
AC 2011-1193: KEEPING THE CONVERSATION ALIVE: MAINTAINING STUDENTS' RESEARCH SKILLS THROUGHOUT THEIR COLLEGE CAREERS

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Keeping the Conversation Alive: Maintaining Students' Research Skills Throughout Their College Careers

Abstract

At Drexel University the library teaches engineering students information research skills in their first and senior years. These students would benefit from a refresher in their middle college years to enhance their abilities in using library databases. Such an opportunity exists in the junior year when all engineering students are required to take “Technology in Historical Perspective” (HIST 285) a course offered by the Department of History and Politics in the College of Arts and Sciences. This course examines the interrelationship between technology and its economic, social, intellectual, and political context. Because it requires a research component, HIST 285 offers the humanities and social science librarian, engineering librarian, and history department faculty the chance to help Drexel’s engineering students refine and enhance their information seeking skills. Here we outline our program for integrating library research instruction, which will incorporate activities to promote engaged student learning and methods for assessing information competence, into the HIST 285 syllabus. By introducing students to a variety of resources including engineering and history databases, primary scientific literature, and patents, we can help students improve their research skills.

Introduction

Drexel’s engineering undergraduates are required to go through a three-course sequence that culminates in the presentation of a new design to their community during their senior year. The sequence is intended to simulate the real world engineering process of working in teams to solve open-ended design problems—and all that this process entails. Practicing and refining students’ information gathering skills is a critical component of the senior design sequence, because true innovation cannot occur without a solid understanding of the ethical, legal, social, and technical contexts in which invention occurs. Well developed library research skills are integral to students’ success in the program. Drexel’s engineering librarian works closely with senior design students both in the formal classroom setting and in one-on-one and small group sessions.

Forming the foundation for engineering students’ research skills is a structured library instruction program during their freshman year. But between their freshman and senior years there is no class required for all engineering students that integrates formal library instruction. For this reason, by the time they arrive at their senior design projects, students have often forgotten their research skills. Additionally, the library’s electronic resources collection is constantly becoming more exhaustive, leading to ever increasing challenges in instructing students in information skills. During the three or four years between receiving formal library instruction, students simply fall behind.

Drexel’s engineering librarian keeps detailed statistics on the questions students ask him. Analysis of these questions indicates that some students have lost some basic information skills acquired during previous library instruction sessions. One of the questions asked by a student in his junior year illustrates this succinctly.

I need the following article:

“Parker, M.D., Rowe, R.C., Upjohn, N.G., 1990. Mixer torque rheometry: A method for quantifying the consistency of wet granulations. Pharm. Tech. Int. 2 (8), 50–62.”

How can I access it online?”

Although this student has been in the college for more than two years and has received formal library instruction, he still needs assistance in locating this journal article. The problem is by no means unique to Drexel. A study of sophomore engineering students' information needs at UCLA, (Ercegovac 2009)¹, reported that sophomore engineering students had difficulties in finding the correct journal using library's online catalog. Students also had trouble understanding the difference between periodical databases and the online library catalog.

Even when students can find information, they have trouble differentiating between appropriate and inappropriate sources for scholarly use. In a two-year citation analysis of freshman engineering design reports Denick, Bhatt, and Layton (2010)² found that even after library instruction early in the term, students did not properly cite sources from handbooks and web resources. Google still appeared to be the preferred choice to find scholarly papers even though library instruction clearly demonstrated the importance of library-subscribed electronic resources.

The engineering librarian has observed that many students in their middle college years contact him for more research help, and sometimes these students are asking basic questions, so it is clear that students would benefit from more library instruction geared towards this specific group. As Nerz and Weiner have described, an approach to integrating information literacy instruction into the engineering curriculum across each year of the undergraduate program can be an effective way to meet this need (2001)³.

An additional problem comes from students transferring from community colleges or international universities into Drexel's engineering programs. These students are not part of the freshman engineering project at Drexel and have missed the library instruction, information quizzes, and design experience requiring them to write a final report with appropriate references. They have also missed the Freshman Writing Program, which all freshmen are required to take in their first year.

Our approach to these challenges echoes Expanding Horizons, Trinity University's campus-wide information literacy initiative, which provides faculty and instruction librarians an organized approach to integrate information skills into “courses and curriculum at each stage of a student's career.” This initiative is aimed at systematizing student achievement of information literacy goals across the campus. Trinity's Information Literacy Committee envisioned a five-year plan for college students in which incoming freshman build a foundation of information skills during their first year, add additional information competencies over time, and reach mastery of those skills before they graduate (Millet, Donald, & Wilson, 2009)⁴.

It is our experience that new approaches to library instruction are necessary to keep students engaged and to encourage them to explore library resources for their class assignments. This paper highlights some approaches we use to foster research skills among students. Some

thoughts on how these activities helped or what needs to be changed in future classes are also provided.

Integrating Library Instruction with History Courses

It is recognized that technology has played, and continues to play, an integral role in civilization. However, the challenge remains to understand the historical development of technology in its varied social, economic, and political contexts. Outlining a forum to help students explore this, Loendorf (2010)⁵ described a junior-level, interdisciplinary course studying the historical foundations of technologies and their impact on human lives. Jing, Gao and Dong (2010)⁶ highlighted teaching and cultivation of humanistic qualities through social history education as a method of encouraging critical thinking methods and a spirit of scientific inquiry. Condoor (2004)⁷ stressed the importance of teaching history of technology and outlined a method of integrating it into the framework of a capstone design project. This project provided students a means to understand the evolutionary nature of technology, the impact of engineering on society, and the role of engineering failures. Condoor's approach helped students to understand the historical contingency central to the evolution of emerging technologies.

The American Historical Association (Stearns, 1998)⁸ asserts: "History helps us understand change and how the society we live in came to be." Teaching history of technology to engineering students will motivate them to understand how technologies have influenced the evolution and emergence of modern society. More than the celebration of great achievements, the methods inherent to historical research teach engineering students useful lifelong learning skills. For example, the close reading of primary source documents, including patents, lab notebooks, or newspaper articles, can help engineering students understand not only the design process but also its relationship to its broader historical context. These are the same crucial thinking skills that engineering students must develop to succeed in their senior design projects and postsecondary careers. Including enhanced training in library research skills in courses such as HIST 285 trains students to locate and use appropriate resources in their engineering assignments.

HIST 285 (Technology in Historical Perspective)

The Department of History and Politics in Drexel University's College of Arts and Sciences offers HIST 285, which is a required course for all engineering students. Engineers typically enroll in HIST 285 in their pre-junior year. It is not open to freshmen, and it often attracts students from other departments. Taught by a number of different history faculty, the course uses a thematic approach that addresses such contemporary historical issues as the relationship between technology, government, and culture. It also covers the topics of technological imperialism, gender, race, and comparative developments in the West, Asia, and Africa. Primarily a lecture course, HIST 285 also incorporates a variety of media, guest lectures, and weekly discussion sessions. A central component to HIST 285 is the research project. Students are required to write a 1500–2000 word research essay (or alternative product, e.g. website, short documentary film, or digital library project) exploring a focused topic in the history of technology. These projects must be founded in scholarly secondary sources, including journal articles and monographs, and primary historical documents such as patents, diaries, and engineering publications, and other credible print and web based resources.

Such assignments can only be executed well if students are trained in the proper research skills. However, as discussed above, many engineering students enrolled in HIST 285 either forget the lessons of their first-year information research orientation or never receive any formal library instruction. Often they have fallen into the habit of using popular search engines like Google, perhaps because other courses do not require them to use quality information resources. This lack makes apparent how crucial it is that the training of research skills is reinforced prior to launching their senior design projects. HIST 285 offers an excellent opportunity to accomplish this.

The new information research tools, databases, and other resources that are developed each year also present a challenge to keeping students' skills current. Helping them identify which new tools will be the most useful in their research is another role for the librarians working with the HIST 285 classes. Faculty and librarians working collaboratively can bring direct and indirect library instruction activities into HIST 285. This approach can help students develop the research skills needed to successfully complete their assignments with the crucial benefit of reinforcing the skills students will need in the senior design projects.

Possible instructional activities

Our approach to reinforcing the information research skills of HIST 285 students, in collaboration with the history faculty members teaching the course, involves a combination of activities, some already in place and some that may be implemented in future terms. In most sections of the course, each student is required to write a paper on a project exploring the history of a particular technology. A unique approach to integrate group learning among students is envisioned even though students are not required to work in a group setting. Other sections of the course have an assignment involving group work, and a different mix of library learning activities may be chosen for those sections. Below are brief descriptions of the planned activities.

Current activities

Direct instruction by librarians

During each quarter when the course is taught, the humanities and social sciences librarian conducts a library instructional session highlighting the important resources and tools that students must use to locate information needed for their project.

Direct instruction by faculty

Faculty members reinforce library resources while teaching content during the term. Important resources and tools are also linked from their course web pages so that students can easily access them through these pages.

Research Guides

Librarians have created useful research guides for HIST 285 and for various science and engineering disciplines. These guides can help students locate information needed for their final project. Research guides are available from the library's web site and can also be found using search engines such as Yahoo and Google. They can also be linked from the course management software.

Consultations

For more in depth research needs, students can consult with librarians. Consultations are carried out in librarians' offices or in separate rooms with computer and projection facilities for groups. In the past students have sought consultation assistance on such topics as the history and invention of the ball point pen, the jet engine, the steam engine, Plexiglass, and the electric guitar.

Students often approach librarians with email questions. Here are two examples:

"I am doing an individual research project for HIST 285 on The Ben Franklin Bridge...I would like to come by ...and see if you can help me collect some sources for my project. ...I am interested in any information on the bridge I can get, as I do not yet have a solid thesis."

"I need some help in locating primary resources for my project paper on the history of electric guitar. I was wondering if you can help me."

Instruction on archival research and creating Omeka projects

One professor teaching a section of HIST 285 has collaborated with the University Archives and its staff to immerse his students in archival research. Students chose a topic related to a technology developed at Drexel, and they received training on both processing archival documents and the use of Omeka, an open source tool for creating and sharing digital collections. They then worked in teams to research their topics and created an online exhibit as the final product. The project required students to work closely with the documents created as part of the invention process.

Vision for innovative activities

Field Trip

This particular activity would take HIST 285 students on a field trip to a place where history comes alive with science and technology related themes. For example, the Franklin Institute in Philadelphia has ongoing exhibits on computing, flight, electricity, automation and "Amazing Machines." Students, librarians, and faculty members can visit these exhibits in a group while they explore different historical aspects of technology and invention. Ideally, the field trip would be scheduled early in the term before students have selected their topics. Discussion after the field trip would help students come up with their own topic. In this case a group approach could be used where peers help each other to find, refine, or modify their choice of topic. Field trips to museums like the Smithsonian and the National Air and Space Museum would help students learn historical concepts behind such technologies and provide meaningful learning experiences (Condoor, 2004)⁷.

"Journal groups" or other peer-review opportunities

Students would explore their research topics in a group setting with or without a librarian present. During topic exploration, active discussion among students and librarians would be encouraged. The dialog could motivate students to find more relevant journal articles, web resources, patents, primary resources, and other materials, for their individual projects. This

group approach would be used to facilitate peer review of each other's research, helping students identify gaps in the information they have gathered.

Vision

We hope to implement these activities and teaching methods in HIST 285 classes during the Summer and Fall quarters of 2011. Since several faculty members teach different sections, we will form collaborative teaching and learning partnerships with them. This arrangement will help develop assessment strategies that may include seeking feedback from student experiences, examining their research papers, and monitoring references to evaluate quality of papers.

The assessment strategy will involve longitudinal examination of the information skills of engineering students as they progress from the freshman design project, through HIST 285, and on to the senior design project. The process could begin as a citation analysis or a test as part of the freshman design project. The use of information resources by students in HIST 285 may be assessed by a citation analysis of the submitted research projects with the analysis itself done by both history faculty and librarians. Another test could then be given at the start of the senior design project with the goal being to measure the retention of information skills across the entire undergraduate degree program. The information skills assessed will be closely linked to the ALA/ACRL/STS Task Force on Information Literacy for Science and Technology's Information Literacy Standards for Science and Engineering/Technology (2006)⁹.

Conclusions

The problem we have attempted to address is essentially one of how students, librarians, and faculty can collaborate in a learning endeavor that enhances engineering students' information skills to prepare them for the heavy research demands of their senior design project. To be creative and innovative engineers, students must understand the novelty of their designs and the context into which their designs are introduced.

Drexel's senior design project encourages students to familiarize themselves with the ethical, legal, and social implications of their designs. Historical research into innovative technologies will help provide students with the ability to understand the contexts in which novel designs have historically been introduced. This foundation of research into innovation will mean that students will be better equipped to identify potential contexts for their own innovative designs and to understand those contexts from an ethical, legal, and social perspective.

That there is a course that all engineering students must take, that it is mostly taken before the senior year, and that the course already involves an information research component presents a fortunate opportunity. HIST 285 comes at the ideal time in a student's college career for a reinforcement of library research skills. Because of the nature of historical research, those skills can be exercised without major changes to either the content or the assignments of the course. The approach that we have described is the product of fruitful collaboration between faculty and librarians to identify methods to increase the information research skills of engineering students in a way that is integral to the history course. We believe that our work within the HIST 285 course will not only help the students write better researched history papers, but also prepare the engineering students for better researched senior design projects.

1. Ercegovac, Z. (2009). What Engineering Sophomores Know and Would like to Know about Engineering Information Sources and Access. *Issues in Science & Technology Librarianship*, (2009) 57. Retrieved from <http://www.istl.org/09-spring/refereed3.html>
2. Denick, D., Bhatt, J., & Layton, B. (2010). Citation analysis of Engineering Design reports for information literacy assessment. Proceedings of the 2010 American Society for Engineering Education Annual Conference & Exposition. Retrieved from <http://www.asee.org/search/proceedings>
3. Nerz, H. F., & Weiner, S. T. (2001). Information competencies: A strategic approach. Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition. Retrieved from <http://www.asee.org/search/proceedings>
4. Millet, M. S., Donald, J., & Wilson, D. W. (2009). Information Literacy across the Curriculum: Expanding Horizons. *College & Undergraduate Libraries*, 16(2), 180-193.
5. Loendorf, W. (2010). The social, economic, and political impact of technology: An historical perspective. Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition. Retrieved from <http://www.asee.org/search/proceedings>
6. Jing ,Y. Gao, S. & Dong, Z.. (2010). Analysis on the cultivation of the humanistic qualities of college students by social history education. In Q. Lou, International Conference on Optics Photonics and Energy Engineering (OPEE 2010), Vol. 2, pp. 99-102. doi:10.1109/OPEE.2010.5508052
7. Condoor, S. (2004). Importance of teaching the history of technology. *Frontiers in Education*, 2004. FIE 2004. 34th Annual (p. T2G/7-T2G10 Vol. 1). Presented at the Frontiers in Education, 2004. FIE 2004. 34th Annual. doi:10.1109/FIE.2004.1408508
8. Stearns, P. (1998). Why Study History? - American Historical Association. Retrieved from <http://www.historians.org/pubs/free/WhyStudyHistory.htm>
9. American Library Association. (2006, July 24). Information Literacy Standards for Science and Technology. Retrieved from <http://www.ala.org/ala/mgrps/divs/acrl/standards/infolitscitech.cfm>