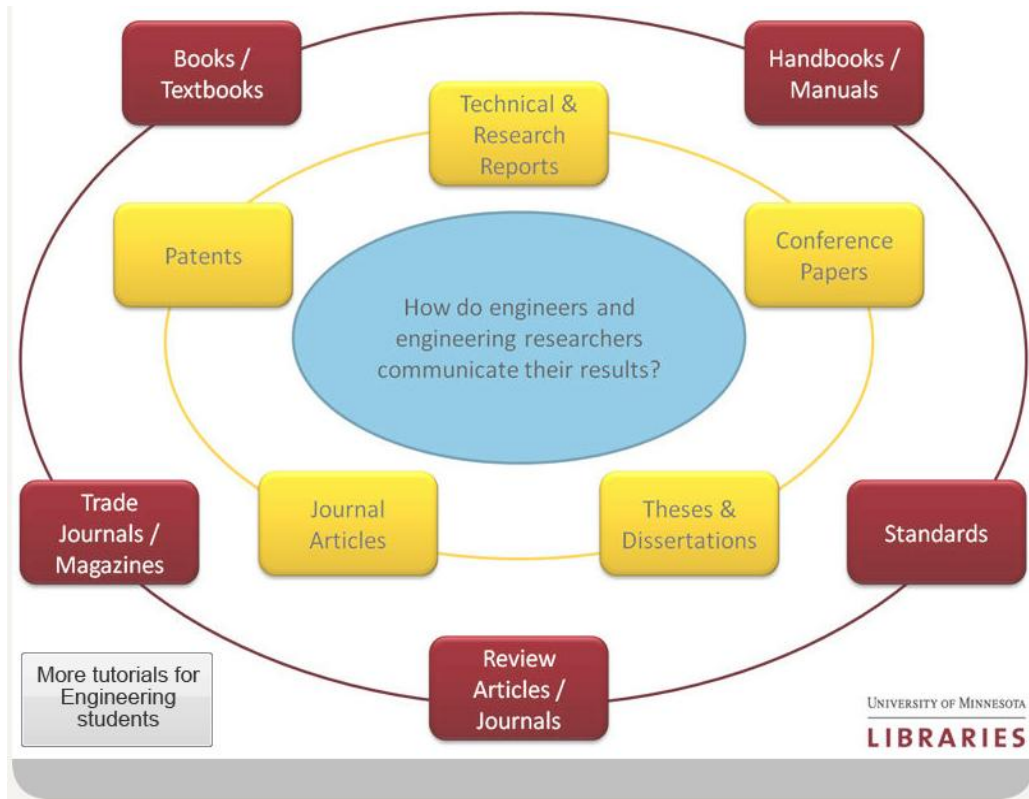


Figure 1. Tutorials are organized around general categories of engineering literature.

An instance of this hub can be customized for a course or for a research lab. For example, a module describing the role of conference proceedings uses citations to papers from a conference in which members of the research lab have presented. The module also lists conferences relevant to the lab’s work and links students to the proceedings. With this structure, the student experiences instruction in a context relevant to their studies and work, and the researcher is able to bring students up to speed in the work of the lab more quickly.

The literature-focused modules are complemented by the set of “how-to” tutorials pictured in Figure 2. The menu shown here is a starting point; other topics are likely to be added over time.

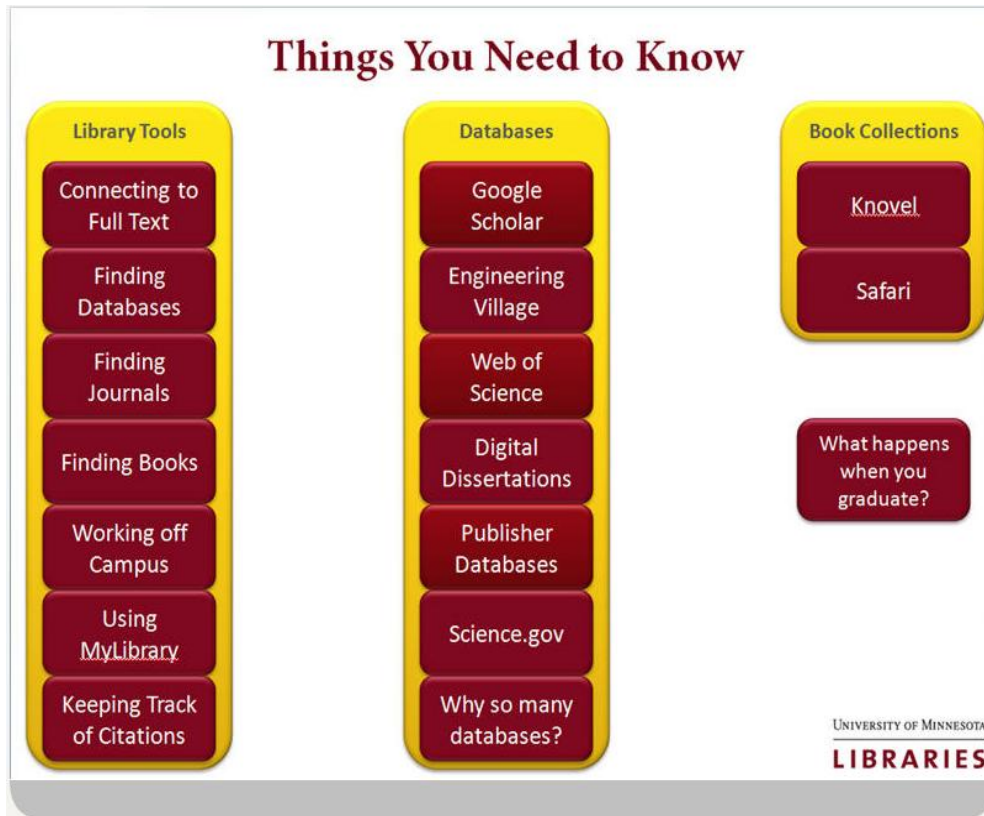


Figure 2. How-to tutorials focus on library tools, databases, and book collections every engineering student should know.

In addition to these practical goals, the tutorial series seeks to fulfill specific objectives. Students will:

- Understand that as affiliates of the college they have many different resources at their fingertips.
- Differentiate between the types of primary and secondary literature most common in engineering.
- Determine which resource or resources make the most sense for their field of research and current information need.
- Find out how to get access to the full text of a desired citation through a library subscription, or a freely-available resource such as USPTO.gov.
- Choose appropriate search tools and use effective and efficient search strategies with those tools.

### **Building the Tutorials: The Development Tool**

One of the keys to building successful online tutorials is software choice. Too many online instruction projects are derailed because the software chosen is too complex for the developer's available time or skill level, or too limited to create a compelling result. Too many initially effective tutorials languish because the software in which they were created does not allow for easy revisions when things change.

All but the shortest tutorials benefit from active learning components. In a review of online tutorials in engineering libraries, Xu states, “Active learning helps beginners store new knowledge by actively practicing, instead of passively memorizing new information.”<sup>6</sup>

To work well in a library environment, an instruction development tool must:

- Be easy enough for an interested subject matter expert to learn with a relatively small time investment.
- Be inexpensive enough to install on staff computers as needed.
- Allow for rapid prototyping, and easy changes to screens after initial production.
- Capture screencasts and provide options for making them interactive (e.g., allow student to click buttons and type in text as appropriate.)
- Provide tools for quizzing the student to assess and/or enhance learning.

University of Minnesota Libraries has standardized on Adobe Captivate<sup>7</sup> for building fairly sophisticated tutorials. Captivate meets all of the criteria outlined above and was already used by some staff when this project began.

As with any even moderately complex software application, learning Captivate does require an investment in time. Rather than develop tutorials by trial and error, the author used a set of training manuals for Captivate 5.<sup>8,9</sup> Working through every exercise in the books took several days, but taking the time up front easily saved twice the time invested. On the advice of a colleague with recent Captivate experience, the author also invested time up front in creating a template project so that every tutorial in the set would share colors and other “skin” elements and have common beginning and ending screens. The current plan includes about 30 unique tutorials, so thinking carefully about these elements at the start was important.

Captivate includes an audio recording feature, but its sound editing capabilities are limited. After trying the built-in tool to record narration for the initial prototypes, the author later switched to Audacity<sup>10</sup>, a popular open source sound editing application. Audacity projects can be converted to MP3 and imported into Captivate projects.

Even with the right tools and training, lessons are learned along the way. Wales and Robertson outline many of the same pitfalls encountered on this project.<sup>11</sup> In addition to creating a standard template and deciding how (and whether) to include narration, Wales and Robertson offer these suggestions for librarians developing online instruction:

- The content experts themselves should produce tutorials, rather than IT staff.
- Storyboarding should be used during design time to reduce production time.
- The tutorials should use interactive elements to keep students engaged.
- Modules should be designed as short sections that can be re-used in other areas.

### **Faculty Involvement**

The best instruction will not help if students do not find it. Advertising on the library website and at graduate student orientations can help, but a particularly effective way to reach graduate students is through their instructors and advisors. Therefore, faculty members were engaged

early in the design process. Several faculty members have agreed to review tutorials as they become available, and there is some talk of requiring graduate students to complete them.

From the very beginning, faculty members offered ideas that improved the design. For example, the idea to integrate a research lab-specific set of resources with the tutorials came from an early discussion with a faculty member. The feature will help faculty members orient new students to the literature specific to their coursework and labs. Faculty members appreciate the potential time savings (for both their students and themselves).

Comments from faculty members on the prototypes have been encouraging:

- “This is just the kind of thing we don’t think to teach about, and it’s the grad students who do all the searching.”
- “We need to come up with ways to ‘spread the news’, because I think you are creating a wonderful resource for our students (and indeed, for the entire [College of Science and Engineering] community).”
- “Let me know when I can show this to my students.”

Early commenters have also suggested many improvements or avenues for future exploration:

- “A flow-chart, table of contents or map in the leger of each frame would be helpful for keeping track of where one is in the video sequence. This would be helpful for spatial learners.”
- “Regarding the format, my own personal preference is to be able to read a document, perhaps with some accompanying images, rather than sit and watch a video. I like the ability to scan through things at my own pace.”
- “Tutorials are great for a beginning student who wants to spend a dedicated amount of time getting to know about library resources. But we also need some quick links to targeted "how to" information...I know you also have some of this information in other forms and locations. Perhaps it is just a matter of cross-referencing?”

Commenters proposed modules to teach skills ranging from using the collaborative features in various citation management tools to following a “who cited whom” trail.

### **Citation Analysis**

The tutorials presented here are certainly not the first online tutorials created by librarians at the University of Minnesota. But this series differs from others because it is written for students in engineering, using engineering terminology for keywords and engineering journals, conference proceedings, books, and databases for every example. Still, how literature is used varies from one engineering discipline to another. Some areas, for example, place conference papers on par with peer-reviewed journal articles while others do not. Focus groups conducted by Hoffmann et al. confirm that engineering students prefer subject-specific instruction that is relevant to their work.<sup>1</sup>

Inspired by the citation analysis work Patricia Kirkwood presented at ASEE 2009<sup>12</sup>, the author undertook an analysis of works cited in recent master’s theses and Ph.D. dissertations from three



departments at the University of Minnesota: Electrical Engineering, Computer Science, and Aerospace Engineering. The intent was to both increase the author's own knowledge of each department's needs and to provide new students with examples of what they could expect to be looking for and reading as they progressed through their programs.

To keep data collection manageable, only theses and dissertations submitted in the calendar years 2008, 2009, and 2010 and available electronically through Proquest Digital Dissertations & Theses or the University's repository were included. Analysis focused on sources listed in the bibliographies. Each citation source was categorized according to document type, using a coding scheme similar to that described by Eckel in his recent analysis of theses at Western Michigan University.<sup>13</sup> For sources identified as journals or books, publisher was determined using UlrichsWeb.

The tutorial set includes a module for each department summarizing the results of the analysis. Students discover:

- How often each type of document was used in their colleagues' dissertations and theses.
- How the results differ between Ph.D. candidates and Masters students.
- Which publishers' journals were most often cited and whether any particular journals were very highly cited.

New students see the information provided in these summaries as practical: They want to know what people like them used to be successful in the same graduate program. The real world examples of publishers, journals, and conferences in their field are a stepping stone to understanding the purpose of each type of literature.

### **Moving from Learning to Applying**

The citation analysis summaries give students an idea of what they may need to read in the future, and suggested resources from faculty advisors inspire them with more precise recommendations. Another tutorial feature, Add to myLibrary, helps students move these resources from objects of inspiration to tools in their new work flow.

The library already has infrastructure in place for each library user to bookmark favorites. This bookmarks list, branded myLibrary, can contain links to databases, online journals, and citations. Links stored in myLibrary are available in a myLibrary tab on the University portal, as shown in Figure 3.

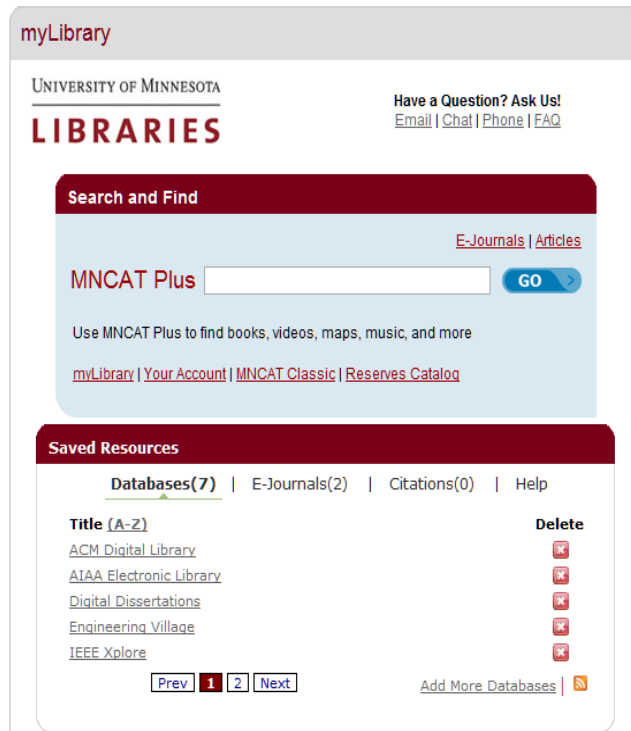


Figure 3. The University’s myU portal includes a myLibrary tab.

The links in myLibrary are also integrated into tabs on the library website when the user logs in. A user can add links to databases and online journals from alphabetical lists of those resources. The OpenURL resolver screen provides a link for adding a citation to the user’s myLibrary.

Within the tutorials, the webpage for each module that discusses specific databases or journals includes a list of those resources along with an Add to myLibrary link for each. When students later go to their portal page or log in to the Libraries website, they see the resources they added and can click the links to go directly to those resources.

### Next Steps

As of this writing, the module in the center of the hub is complete, as is the citation analysis summary for electrical engineering. Selected faculty members and library colleagues have provided feedback. Scripts and screen capture are complete for most of the Library Tools You Need to Know modules. All content is on track to be available for new graduate students starting late in the summer of 2011. To see the working prototype, go to <http://z.umn.edu/englit>.

Considering the time invested in creating these engineering-specific tutorials, assessment will be needed to both improve the tutorials themselves and to prioritize future development. Discussions with the Libraries’ instructional designer to determine the best means of conducting an assessment are just beginning. Ideally, assessments would document how comfortable students feel with their ability to complete a literature review before and after viewing the tutorials, and also measure their learning and retention.

Outside of the tutorials, the author continues to analyze the citation analysis data. Comparing departments to each other or comparing Masters theses to Ph.D. dissertations may yield results worth exploring further.

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