Engineering Ethics and the Drexel University Library: A Collaborative Teaching Partnership

Jay Bhatt, Mark Manion, & Eli Fromm
Drexel University

Abstract

At Drexel University, the present undergraduate engineering curriculum has evolved from the Enhanced Educational Experience for Engineering Students (E^4) project and the Gateway Engineering Education Coalition, both National Science Foundation (NSF) funded initiatives to re-engineer undergraduate engineering education. Since its institutionalization in 1994, the curriculum has served as a model for an integrated lower-division engineering curriculum. One aspect of engineering education proposed in this curriculum was "addressing ethics in the context of an engineering issue". To accomplish this goal, courses were designed with engineering ethics topics embedded within the syllabus.

In parallel, the past decade has seen extensive growth in the number of electronic journals such as those from the IEEE, and electronic books available as subscription based library electronic resources. Along with the web, this has created an information overload that is now a major source of confusion among students. This paper discusses an effort to integrate these resources into coursework, as collaborative partnerships among the faculty, the library and students. We describe various materials used for teaching ethics, library created web-based instruction, librarian consultations with students to help them find various sources of information for engineering ethics, and in the process target ABET requirements of lifelong learning.

I. A Brief History of Engineering Ethics at Drexel

In 1988 Drexel University's College of Engineering began an experiment to dramatically restructure the undergraduate engineering program. The restructuring went well beyond curricular issues alone to address the relationship of the many aspects of a student's program to one another and to the general educational culture. At the core of this restructuring were several concepts:

- The vertical integration of basic math and sciences interwoven and concurrent with an engineering intellectual centerpiece to develop the theoretical base around the engineering intellectual issue.
- Introducing engineering early and thus providing the student with a professional context for the foundation studies of mathematics and sciences.
- A movement from the traditional sequential layered approach of independent and somewhat isolated courses to an integrated whole from the first day of the student's college experience.

- Increased emphasis on experiential learning of engineering and tying that together with the classroom instruction.
- Emphasis on teamwork as well as independent work; developing leadership and academic depth.
- The imperative for superior communication skills, the development of teaming and organizational skills as well as independent work.
- Illustrate the relationship of the basic sciences, engineering, and the liberal arts. In particular the relationship of science and technology to social systems and political policy.

The objective has been to identify the student with the concept of an emerging professional. In that context the issues of social responsibility, learning from historical experiences, and ethics become important. The success of the original experiment (E^4) led, ultimately, to the formation of the Gateway Engineering Education Coalition, a group of seven Schools of Engineering with the program leader located at Drexel. The Coalition has pursued the common goals noted above. At Drexel, engineering students have liberal arts studies usually in the first two years integrated into their total curricula and student experience, as noted above.

II. Engineering Ethics Courses at Drexel

At the heart of our ethics-in-engineering program is a multidisciplinary approach that relies on the field experience of practicing engineers, the conceptual analysis provided by philosophers and ethicists, along with resources from drama, literature, history, and the social sciences. Our program is tied to topical classes that engineering students take elsewhere in the curriculum, and to parallel components in history of technology. The team includes instructors from Engineering, Philosophy, History and Politics, and Literature, all bringing their particular areas of expertise to bear on the entire range of issues discussed. The program requires that the student participate in essay writing, oral presentations, dramatic re-enactments of famous (or notorious) ethical case studies, and in-class debates. We aim to provide experience which is multidimensional, and which presents ethics not as another isolated discipline that requires mastery, but as fundamental to all engineering activities. Overall, this program requires thirty weeks of instruction in engineering ethics (10 weeks – Evaluation and Presentation of Data EPED 231, 10 weeks – Evaluation and Presentation of Data EPED 232, and 10 weeks - PHIL 315 Engineering Ethics). This provides the opportunity to develop a curriculum in engineering ethics with a breadth of topics and a depth of analysis missing in most other engineering schools' curricula.

The selection of this model grew primarily from challenges that the engineering program at Drexel faced as a result of its mandatory cooperative education ("co-op") programs. Students who returned to school from co-op assignments, their employers, and school officials involved with co-op, have alerted the curricular committees to the clear need to revisit and strengthen the ethics programs in the college. Our students faced challenges in the work place that they felt unequipped to deal with. Students' employers felt that a host of issues related to professional behavior, respect for proprietary information and communication skills, needed to be addressed. The rebuilding of the programs in response to these challenges coincided with the emergence of the ABET EAC Criteria.[1] The multifaceted approach of the criteria was consistent with our view that ethics instruction should be given "in context," and is closely related to other planned activities in the students' curriculum (*e.g.*, laboratories in the sophomore years.) Moreover, the

choice of this model reflects our belief that the combination of ethics instruction relating to professionalism and individual responsibility, along with extended treatment of themes, concepts and categories for dealing with the social, political, and environmental context of engineering practice is an effective curricular model for responding to the ABET Criteria 2000.

EPED 231 and EPED 231

All sophomore students in Drexel's College of Engineering (CoE) are required to take twenty weeks of "Evaluation and Presentation of Engineering Data" (EPED 231 and EPED 232). This 8-credit two-quarter class includes four components: (1) a topical laboratory (three hours per week) covering classical experiments in systems theory, strengths of materials, and physics (energy and thermodynamics); (2) a history of technology component, which accompanies the experiments with the relevant historical and societal background (one hour per week); and (3) a two-hour weekly meeting focusing on engineering ethics, which, among other topics, discusses issues of presentation and evaluation of data from an ethical perspective. The aim of this class sequence is to provide the laboratory, history and ethics experience as one unit, with the various components drawing on and relying on each other.

We have found that the best method of instruction is to implement a plurality of methods, including code-based reasoning, case-based reasoning, moral problem-solving approaches, as well as philosophical analysis concerning the impacts of technology on society. In addition, we use different media--such as dramatic re-enactment of cases and reading of plays--that has the additional advantage of breaking the tedium of frontal lectures, and increasing overall interactivity in the classroom. This "methodological pluralism" proves to be very effective, both in the communication of information, as well aiding in the students' development of critical reasoning skills and complex moral problem strategies.

Teaching code-based reasoning increases students' knowledge of standards of conduct. It instructs the future professional on his/her duties and obligations as defined, both by informal or personal codes, as well as formal and professional codes. In addition, it draws on the professional's understanding of societal standards of conduct and the resulting duties and obligations. Teaching case-based reasoning increases ethical sensitivity to complex issues by stressing the particulars of each case and the (often open-ended) problems and complex moral ambiguities and ethical uncertainties surrounding engineering practice. Teaching moral problem solving methods increases the capacity for ethical judgment, and facilitates critical scrutiny of the logic of moral reasoning.

Teaching social and political responsibilities increases awareness of the complex ways technology impacts society, both positively and negatively. It increases the professional's sense of empowerment with respect to the choice of engineering as a potential career. Students become aware that, as engineers, they have the potential to do both great social benefit, but also to do grave social harm.

The first quarter of the ethics component in the sophomore year introduces the students to the concepts of professionalism, engineering codes of ethics, code-based reasoning, and case-based reasoning strategies. Many micro-case studies are referenced and analyzed during classroom

discussion, and a major case study in professionalism is then studied and analyzed in detail. Examples of such "major" case studies are the "59 Story Building" case, involving the Citicorp Center in New York City, and the history of Cold Fusion. In addition, the students read a play that illustrates a major issue in professional ethics. Among plays read in the past were George B. Shaw's *Major Barbara* and David Mamet's *Glengarry Glen Ross*.[2]

The second quarter of the ethics component in the sophomore year moves closer to issues of data analysis and presentation, ethical issues in engineering R&D, and to social impact topics. Students are also introduced to the concept and methodology of moral problem solving. Numerous cases are presented and discussed, using the logic of moral reasoning. In addition, students are introduced to *engineering law* through the review of contract law and product liability law. Case studies are referenced to illustrate the subtleties of legal matters. In addition to the on-going analysis of micro case studies, a major case study involving engineering law and engineering ethics is studied in detail. In the most recent past we have used the J. Robert Oppenheimer "affair" of 1952-1953 for this "major" case study. In previous terms we have used the "Baltimore Affair" for that purpose. Plays that we have read in the second term included Bertolt Brecht's *"Galileo,"* and Friedrich Duerrenmatt's *"The Physicists."*

Student assessment includes weekly quizzes which cover the reading material, written case-study assignments, and a paper on the play. The last two weeks are devoted to student presentations. These are 10-minute public debates; the objective is to analyze an engineering question with ethical ramifications (*e.g.*, should I-95 and the Pennsylvania Turnpike be connected in Northeastern Pennsylvania?) Debaters are instructed to be confrontational, and present the two opposing viewpoints on the issue. Students are further asked to use the codes of ethics and the moral theories discussed in class to enrich their arguments.

Philosophy 315 Engineering Ethics

In their third year, Drexel engineering students take PHIL 315 Engineering Ethics. Building on the foundations laid by EPED 231 and EPED 232, this third course analyzes the broader social responsibilities of the engineering profession, and addresses the macro and political issues concerning the impact of technology on society. Course offerings in PHIL 315 Engineering Ethics have grown tremendously over the last six years since its implementation. Approximately 25-30 sections of PHIL 315 Engineering Ethics are offered annually. This means that about 600-700 Drexel students take the course each year**.** The course represents a critical reflection on the nature of engineering and technology, as well as a critical reflection on the ethical obligations and responsibilities unique to the engineering profession. Topics covered include: the place and purpose of engineering codes of ethics; the social responsibilities of engineering, the ethics of whistle blowing and organizational (dis) obedience; ethical issues of risk perception, analysis, assessment and management; the interactions between science, technology, and human values; and socio-historical analysis of the impact of technology on society and culture. Of particular importance here is the concept of *Risk*. Indeed, few topics are more germane to the relationship of contemporary technology and human values than risk assessment and equitable risk management. These topics contribute to an understanding of the interactions among science, technology and society, by raising questions about acceptability of risk, the appropriateness of technical versus cultural perceptions of risk, equity issues in the distribution of risk, and the

ethical responsibilities of individuals, corporations, and governments concerning the safe and beneficial operation of complex sociotechnical systems.

Our strategy is to introduce the various topics in stages:

1) Engineering Professionalism and Individual Responsibility—an understanding of the nature of ethical responsibilities and an introduction to code- and case-based reasoning, and how these help to determine appropriate courses of action, especially when responsibilities are either not clear or come into conflict (sophomore year - first quarter).

2) Engineering and Society—an understanding of the professional nature of engineering and the implications of the social responsibilities of engineering; relations between engineering ethics and the law (sophomore year - second quarter; pre-junior year).

3) Technology and Society—an understanding of the complex interrelationships between technological development and societal and individual well-being; the relation between engineering and the environment (sophomore year-second quarter; pre-junior year).

4) Technology and Public Policy—an understanding of the politics of technology assessment, the socio-techno-politics of risk, and the role of the engineer in the management of technology (pre-junior year).

The first stage includes the issues that impact most immediately and directly on engineers in practice, whether employees, independent entrepreneurs, or consultants. These issues include matters of individual responsibility related to technical competence, legal liability, or causal responsibility. The second stage includes issues that are not so clear-cut, and are often associated with difficult questions such as individual versus collective responsibilities. Among those are controversial cases of whistle blowing, reproductive technologies, and changing technologies that affect the workplace. The third stage considers ethical responsibility in its full "social" sense. Typical problem-sets at this stage exemplify both collective and individual responsibility, and are typically extremely complex. Nuclear weaponry, biotechnology, world hunger, or the ethics of technology transfer are typical examples. The fourth stage focuses on the public policy ramifications of engineering, both through explicit action of engineers, and the political reaction to engineering innovation. A typical example here is the effect of changes in information technology and communication technology on the law and on the societal role of computers and mobile phones.

III. Role of the Library in Support of Engineering Ethics Research Sources Available and Instruction on Their Use

Due to the nature of the courses just described, students need to locate, read, and analyze course related material such as reports, articles published in magazines and scholarly journals, and case studies available on the web. Given the multidisciplinary nature of the material, students must rely on resources from many subject areas such as Philosophy, Politics, and Literature. In addition to the ethics courses all students working on design projects are required to address

possible ethical issues they might face and provide solutions along with the concrete steps they would take to resolve the problem.[2]

It is clear that the library has a significant role providing supporting material for the engineering ethics curriculum. Students are required to participate in essay writing, ethical case studies, debates and research on the topics assigned to them. In order to successfully complete their assignments, students must collect sufficient materials from a variety of resources to provide the evidence to support their arguments on a particular case. Open-ended discussion and electronic dialogues have also been effective and beneficial because they stimulate debates while the students are exploring various ethical issues in their independent coursework.[3] Electronic dialogues provide a forum to extend the debates beyond the regular class time.[3]

Even though students have been exposed to the library research during their freshman design Experience, without intervention they tend to rely more on freely available web sites to obtain supporting material for their assignments and debates. The Drexel Engineering Curriculum (tDEC) design program for freshman involves about 600 students in approximately 120 teams working on different design projects. While assisting these team-based projects, we found that the students enjoyed and benefited from both individual and group consultations with the librarians.[4] The design project requires in-depth research on the topic that the students have chosen for their group project. Students work in groups of four to six, collaborating on various facets of the project topic.

Because of the complex nature of the freshman design projects, students consult many information resources available from the library to find what they are looking for. They often felt a need to consult with the librarians in order to utilize the available resources more efficiently. During such consultations, librarians and students explore fundamental engineering resources, such as encyclopedias, handbooks and scholarly journals. On many occasions, students recognized the usefulness of such resources over free web-based resources, and as a result, their final project reports showed considerable improvements. According to the instructors the quality of final design reports was definitely improved.[4] We perceive that this was due to the combined library and faculty's emphasis on using authoritative research sources, and citing them in their final reports.

During the tDEC design program for freshman, students are introduced to the concept of ethical use of information, importance of properly citing the resources found, and avoiding plagiarism during the course of their design projects. The library instruction sessions for the tDEC design program for freshman covers this important aspect of information ethics. Librarians at Drexel have created websites on Plagiarism at
http://www.library.drexel.edu/research/tutorials/plagiarism4.html

and citation style guide at
http://www.library.drexel.edu/research/tutorials/citation/default.html.

These websites together with concepts of academic integrity are actively promoted by both faculty and librarians to students in tDEC design program for freshman. The engineering librarian and the faculty together have envisioned further stressing ethical aspects of information

use during teaching engineering ethics in EPED 231, EPED 232 and PHIL 315. Because of the continued emphasis on the ethical use of information from tDEC design program for freshman, students are expected to become lifelong supporters of using information ethically.

In courses such as EPED 231 and EPED 232 during their sophomore years, students are instructed to do research related to an assigned article. The instructor clearly indicates that the article is an opinion piece and the students may need to research the issues that support or refute the assertions that are made by its author in order to gain a better understanding of the topic assigned. There are many web related resources such as "Introducing Ethics Case Studies Into Required Undergraduate Engineering Courses", developed at Texas A&M University, which can be useful for students learning ethics, but students are required to perform their own searches to find appropriate and relevant discussion material using a variety of library resources.[5]

Since the coursework requires using available library resources such as books, audio and video resources, library subscribed databases and electronic journals, it is key to provide library instruction on how to find these resources –not only to retrieve ethics information but, ultimately, to help students learn to use library resources effectively for their other courses and projects. Unfortunately, in many situations the library instruction component is often ignored even where web-based resources are used for teaching engineering ethics. For example, in a study of information technology and engineering ethics by Terry et al. in which a two credit engineering ethics course was introduced, the authors showed the internet resources on engineering ethics but the University-wide library subscribed print and electronic resources were not discussed.[3] On the other hand, Thomes, Cornell and Gottfried report a study dealing with teaching freshman to write technical reports and learn to use library resources effectively in which students were asked to identify any ethical problems in assigned cases related to technological failures. They were then required to use library resources, including electronic indexes, to locate supporting materials for their viewpoints.[6]

Another way to stress the importance of library resources for students in these classes is to use the same approach for consultations used with freshman engineering students. Consultations with librarians often involve helping the students brainstorm about how to find supporting materials. With this approach, the librarian is seen as someone who facilitates and mediates the information retrieval process with students.

The following is an example that illustrates our approach:

A student was exploring the type of ethical issues involved with the shuttle disaster. Using dialogue-based interactive conversation with the student, the librarian helped the student analyze the topic and this resulted in successfully finding articles that the student found to be very useful. During the process, the student was shown major electronic subscription based databases such as *Applied Science and Technology Abstracts* and *IEEE Xplore*. After learning how to search in those databases, the student was successful in finding several articles where ethical issues dealing with the shuttle disasters were analyzed.

Drexel students have used databases such as *Ei Compendex* and *IEEE Xplore* to find research articles for their design projects, but many had not yet realized that articles on ethics can be

found using the same databases as well as non-technical databases like *ABI/Inform*. Our observations and initial discussions with students and faculty have confirmed this.

To address this problem, an email was sent to all engineering faculty and students with a few tips on searching for engineering ethics information. It focused on using the online library catalog effectively and included some examples of books located using the catalog. Some examples of the titles of books found in the catalog and included in the email were:

Social, ethical, and policy implications of engineering
Engineering ethics: concepts and cases, and
What every engineer should know about ethics

The email also included some tips on using electronic databases to find scholarly journal articles. This email generated a number of responses from both faculty and students, including comments from the faculty in appreciation of the library's efforts, requests for the tip email to be sent a second time in case some students and faculty missed or deleted it, and finally requests to schedule formal library oriented sessions.

Expanding the role of the library in support of the Engineering Ethics Program

Library Instruction Until recently, there were no specific library instruction sessions conducted for any of the engineering ethics courses such as EPED 231, EPED 232, and PHIL 315. We believe that library staff instruction sessions form an integral part of teaching engineering ethics and that they could, and should be designed, developed and given in collaboration with the faculty involved. The collaboration model of faculty-librarian cooperation in teaching is also advocated by Farber in his survey of 25-30 years of library instruction.[7]

A major initiative in this instruction would be to make students aware of the availability of library resources both on campus and remotely, in doing this they would learn about subscription-based library resources, and the fact that even though they appear to be available free to them, the Library has paid for their access. Students would learn that they can locate peer reviewed scholarly papers in those databases and that the content of such databases is not included in free search engines such as Google or Yahoo. Therefore, if they simply rely on free web sites, they will miss quality information available in those electronic databases. A long-term result from these sessions would be to form a base of the necessary research and critical thinking skills which they can apply to any information seeking tasks they will be performing in their future careers - essentially promoting the concept of life-long learning.

Library Website on Engineering Ethics. Librarians in partnership with the faculty created a web resource guide for students in the ethics-related courses called Engineering Ethics. Resources identified in the guide are approved by the faculty-librarian team in charge of web development.

The Guide is even more useful when access to the web site is provided from multiple locations such as from the Library's site, the course pages and via online interactive course management systems such as webCT and Blackboard. With this in mind, a research guide to support engineering ethics in different courses and design projects was created. It is linked from the Main

Engineering Research Help page (Engineering Guides) at http://www.library.drexel.edu/research/guides/engguides.html and can be accessed from the Resource Guide on Engineering Ethics at http://www.library.drexel.edu/research/guides/pdfs/engethics.html

The research guide provides starting points including a sample of print books on ethics and other social issues applied to engineering design, links to several library subscribed databases, Library of Congress call number ranges to assist students in directing them to library shelf locations where related books can be found, and some quality web sites on engineering ethics such as onlineethics.org which provides discussion based on the cases considered by the Board of Ethical Review (BER) of the National Society of Professional Engineers (NSPE).

It is envisioned that creative use of the resource guide coupled with the library instruction session on research skills will effectively guide students of engineering ethics in successful retrieval of useful information from a variety of tools, particularly from peer reviewed literature. For example, a particular assignment requires students to investigate human error and system failure during accidents such as the Bhopal or Three-Mile Island disasters using the *IEEE Xplore* database linked from the resource guide. Here they can retrieve articles like 'Extending the application of formal methods to analyze human error and system failure during accident investigations' from *Software Engineering Journal* published in November 1996.

IV. Librarians and Professors: A Collaborative Teaching-Researching Partnership

We at Drexel have articulated at least three fundamental goals that provide the necessary foundations for successful professor-librarian collaboration. These are: (1) Increasing Information Literacy, (2) Professor-Librarian Collaboration and Information Exchange, (3) Enhancement of the academic experience of Drexel students in order to foster life-long learning. Information literacy is defined by the American Library Association (ALA) as knowing how to find, evaluate and use information effectively. The Engineering Ethics information literacy program is designed to be supportive of the *Information Literacy Competency Standards for Higher Education* document available from the *ALA ACRL Standards & Guidelines*.[8] At Drexel professor-librarian collaborations enhance the students' engineering ethics education through various strategies, including:

Networking: Sharing information about a common goal.[9] It is very important for faculty members and librarians to work together and readily share necessary information. Discussions during formal meetings, emails, and informal lunches are some of the ways by which networking among faculty and librarians can be established. This process of collaboration and "networking" can often result in very beneficial and effective relationships between the department, the faculty and the library. In the process, it will successfully contribute towards meeting goal#2 described above.

Developing the library collection together. [9] Another fruitful area for collaboration is collecting library materials. There are a variety of resources in many formats including books, cases, reports, DVD or video material showing debates on various issues, transcripts of interviews with professionals investigating engineering cases or case studies of technological failures.

Documentaries are another important resource that are vital to students. One workable process is for the librarian to identify a list of books and other materials that the library owns as well as resources the library does not own based on the course syllabi provided by the faculty members; the librarian can send this list of books and resources to the faculty members for feedback, and notify the faculty when new materials become available. Faculty can also make their suggestions about the collection independently to the librarian. This strategy also helps in meeting the goal #2 dealing with Professor librarian collaboration.

Teaching critical thinking skills together.[9] Faculty and librarians working as a team can begin to identify different ways in which critical thinking skills can be taught. For example, since students in ethics courses are already required to participate in debates, learning how to make effective arguments can be very crucial for these students.

One strategy that is in place at Dartmouth to teach students the necessary critical thinking skills for constructing a convincing, logically sound argument is for faculty and librarians to work together during an instructional session that teaches critical reasoning skills, designing and developing a variety of issues which require debates, and creating assignments where students are required to apply the skills learned. [10] At Florida International University (FIU), the Information Literacy Initiative considered teaching critical thinking skills a central component to imparting information literacy to the students.[11] With the focus on teaching critical thinking skills, FIU librarians realized the importance of developing relationships and partnerships with other campus partners such as undergraduate studies, academic computing, the Academy for the Art of Teaching, and both the faculty and the administration. Since one of the primary goals of the Academy for the Art of Teaching at FIU was teaching critical thinking skills, it became easier for the librarians to collaborate with them in working towards the common goal of information literacy.[11]

The positive experiences of successful collaboration between faculty and librarian incorporating critical thinking skills are also described in a study about a business course at Villa Julie College, a small comprehensive college in Maryland.[12] The course required students to develop a search strategy for their assignment, identify key search terms representing their research topic, and use both electronic subscription based business databases and Internet web sites to find articles and relevant information which they needed to evaluate for quality and authority.[12] Here at Drexel, we plan to integrate similar search techniques for information retrieval in engineering ethics courses, where obtaining information from electronic subscription based databases and Internet web sites is important, but more importantly, evaluating and selecting quality resources for their assignments is considered vital. Professor-librarian teams at Drexel will work together in teaching these critical thinking skills. This approach will help us meet our goal#1 of increasing information literacy skills, goal #2 of professor-librarian collaboration, and goal#3 of fostering life-long learning.

Incorporation of library assignments in faculty courses.[9] To achieve this goal, both faculty and librarians work closely to develop assignments such that students use critical thinking skills to provide evidence and support to the arguments they are applying to their particular cases. We completely agree with Larson's assertion that both faculty and librarians must realize that they are in the same business of teaching their students various information related skills.[13] Poor

communication between the librarians and the faculty about assignments can cause problems even at the reference desk as is shown in a study conducted at the City University of New York surveying six community colleges.[14] In our model for Drexel, we aim for collaboration at every level. With the librarians' knowledge of the goals and purpose of given assignments, they will be in a better position to render assistance to students when needed. This approach targets information literacy, life-long learning and collaboration goals.

Coordination.[9] Both faculty and librarians while working independently towards a common goal can coordinate to create library instruction sessions in support of an assignment. The focus here is on basic search skills such as Subject versus Keyword Searching, Library of Congress Subject Headings, creating effective search strings using synonyms, combining search terms using "AND" and "OR" (Boolean Searching), and using search terms identified in various electronic databases to locate appropriate citations. This instruction session will also introduce students to a variety of information resources available and will provide an effective medium to motivate active participation of students through dynamic interaction. This interaction can be in the form of collaborative team based searching for a particular topic assigned to each team, and then having each team presenting the defense of their position on the given topic. Besides the information research skills, presentation skills of students are also stressed – an important asset and a very useful contributor in life long learning. This again helps us meet goal#3 dealing with life-long learning.

Collaboration.[9] At every stage of course planning, materials design and development for teaching, and content building, both faculty and librarians should collaborate with the ultimate aim of mutually agreeable teaching schemes for these courses. Faculty-librarian partnership can evolve into a team based teaching structure resulting in both being involved at various stages of the educational experience. The success of team-taught courses by faculty and librarians has been documented by Chiste, Glover & Westwood.[15] They attribute the success of their management course at the University of Lethbridge, which aims to 'show of teaching team solidarity' where both the professor and the librarian work on equal basis and with full knowledge of each other's needs and goals. Effective collaboration and partnership between the two is a precondition for success in a team taught course. Such a collaboration first begins with the professor providing the syllabus for the course, teaching sessions are planned based on the collaborative brainstorming process with intelligent feedback between librarian and professor, and a series of assignments prepared by both the librarian and the instructor together. The importance of the faculty-librarian team presenting a 'united front' in the success of team taught instructional programs has also been illustrated in a study in which the team effort had been claimed as a crucial factor in Information Retrieval Skills programs at Doane College (Nebraska).[16]

Rader in 'Faculty-Librarian Collaboration in Building the Curriculum for the Millennium: The US Experience' provides further examples of successful professor-librarian collaboration.[17] These include: the Library Liaison Program at the University of Louisville based on librarian-faculty partnership in all disciplines through collection development and collaborative efforts in bringing information literacy into the curriculum, and the Interdisciplinary Computer Applications course at Hunter College which is based on the collaboration between the librarian and a Philosophy professor to teach computer applications. All seem to indicate that the dynamic

librarian-faculty interaction is extremely important in building successful instructional programs. We envision a similar librarian-faculty interaction, collaboration and team teaching in PHIL 315 engineering ethics course at Drexel. Collectively, all strategies described above help in meeting all three goals outlined at the beginning of this section.

Future Library Instruction

We envision that since PHIL 315 is a course taken by all engineering students, and is offered during the third year, library instruction will motivate them to learn new resources and additional research skills since their first exposure during freshman design projects. They will be able to transfer these skills more easily when they begin their Senior Design Projects in the final year. Therefore, this instruction will be planned, developed and implemented in a manner that will reinforce lifelong learning. Snavely has recommended a course-integrated across the curriculum model for information literacy to help students become life long learners. The emphasis is on 'continuing conversations' among librarians, faculty, students and staff so that these collaborations will be successful in creating a lifelong community of learners through the information literacy programs created across the curriculum.[18] Snavely also points out that one of the factors that contribute to the success of information literacy programs is the library seminars and collaborative workshops provided for the students.[18] Our instruction will be interactive in nature where students will participate in small groups to actually carry out the information seeking and evaluation process and make appropriate decisions in choosing resources for their sample in-class activity. The skills learned will be transferable and can be applied to their assignments. Faculty and librarians will partner to design, develop and implement library instruction for EPED 231, EPED 232 and PHIL 315. It is too early to say how library instruction in these courses will differ at this stage, but depending upon the staff availability, and budget, we intend to integrate this much needed library instruction component with these courses.

Future Directions

In order to better understand students' information needs in engineering ethics, we will conduct a few focus groups. Focus groups will consist of students taking courses requiring engineering ethics. At least three observation sessions will be conducted: first, before the library session; again, after the Library session; and the third after reports are done. Insight gained from the feedback will help us to modify and further improve our Faculty and Library collaborative teaching efforts in engineering ethics.

V. Conclusion

We have described the curricular, pedagogical, and methodological objectives that the engineering ethics professor/librarian partnership aims to meet. At the core of our approach is the belief that the engineering ethics program, including courses, syllabi, and instructional focus, should be interwoven into an integrated engineering curriculum, and relate closely to other analytical and hands-on activities of the engineering student, in the classroom, in the lab, and in library research activities. The study of ethics should supplement, clarify, and modify the values acquired during professional socialization, and draw on real-life experiences collected by the student in the school and the workplace. It is expected that a program of this nature is but a

foreshadowing of the kind of engineering education likely to emerge as the profession grapples with 1) the theoretical and practical implementation of the ABET Criteria; and 2) the design, implementation, and management of technological development as it impacts the political and cultural aspects of modern society. The collaboration between the Faculty in engineering ethics, and the Drexel University Library will play a significant role in assisting students in making informed decisions in their professional lives in future, and in the process contributing towards life long learning.

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Biographies

JAY BHATT is the Information Services librarian for Engineering at Drexel University. He is responsible for building library collections in engineering subject areas, outreach to faculty and students, and assisting faculty and students in their information retrieval process. He is actively involved with the Engineering Libraries Division of the ASEE. He is also the 2003 recipient of Drexel University's Harold Myers Distinguished Service Award.

DR. MARK MANION is an Assistant Professor and the Director of Drexel's philosophy program. He is co-author of Minding the Machines: Preventing Technological Disasters (Prentice Hall, 2002). He has published articles in the IEEE Technology and Society Magazine, International Journal of Risk Assessment and Management, Technology in Society, Computers and Society, and other leading professional journals.

DR. ELI FROMM is the Roy A. Brothers University Professor, Prof. of Electrical and Computer Engineering, and Dir., Center for Educational Research at Drexel University. He has also served as V.P. for Educational Research, Vice Provost for Research and Graduate Studies, and interim Dean of Engineering. He was the P.I. of the Drexel E^4 project and the Gateway Coalition. He is the inaugural recipient (2002) of the NAE's Bernard M. Gordon Prize.