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INSPIRING INNOVATION WITH PATENT INFORMATION LITERACY IN THE ENGINEERING TECHNOLOGY CURRICULUM

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Abstract

Patents have wide appeal to students, faculty, and employers and can be a potent tool for integrating information literacy (IL) into engineering and technology curricula. There is evidence to show that students use patents to assess the patentability of their design ideas, explore the state of the art in a given area of technology, and to inspire creativity in their work. Faculty use patents and other complementary forms of gray literature to go beyond the traditional IL world of scholarly literature and engage students with information problems that reflect real-world design challenges. Working with patents allows students to develop strategic, innovative and practical information skills that are valuable and attractive to employers in the modern technology workplace.

Putting these ideas of patent-related information literacy into practice, this paper will discuss the collaborative efforts between academic librarians and disciplinary faculty to integrate patent IL content into a scaffolded IL sequence in a technology-focused undergraduate curriculum. This sequence, which also covers scholarly information and technical standards, presents students with increasingly complex information problems over the course of their academic career. The entire IL sequence, which includes four design classes, will be described, with a primary focus on how patent IL fits into and enhances this model.

Keywords: patents, information literacy, standards

Introduction

Patents, in addition to their commercial value, are indispensable sources of information for engineers and technologists. For working engineers and technologists, patents are an incredible (and free) source of technical information and a tool to help them avoid duplicative designs. For employers, patents protect their intellectual property and provide insight into the technological advances being made by their competitors. For students, patents can act as case studies, showing how others have previously attempted to solve a given problem, and give them a better idea of how information practices may differ outside of academia. For librarians working in the information literacy space, patents should be a powerful tool to incorporate information literacy content into engineering and technology curricula.

The “real world” aspect of the patent literature is especially useful for the implementation of an information literacy instruction program. In terms of outreach, engineering and technology faculty often use patents and patent information as information sources and to protect their own (or their university’s) intellectual property, and they may see the value in exposing students to it, perhaps even over and above traditional scholarly information. This is especially true in more applied subject areas (e.g. engineering technology), where faculty often work on more practical and less theoretical research projects. As previously mentioned, students see the appeal of patents immediately. Patents take ideas of design out of the realm of the abstract and make them concrete. While patents may be difficult to search and interpret, they provide the ability to connect the design process to work that actual engineers and technologists do in the field. A student might see patents not only as a catalog of existing inventions, but as a starting point for where a given technology might go in the future.

Other forms of gray literature can offer similar benefits. Standards are heavily used by working engineers and technologists to ensure safety, cross-compatibility, and quality in their designs. When students use standards to guide their own designs, they are able to incorporate known constraints and industry norms early in the process, avoiding potentially time consuming and costly changes in the later design stages. Technical reports and government documents, while not the focus of this paper, can be similarly useful, depending on the specific context of a given course or program.

At Purdue University, collaborations between the Purdue University Libraries and the Purdue Polytechnic Institute (PPI, formerly Purdue University’s College of Technology) have resulted in the integration of information literacy instruction across the undergraduate curriculum. Students in the Mechanical Engineering Technology (MET) program are exposed to traditional scholarly information resources as first-year students, introduced to standards as sophomores, patents as juniors, and given the opportunity as seniors to bring all of these tools together as part of a capstone course. At each level, the students incorporate these information sources into team-based design projects that focus on solving real-world problems.

Literature Review

Patents and other forms of gray literature have long had a role in the practice of engineering librarianship and related information literacy activities. Patents have used in an information literacy context as both a supplement to the scholarly literature (Seeber, 2007) and as a tool to determine commercial viability of a student project (Meier, 2015; Wohrley & Mitchell, 1997). In addition to these two roles, a recent study has indicated that patents may be an avenue to introduce information literacy concepts into the design process as a spur for creativity (Phillips & Zwicky, 2017). When introduced to patents outside of the frame of commercial value, students have been shown to use patents to inspire and validate their own proposed solutions to technical problems. Beyond patents, integrating standards IL into curricula enables students to identify where standards apply to their designs, and how to locate and access relevant technical standards (Phillips & McPherson, 2016).

In engineering and technology education more generally, patents and standards can take on additional roles. Patents, specifically, are ideally suited to be used as case studies, with the idea that each patent is an attempt by an inventor (not necessarily successful) to solve a

particular problem through the application of technology. By following specific inventors or patent classifications, it is even possible to see how these solutions changed over time(Whittemore, 1981). More broadly, an engineering and technology student who may never publish a scholarly article may find themselves in a position where they need to file for a patent (MacMillan, 2005). Similarly, standards' primary use case is not their information content, but their application. Student use of standards in design projects is an accreditation requirement for the Accreditation Board for Engineering and Technology (ABET), the primary accreditor for engineering and engineering technology programs in the United States (Khan, Karim, & McClain, 2013).

Incorporating information literacy into instruction on a curricular level, strategically implemented and based in specific competencies, is the most effective means of teaching engineering information literacy in a university setting (Weiner & Nerz, 2001). This means engineering information specialists/librarians need to be involved in multiple courses within a department's course sequence, ascending in complexity with each iteration, and that information literacy needs to be actually incorporated into the work of the courses. A one-off lecture and standalone assignment are not sufficient; students must connect information literacy to the course's engineering content. In an ideal scenario, this curriculum integration would include information literacy components in each course, with librarians deeply embedded and working extensively with students one-on-one, however this is deeply unrealistic, given staffing levels and disciplinary faculty buy-in. A more typical implementation of curriculum integration aims librarian attention on a handful of courses, focusing effort and resources towards specific courses where the connections to information literacy content are more obvious, such as those that feature design projects (Nerz & Bullard, 2006).

Program Background

Purdue Polytechnic Institute is a primarily undergraduate-focused academic unit within Purdue University, offering degrees in a variety of applied engineering and technology subject areas ("Purdue Polytechnic Institute," n.d.). While it has programs at Purdue University campuses around the state of Indiana, PPI is based out of the main West Lafayette campus. Its Mechanical Engineering Technology program is a department within the PPI's School of Engineering Technology that teaches applied engineering principles related to mechanical components, systems, and practices ("Purdue Mechanical Engineering Technology," n.d.). The MET program has a heavy focus on the practical side of engineering technology, with an emphasis on working in teams to solve engineering design problems.

Purdue Libraries has historically had a strong relationship with the College of Technology and later the PPI. There has been a Libraries presence in MET since the 1980s, with Libraries and Technology faculty members collaborating on developing assignments to introduce students to various information resources (Erdmann & Harding, 1988, 2010). Within the MET curriculum, the Purdue Libraries currently plays a role in four courses, TECH 120, MET 102, MET 302, and the capstone MET 401/402 (cross-listed with several other departments).

Interventions

Collaboration

The process for developing this curricular integration began with collaboration between faculty members in the Libraries and the Polytechnic, initially on a single course (MET 102) and then expanding into more courses as opportunities for further collaboration were identified. Parallel to this, faculty members within the PPI have been participating in Purdue University's Instruction Matters: Purdue Academic Course Transformation (IMPACT) course redesign program. IMPACT, a collaboration between the Libraries and the university's Center for Instructional Excellence, stresses student-centered active learning ("Purdue Impact," n.d.). PPI faculty who participated in IMPACT, such as the facilitator of the MET capstone, proved to be open to expanded collaboration on information literacy topics, particularly in areas of direct relevance to "real world" careers, such as patents and standards.

TECH 120 (Design Thinking in Technology)

TECH 120 is a first-year design course, meant to familiarize students with the concept and process of engineering design, typically focused on solving problems for the campus (e.g. long lines at dining halls, inconvenient traffic crossings). As it is a somewhat generic course, aimed at students in a variety of technological disciplines, the information literacy content is more generic than specific to any one discipline. There is discussion of scholarly articles and broad information literacy topics (such as search strategies and assessing credibility), but it may not dig into the specific resources and techniques utilized by students in a particular engineering or technology discipline.

The Libraries' have had a consistent presence in TECH 120, with Libraries faculty occasionally serving as instructors of record for some sections of the course. Even without that direct instructional role, however, every section of the course receives at least one visit from an engineering information specialist to cover the basic information literacy material. In the librarian-run sessions, recent research projects involved using "design journals" to investigate how first-year students use information (Fosmire, Johnson, & Mentzer, 2017).

MET 102 (Production Design & Specifications)

The sophomore-level MET 102 is a CAD-focused design course, centered on the development of sound mechanical designs. Given this focus, technical standards are a natural fit, as they can be easily integrated in the context of the products and components the students' are focused on designing, such as screw threads and gears (Phillips & McPherson, 2016).

Librarians support and interact with this course in several ways. Through close collaboration with the instructor, they develop instructional materials and assignments (Phillips, Fosmire, & McPherson, 2017), scaffolding into the lesson plans over several weeks so that students are exposed to standards gradually and through increasingly complex assignments. The lessons cover a variety of topics, including what standards are, how they are developed and disseminated, their perceived benefits and limitations, and how to search, access, evaluate, and use standards. Librarians also serve as consultants for students and student groups with standards-related needs.

MET 302 (CAD in the Enterprise)

By their junior years, MET students have hopefully become acquainted with traditional scholarly resources, and they are expected to tackle more sophisticated engineering design projects. In MET 302, engineering technology students work on a semester-long, team-based design project, aimed at solving a real-world problem. The students work extensively with various CAD programs and are expected to develop a working prototype of their design. Given the focus on both the real-world context and the development of a novel, useful device, this design project is an ideal place to incorporate information literacy content related to patents into the course. Librarians are involved in the design of the patent-focused content and also support students in a consultant role, as necessary (Phillips & Zwicky, 2017).

The patent-focused intervention for this course involves several components. The first is a straightforward assignment that walks students through the parts of a patent and acclimates them to the language of patents. Next comes a visit by librarians to the class to formally introduce the concept of patent searching, with an entire class period devoted to working through patent searches. By this point in the semester, the students have already selected their design project and they are able to do searches that directly impact their designs. Finally, the librarians assess the students' grasp of patents and patent searching through pre- and post-testing, as well as the examination of student work products. In some semesters, librarians have attended students' final presentations to ask questions about their use of patent information.

MET 401 & 402 (Capstone Project)

As seniors, MET students take a two-semester capstone design course, in which they are expected to learn and utilize principles of project management in the completion of an externally-sponsored design project. In information terms, this means bringing everything together and using the full panoply of information sources covered in previous courses. Again, librarians are involved as both lecturers, refreshing students on relevant tools and resources, and as consultants, helping students solve information problems they encounter in the course of their design project.

Results & Discussion

The sum total of these efforts is a full curricular approach to incorporating information literacy into the MET program at Purdue University. Students graduate through a series of courses in which they are exposed to progressively more complex and relevant information sources, culminating in a senior design capstone where all the pieces come together in a single project. Although there has been assessment work on the individual course level (i.e. the previously referenced work of the authors), there is a lack of assessment of the overall program. Partly this is due to the piecemeal nature of the work, with different librarians working with different classes, and the longitudinal nature of curricular assessment. Anecdotally, however, the reaction of the MET faculty and students has been uniformly positive. They have observed

improved outcomes for students in the courses where librarians provide support, and they have noted better levels of preparedness in students entering their courses from earlier parts of the sequence.

In addition to the perception on the part of the disciplinary faculty, a useful data point for generating additional collaboration opportunities, different research projects undertaken in several of the courses have demonstrated information literacy gains at the individual course level. Fosmire, Johnson, and Mentzer (2017) demonstrated the viability of the "design journal" assessment methodology. Phillips and McPherson (2016) demonstrated the value of information literacy interventions related to standards, in terms of student outcomes. Phillips and Zwicky (2017, also the authors of this paper) found interesting applications of patent information by students in the ideation and validation phases of the design process. In this last case, several students commented on the value of patent information. One student, in their project report, noted that "It really was helpful to see past successes and failures in this design in order to avoid those same pitfalls." In another student's personal reflection paper, a student stated "I still feel as though we looked at the patent for [our project] and thought about how we can make it different enough to not be normal, whereas I think it would've been more interesting to use [these] patents to be inspired to make something different and more creative."

Conclusion & Future Work

Patents and standards, alongside other forms of gray literature, are powerful tools both for engineers and technologists and for librarians working to communicate information literacy concepts to engineering and technology students. The real-world relevance and practical nature of patents and standards are potential keys to both outreach and instruction aimed at an engineering and technology audience, with appeal for faculty and students in those areas. While traditional scholarly resources are still relevant, more in-depth use of patents and standards has the potential to greatly enhance information literacy instruction practices in the engineering and technology space.

The next steps for these projects could include greater coordination between the faculty members supporting the various courses (these are, in many cases, the same people) and the addition of some form of cumulative, longitudinal assessment covering the entire sequence. Additionally, some form of assessment specific to the capstone course may be necessary, independent of the others. While these next steps could improve the sequence as a whole, this sequence already succeeds as a model for curricular integration of information literacy into an academic engineering technology program using patents and standards, as well as a platform for research into the information practices of its students and the applications of patents and standards in an information literacy context.

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