AC 2010-875: ENGINEERING LIBRARIAN PARTICIPATION IN TECHNOLOGY CURRICULAR REDESIGN: LIFELONG LEARNING, INFORMATION LITERACY, AND ABET CRITERION 3.

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The Need for and Definition of Lifelong Learning Skills

The content knowledge of technical majors has been estimated to have a half-life of less than five years.\(^1\) Thus, one of the most important skills students can take away from their technical education is the ability to become ‘curious and persistent continuous learners,’ to quote Purdue University’s *Purdue Engineer of 2020* outcomes statement.\(^2\) The engineering community has long realized the need for lifelong learning, as evidenced by the theme of the 1978 ASEE Annual Conference of ‘Career Management – Lifelong Learning.’ However, with the publication of Educating the Engineer of 2020, which recommends, ‘…as well as delivering content, engineering schools must teach engineering students how to learn, and must play a continuing role along with professional organizations in facilitating lifelong learning,’(pg. 55) lifelong learning has taken on much greater visibility in the engineering curriculum. ABET’s accreditation criterion 3.h, which requires that students recognize ‘…the need for, and an ability to engage in life-long learning’, codifies the importance of these skills.\(^3\)

Certainly, lifelong learning requires strong content knowledge. Without fundamental subject knowledge, there is no foundation upon which to learn new concepts and skills. However, as ABET and the National Academy of Engineering above have noticed, students need to acquire other skills in order to be successful. Shuman, Besterfield-Sacre, and McGourty\(^4\) propose that engineers undertaking lifelong learning need to ‘…demonstrate reading, writing, listening, and speaking skills, demonstrate an awareness of what needs to be learned; follow a learning plan; identify, retrieve and organize information; demonstrate critical thinking skills; and reflect on one’s own understanding.’ This is in line with Knowles\(^5\), speaking specifically about self-directed learning, who posits that successful self-directed learners must be able to identify their learning need, determine a learning plan to acquire the skills or abilities to meet the need, actually implement the plan, and be able to determine whether they met their learning goals. The Association of American Colleges and Universities have recently created a draft VALUE rubric,\(^6\) that defines curiosity, initiative, independence, transfer and reflection as the key components of lifelong learning competencies.

Information Literacy and Lifelong Learning

While information literacy isn’t explicitly mentioned above in the descriptions of core lifelong learning skills, looking at the Association of College and Research Libraries’ (ACRL) information literacy competency standards for higher education rapidly yields many strong parallels between the two. According to the standards, students need to be able to:

1. Determine the extent of information needed
2. Access the needed information effectively and efficiently  
3. Evaluate information and its sources critically  
4. Incorporate selected information into one’s knowledgebase  
5. Use information effectively to accomplish a specific purpose  
6. Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

In addition, the ACRL Science and Technology Section (STS)’s ‘flavor’ of information literacy standards also maintains that a student ‘…understands that information literacy is an ongoing process and an important component of lifelong learning and recognizes the need to keep current regarding new developments in his or her field.’

Viewed from the perspective of lifelong learning, the ability to ‘determine the extent of information needed,’ corresponds to articulating a ‘learning need’. ‘Access[ing] the needed information’ and ‘using information effectively to accomplish a specific purpose’ fits within the framework of developing and carrying out a learning plan. ‘Evaluat[ing] the information and its sources critically,’ incorporates the ‘critical thinking’ skills of Shuman et al., and ‘incorporat[ing] selected information into one’s knowledgebase’ accesses the ‘self-reflection’ component mentioned by Knowles and the AACU.

Certainly, lifelong learning comprises more than information literacy alone, as not all learning requires the provision or incorporation of new information. The development of a new skill may require practice of that skill, for example, learning to play a musical instrument, rather than the acquisition of new knowledge. However, librarians, instructors, and students benefit from the coupling of information skills with the more general lifelong learning skills. Lifelong learning provides a larger context for the importance of information skills for students, and librarians’ expertise with information literacy competencies can enhance the quality of lifelong learning skills taught by engineering faculty.

In order to solidify the integration of information literacy and lifelong learning concepts, ideally, librarians and engineering faculty need to collaboratively articulate the relevant information literacy skills in terms of lifelong learning (and indeed, other ABET student performance) outcomes. Once translated into the language of ABET, those competencies can be cemented into curricular expectations at the department and college levels.

Librarian Involvement in Curricula Design/Overhaul

Librarians have sought for many years to integrate information literacy skills throughout the curricula of their liaison departments. Baker and Pelster discuss the history of librarian involvement in curricular design. They focus on proactive involvement of librarians in the educational design process, and ultimately, a meaningful partnership between discipline faculty and librarians. Engineering and science librarians have attempted to develop meaningful
partnerships in a variety of disciplines through curricular development. Individual courses have been overhauled in collaboration with faculty members. Custom services have been offered to improve student outcomes in specific courses. In particular, librarian involvement in design courses has proved to be a successful point of collaboration. Additionally, librarians have developed tools for interacting with faculty around issues of information literacy, including analysis of syllabi and assignment analysis.

In some cases, librarians have been asked to collaborate in a total curriculum overhaul for a department, college, or university. In the case of Hulse et al., a single capstone course was designed with librarian input to meet desired lifelong learning outcomes. Macalpine and Uddin integrated information literacy across four years of design courses at Trinity University. Similarly, Nerz and Bullard integrated information literacy objectives into a freshman, sophomore, junior, and senior level chemical engineering course series, by linking information literacy standard criteria to existing course assignments. Riley et al. redesigned the entire departmental curriculum while including an information literacy/lifelong learning component across the curriculum.

Many librarians and faculty focus curricular redesign around the ALA/ACRL/STS Standards for Information Literacy in Science and Technology. Trussell examined ABET 2000+ in light of existing information literacy practice. Riley compared ABET Criterion 3, ALA Standards for Information Literacy and the curriculum outcomes for a redesign of the Smith College curriculum to insure integration of information literacy across the curriculum.

Case Study

Librarians often find themselves excluded from the curriculum overhauls that occur in their liaison departments. The departments consider the curriculum ‘their responsibility’ and haven’t traditionally thought of gathering input from stakeholders outside their discipline. Since they may consider curricular reform an internal activity, librarians may not even know such activity is taking place until it is already well underway or even completed. At that point, a librarian has lost the opportunity to proactively influence the new curriculum; rather they are forced to ‘patch’ their information competencies onto the new language and outcomes determined by the department.

However, at Purdue University, the Electrical and Computer Engineering Technology (ECET) Department invited a member of the engineering library faculty to participate in a major overhaul of their curriculum. The invitation to participate came during an introductory meeting, as the library faculty member prepared to become the liaison to the ECET department. While the department assigned the librarian to a group discussing changes to the non-ECET core courses required to round out ECET students’ college experience, such as humanities, management, and science courses, the department head specifically requested that the library faculty member consider how to integrate lifelong learning and creativity into all parts of the curriculum,
focusing on ways to ensure that the department would graduate well-rounded engineers and technologists.

The library faculty member then met with the non-ECET core courses subcommittee. The objective of the committee was to develop the non-technology core objectives that students were expected to attain while in the program. In the course of these discussions, it became clear that the technology faculty did not believe their students displayed effective information literacy skills, that critical thinking and creativity enhancing skills such as brainstorming and mind mapping needed to be developed, and that the department needed to reinforce all of these skills throughout the curriculum to develop students capable of lifelong learning.

With these guidelines in mind, the library faculty member prepared a document that compared the missions of the university, the College of Technology, and the ECET department, as well as the ABET Technology Accreditation standards Section 3 and the ACRL Standards for Information Literacy for Science and Technology. This document served as a baseline and guide for skills and characteristics required or desired in graduates of the ECET department and gave a picture of possible standardized outcomes. (See Appendix 1.) It was inspired by the work of Riley et al, which described the redesign of Smith College’s engineering curriculum.

The document demonstrated that information literacy skills supported not only lifelong learning, but also supported all of the other ABET Criterion 3 objectives. Indeed, the ABET Criteria 3 objectives map most strongly to the ALA/ACRL/STS standards not in criterion 3.h, otherwise known as lifelong learning, but in criterion 3.c (An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes) and in criterion 3. g (an ability to communicate effectively). The ‘ability to analyze and interpret experiments and apply experimental results to improve processes’ (3.c) would not be possible without the ability to ‘recognize interrelationships among concepts and combines them into potentially useful primary statements and/or summary findings with supporting evidence’ (ACRL 3.3.a). Similarly, in order to ‘communicate effectively’ (ABET Criterion 3.g), ECET students must be able to select ‘a communication medium and format that best supports the purposes of the product or performance and the intended audience (ACRL 4.6.a).”

The non-ECET core courses subcommittee members were particularly intrigued by comparing the ALA/ACRL/STS standards with the skill sets that they felt their students currently possessed and those that the students should obtain by the time they graduate. As the curriculum in effect at that time stood, instructors prior to the senior year rarely required external literature reviews. Students did not receive practice in gathering and synthesizing information from articles in a consistent way until their senior design project. As the advisor of the senior design course noted, under the existing curriculum, students would arrive in senior design and upon receiving regular email updates making them aware of resources and scholarly articles relevant to their projects, frequently ask the faculty member to stop sending the email because the students could not keep up with the in-flow of information.
Additionally, each faculty member had different expectations for the lab notebooks kept by the students. Given the different levels of accountability and detail expected across the curriculum, students came to the senior year with varying degrees of proficiency at citing external sources, tracking research progress, and communicating results of their research.

For the faculty members, the science and technology standards were not ‘extra’ educational objectives to teach, but rather skills that they believed their students needed in order to be successful both academically and in their future employment in high tech industries. In response to the document prepared by the library liaison, the subcommittee had several discussions regarding ways to facilitate the inclusion of lifelong learning and information literacy into both the core and non-core ECET curricula. The consensus was that current practice needed to be altered so that students were getting consistent education in information literacy throughout the four years of the curriculum.

The faculty members on the non-ECET core curriculum committee made the decision to provide two recommendations, one recommendation regarding inclusion of lifelong learning and professional skills in an integrated manner throughout the core and non-core curricula, and one recommendation regarding the non-core curricula.

The initial presentation of the recommendations to the ECET faculty was received with many questions regarding the practical implications of the changes. ECET faculty voiced concerns about integrating more objectives, when the redesigned ECET courses will already include more technical objectives in less depth. The faculty also questioned which learning outcomes would be measured to demonstrate student integration of lifelong learning skills. There was little discussion of the assumptions behind the recommendations among the ECET faculty. The consensus seemed to be that lifelong learning skills needed to be integrated, but confusion as to the specific details of the implementation.

The subcommittee then presented the recommendations during a major faculty meeting to officially bring together the new curriculum. The recommendations were generally well received. The discussion focused upon a few suggestions that the subcommittee made as potential objectives to be spiraled throughout the curriculum. In particular, faculty members focused upon lab report and notebook formats. While some felt that a uniform standard, including citation style, would boost lifelong learning outcomes for the students, others felt that employers will have different expectations regarding lab notebook format, and therefore the students should learn flexibility in notebook keeping through deliberate differentiation in style among courses.

The ‘straw man’ curriculum presented at the faculty meeting was generally supported but also needed revisions to course flow, pre-requisites, and the possible development of a ‘straight to Master’s’ degree. Given these not insignificant alterations, it is possible that the curriculum will still undergo major revisions. The straw man curriculum was not developed to the point where...
individual course objectives were explicitly mentioned and did not address information literacy/lifelong learning implementation in the courses.

Reflections

The process of going through the curriculum redesign as a member of the process was invaluable. The library liaison assumed the position of ECET liaison immediately prior to joining the committee. As a member of the committee, relationships with other committee members, the department head, and the department secretary developed. Additionally, although attending monthly faculty meetings throughout the semester was a large investment of time, it also was an invaluable way of meeting the department’s entire faculty, understanding the research interests of many of the faculty, and learning likely faculty members to collaborate with in the future.

Witnessing the process of developing the curriculum provided insight into the culture of the department. It quickly became clear that as the curriculum was being developed, the future of the department and the profession were also being reflected upon and discussed. The departmental culture was being discussed in specific ways, as in the negotiation of the objectives that the faculty members felt distinguished the education of an electrical engineering technologist from an electrical engineer.

In terms of information literacy, it is uncertain that in fact information literacy and lifelong learning objectives will be introduced through the curriculum in a meaningful way. While there is considerable support, administratively, for information literacy competencies, the implementation of the objectives falls to individual faculty members, who will have to rewrite course assignments and change previous practices to integrate lifelong learning and information literacy objectives.

During the discussion of the ‘straw man’ curriculum changes, faculty members focused on those areas of information literacy that are generally already included in some way in individual course syllabi (e.g. the lab notebooks). Fully implementing lifelong learning across the curriculum will require changes in the syllabi for a number of courses. Currently, individual faculty members are not required under this curriculum revision to completely change course activities, and it would be a monumental task to redesign every class from the ground up. In the expectation that information literacy will be spiraled through the curriculum, there is an implicit expectation that major revisions in pedagogical techniques and assignments are on the horizon. This requires a large amount of work and time on the part of each faculty member.

The librarian noticed that, during the curriculum redevelopment process, ECET faculty tended to focus on the lab notebook as their connection to information literacy and lifelong learning. Many of the information literacy and lifelong learning objectives, or at least the language used to describe the concepts, the librarian broached appeared unfamiliar to them, even though, in some
cases, they had even provided instruction on some of those concepts. This provides a wonderful new opportunity for collaboration between the libraries and the ECET department as they wrestle with the most effective ways to integrate lifelong learning and information literacy throughout the curriculum. The liaison’s work on the subcommittee and attendance at the faculty meetings have provided the groundwork for this library involvement in future course revisions and may well prove to have the most impact on information literacy as the curriculum is enacted.

References

Appendix 1

Strategic Support and Integration of Lifelong Learning Skills

ECET Draft Plan

September 2009

Introduction

What is information literacy? And how is it related to lifelong learning? Information literacy as defined by the Association of College and Research Libraries (ACRL) is ‘…the set of skills needed to find, retrieve, analyze, and use information.’¹

Information literacy, as defined above and used by librarians, is critical to the ability for students to become fully capable lifelong learners. The rapid growth of information in all fields of study, but most particularly in technical degree programs, means that students will not learn all there is to know about their chosen profession before leaving school. Thus, they need to gain the skills to be lifelong learners to keep-up with the innovations and changes in their profession.

‘Ultimately, information literate people are those who have learned how to learn. They know how to learn because they know knowledge is organized, how to find information and how to use information in such a way that others can learn from them. They are people prepared for lifelong learning, because they can always find the information needed for any task or decision at hand.’²

Purdue University Strategic Plan Goals

Purdue University highlights the need for these skills in the most recent strategic plan in Goal 1,
Launching tomorrow's leaders by enhancing student success with careers in a dynamic global society, as well as fostering intellectual, professional and personal development for lifelong learning.'

More specifically, one of the strategies for achievement of this goal reads:

Instill in students a passion for academic success as well as lifelong learning through currency in knowledge, pedagogical variety including distance learning programs/options, and conduct learning outcomes assessment for continuous improvement.

Thus, at the university level there is recognition of a need to ensure all of our graduates have these competencies.

College of Technology Mission and Goals

The mission for the College of Technology, as articulated in their mission statement says;

In fulfilling its mission, the College of Technology strives to:

  Provide a student-centered learning environment maintained to ensure that graduates are accomplished in technical expertise, leadership, and collaboration skills necessary to excel in the global technological economy.4

Additionally, the College of Technology Strategic Plan features Strategy 15:

Strategy 15: Increase the integration of leadership lessons in areas such as critical thinking, communication, ethical responsibility, collaboration on interdisciplinary teams, and the societal context for change.5

Purdue University Libraries Mission and Goals

Finally, the Libraries mission statement is ‘… to foster a dynamic information environment that advances learning, discovery and engagement.’6 Within the objective of learning, the goal for information literacy is to

  advance learning with information literacy initiatives and further the University’s learning goal with focused collections and information resources.6

ABET Accreditation Criteria mapped to ACRL Information Literacy Standards

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<tr>
<th>ABET Criterion 37</th>
<th>ACRL Standards for Science and Engineering/Technology Performance Indicators8</th>
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<tr>
<td>a. An appropriate mastery of the</td>
<td>3.1.a; 3.3.c; 3.6.a; 3.6.b; 4.1.b; 4.1.d; 4.2.a;</td>
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<td>Knowledge, techniques, skills, and modern tools of their disciplines</td>
<td>4.3.b; 2.1.a; 1.3a-f</td>
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<td>b. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology</td>
<td>3.1.b; 3.1.c; 3.2.a; 3.4.a-g; 3.6.c; 3.7.a; 4.1.a; 4.1.b; 4.2.a; 1.4.a-e; 5.1.a-d</td>
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<td>c. An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes</td>
<td>3.2.b; 3.3.a-b; 3.5.b; 3.7.b; 4.1.a-c; 4.2.a-b; 4.3.c; 2.1.a; 1.2.d; 3.2.e; 4.5.a-c</td>
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<td>d. An ability to apply creativity in the design of systems, components, or processes appropriate to program educational objectives</td>
<td>4.2.b; 4.4.a-b;</td>
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<td>e. An ability to function effectively on teams</td>
<td>3.6.c; 2.3.d; 3.5.b</td>
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<td>f. An ability to identify, analyze and solve technical problems</td>
<td>1.1.b</td>
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<td>g. An ability to communicate effectively</td>
<td>3.6.c; 4.1.b; 4.3.a-d; 2.3.d; 1.2.b; 3.5.a; 3.5.c; 4.3.a-c; 4.6</td>
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<td>h. A recognition of the need for, and an ability to engage in lifelong learning</td>
<td>3.1.a-3.7.b; 4.1.a-4.6.d; 2.2.a-f; 3.2.b-d; 3.2.f-g</td>
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<td>i. An ability to understand professional, ethical and social responsibilities</td>
<td>3.2.a-b; 4.1.a-d; 4.2.a-g</td>
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<td>j. A respect for diversity and a knowledge of contemporary professional, societal and global issues</td>
<td>3.2.d</td>
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<td>k. A commitment to quality, timeliness, and continuous improvement</td>
<td>3.2.a; 3.5.a; 3.7.c</td>
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Assessment Ideas For ABET Criteria

These represent potential ideas for inclusion and assessment. This list is not comprehensive, but shows ideas for integration of lifelong learning and information literacy in the curriculum.

| ABET Criterion 3  |
|---|---|
| a. An appropriate mastery of the knowledge, techniques, skills, and modern tools of their disciplines | • Brainstorming portfolio for design courses  
• Integration of standardized practices in senior design projects |
| b. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology | • Written reflection on articles in industry journals  
• Demonstrate ability to gather |
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<td>technology</td>
<td>information through bibliography or review of literature in design courses</td>
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<td>c. An ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes</td>
<td>• Project management skills introduced throughout four years</td>
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| d. An ability to apply creativity in the design of systems, components, or processes appropriate to program educational objectives | • Design/brainstorming portfolios  
• User centered design reflection during design projects  
• Involvement in EPICS/ service learning |
| e. An ability to function effectively on teams | • Demonstrate teaming best practices; Peer review of performance during team projects  
• EPICS/ service learning participation |
| f. An ability to identify, analyze and solve technical problems | • Reduce prescribed homework through four years. Increase open ended problem solving/design |
| g. An ability to communicate effectively | • Standardized lab notebook/report kept for all classes  
• IEEE citation style adopted as standard for department |
| h. A recognition of the need for, and an ability to engage in lifelong learning | • Demonstrate use of social networking/Web 2.0 tools to gather relevant information for assignment |
| i. An ability to understand professional, ethical and social responsibilities | • Great Issues Class (College of Technology Core?)  
• Assignment: Compare/contrast relevant engineering society Codes of Ethics |
| j. A respect for diversity and a knowledge of contemporary professional, societal and global issues | • Great Issues Class (College of Technology Core?)  
• EPICS/ service learning participation  
• ‘ECET in the news’ portfolio/analysis |
| k. A commitment to quality, timeliness, and continuous improvement | • Rubric for assessing user centered design |


