AC 2008-973: LIBERAL EDUCATION: A SURVEY OF GOALS

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Abstract

In the fall of 2006 the authors’ institution started a process of re-evaluating its general education program. And like many other masters-level institutions, the university’s general education program was a curriculum common to all programs on campus, whether in the college of arts and sciences, engineering, education or business. As often happens at smaller universities, engineering faculty at the university had the opportunity (and took advantage of the opportunity) to help shape the general education curriculum, balancing the needs of its engineering students with the mission of the university to produce liberally educated men and women. This paper examines how 33 institutions try to resolve this tension of particular professional needs and overarching liberal education needs in their general education programs. Institutions in the study were chosen from the 2007 *US News and World Report* rankings of colleges and universities, focusing on high ranking schools in the category of undergraduate engineering programs and regional masters level universities with an engineering program.

Previous studies in this area have focused primarily on the percentage of course work in general education for the engineering student, recognizing the constraints in an undergraduate engineering curriculum that prepares students for practice in four years. Secondarily, previous studies have focused on the courses (English, History, Art, etc) that comprise a general education program. In contrast, with the shift in assessment from a checklist of courses to an examination of outcomes, the study presented in this paper focuses primarily on the stated mission and goals of an institution’s general education program as well as on the outcomes that relate to the general education component of the institution’s engineering programs. Further, given the emphasis in assessment on transparency and public accountability, the institutions’ websites were used as the primary sources of information for the mission of the general education program at the institution, whether through an online catalog or separate webpage for their general education program. It has been found that the most common goals for general education programs include writing and communication as well as civic responsibility. However, the survey of programs reveals other underlying issues that engineering programs may wish to consider as they provide input into the general education programs of their respective institutions, including globalism and diversity, the interconnectedness of learning areas, and attitudes for life-long learning. The results of the survey are examined in light of two perspectives, one from outside the profession (Association of American Colleges and Universities, *College Learning for a New Global Century*) and another from inside the profession (American Society of Civil Engineers, *Civil Engineering Body of Knowledge for the 21st Century, 2nd edition, Draft 8*).

Introduction

In the 2006-2007 academic year, the University of Evansville, under the guidance of its General Education Subcommittee of the Faculty Senate Curriculum Committee, undertook a re-evaluation of the general education program requirements that all its undergraduates must fulfill to earn a degree in one of its four schools: arts and sciences, education and health sciences, business administration, and engineering and computer science. In addition to focus group
discussions with students and faculty that centered on strengths, weaknesses, opportunities, and threats, the subcommittee distributed a survey instrument to all faculty to gauge perceptions about the state of general education at the university. The instrument was adapted from “Assessing General Education: A Questionnaire to Initiate Campus Conversation” by Jack Meacham and distributed by the American Association of Colleges and Universities. The last question in the survey asked faculty to rank the quality of the general education program on a scale from 1 to 5, where 1 was associated with the statement, “Our general education program satisfies the minimal accreditation requirements.” The score of 5 was associated with the statement, “Our general education program surpasses in quality those of our peer institutions.” With 40% of the faculty responding (and 61% of the respondents from the college of arts and sciences), the mean response to this question of quality was 2.9, the median was 3.0 and the standard deviation was 1.0. Although the faculty response rate was a subject of contention at subsequent faculty meetings, the question did provide a snapshot of faculty enthusiasm (or lack thereof) for the current general education program. For the authors, however, it raised a larger question that could be approached by actual data as opposed to just perception. Namely, how does the general education program at the University of Evansville compare in content, if not in quality, with other such programs across the country?

To answer this question, and to identify possible new models and best practices that could translate well into the culture at the University of Evansville, a review of general education curricula of colleges and universities with engineering programs was performed by the authors, the results of which are reported in this paper. As implied in the survey question (“our general education program satisfies the minimal accreditation requirements”), a common perception is that professional-school accreditation requirements (a) constrain the creative development of general education programs and (b) are concerned only with the number of humanities and social science courses in a general education program. Indeed, previous reviews of general education programs have tended to focus on the percentage of the curriculum that is devoted to non-technical topics, as well as on particular kinds of courses (e.g., English, History, Philosophy, etc.). However, educational trends both inside the profession\(^1\) as well as outside of the profession\(^2\) focus on outcomes, identifying cognitive skills that are required for an educated person in general or for an educated engineer in particular. Consequently, this study focuses on the stated outcomes and goals of colleges and universities with programs accredited by the Engineering Accreditation Commission-Accreditation Board for Engineering and Technology (or EAC-ABET). Because the original motivation for this study was for the design of a new general education program at the University of Evansville, the study focused on masters and bachelors schools, excluding large, national research universities. However, it is hoped that the data gathered may prove useful to other engineering departments who are involved in a critical review of the courses taken by our students to broaden their perspective on their chosen profession.

**Past Surveys of Liberal Education**

The demands facing engineering education pose many challenges to incorporating a liberal dimension in the curriculum. The main challenge is usually framed as a competition over the finite resource of credit hours to graduation (in four years) by technical versus non-technical courses. Engineering educators have the primary responsibility of ensuring that their graduates
have a minimum set of technical competencies to develop into productive engineering professionals. On the other hand, many engineering educators who value the broadening and leavening effects of liberal arts courses understand that some technical courses must be sacrificed in the curriculum to include necessary exposure to “the other side” of campus. Several researchers have highlighted the effects of these competing values by surveying the number and proportion of credit hours devoted to liberal education.

Rojter, in his study of six Australian universities\(^3\), presents an educational system still struggling with the value of liberal education. Earliest figures from 1987 reveal that two courses of study at two Australian universities allocated no humanities, social sciences or management subjects in their curricula. Subsequent surveys of curricula in 1992, 1997 and 2000 revealed improvement in percent allocation across the board at all universities and all courses of study. Even so, the highest allocation was 19.8% in manufacturing at the University of New South Wales. As the author points out, this is well below the 24% allocation recommended by the Institution of Engineers Australia.

In the United States, Stouffer and Russell performed a very comprehensive survey of civil engineering curricula.\(^4,5\) The survey is based on data compiled from recent EAC-ABET accreditation visits. Ninety of the 218 accredited civil engineering programs participated in the survey. Like the current study, Stouffer and Russell use U. S. News and World Report rankings as a basis for categorizing schools, indicating that 21 of the top 26 undergraduate programs with a corresponding graduate program and 6 of the top 12 undergraduate-only engineering schools were part of the pool of 90 schools. Their 2003 paper focuses on the sequence and proportion of liberal arts courses. Stouffer and Russell contend that “civil engineering students have little exposure to the liberal arts or important professional skills.”

Stouffer and Russell find that on average for the 90 schools participating in the survey, 20.5% of the undergraduate curriculum is set aside for general education. For a standard 128-semester-credit-hour curriculum, this constitutes 26.2 semester-credit hours. In addition, Stouffer and Russell find that of the 26.2 hours, on average 33.8% is devoted to liberal arts electives, 15.9% to open or general electives (any course excluding math, science, or engineering), 15.2% to “other subjects,” 12.5% to English composition and 4.5% to speech and communication. According to these statistics, 64.9% of the general education allocation permits student choice. However, some schools require specific courses in some categories. Stouffer and Russell report that 6.8% of the general education allocation is devoted to economics, 2.8% to English literature, and 0.6% to Foreign Language. To determine the “popularity” of some courses, Stouffer and Russell also provide statistics on the percentage of schools reporting requirements in Economics (59%), History (25%), and Philosophy/Religion (25%), Foreign Language (3.3%).

In their papers, Stouffer and Russell raise several concerns. First, as implied by the statistics, more than half of the general education courses are left as electives, which they point out is often chosen by students based on how well the liberal arts classes fit in their schedules and based on hearsay from their peers. Second, they contend that some of the liberal arts courses may come at the wrong time in the curriculum, as in the case of freshman composition and speech, before engineering students have content to integrate with the communication techniques learned. Third, Stouffer and Russell contend that “the exact courses are not as important as the structure
that goes behind the courses.” Finally, Stouffer and Russell recommend that “departments must take an active hand in assembling a series of courses, offered at the correct time and at the correct depth, that help address the issues pertinent to being a well-rounded professional engineer.” [emphases added].

A more comprehensive survey of general education was conducted during the spring of 2000 by Ratcliff, et al. The survey received responses from chief academic officers of 279 schools comprised of 14.3% Research Universities, 9% Doctoral Institutions, 34.3% Master’s Institutions and 42.3% Baccalaureate Colleges. A little more than a third were public institutions and a little less than a third were private institutions with a religious affiliation, the remaining one third being privates with no religious affiliation.

Like other surveys, the proportion of general education courses in the curriculum was a significant focus. The survey revealed that the general education program comprises 37.6% of the graduation requirement at the participating schools. In a more typical 120-semester-hour curriculum, a requirement of 37.6% translates into 45.1 semester credit hours. It should be noted that the general education described by this national report includes math, physical sciences, and life sciences. If we assume that typically 10 hours of the general education program is comprised of math and science (3 hours of math, 7 hours of natural and life sciences), then the humanities and social sciences portion of the general education program consists of about 35 credit hours, or 29% of a 120-hour curriculum. This percentage is significantly different from the figures cited by Stouffer and Russell.

From the Ratcliff survey, 61.3% of the schools report content requirements in literature, 60.7% in History, 60.6% in Philosophy and Ethics, 46.9% in Foreign Languages. Further, in keeping with the understanding that cognitive areas (and related outcomes) are as important as content areas, Ratcliff’s survey reveals that 91% of the schools report goals in the area of critical reading and writing, 72% in critical thinking, 63% in speaking and listening, 67% in cultural diversity and 55% in global studies. While the Ratcliff study provides a picture of goals in general education, it is unclear what percentage of these schools contains EAC-ABET accredited engineering programs.

Guiding Directions for Liberal Education

These and other similar previous studies provide some idea about the state of practice in providing a liberal education but several sources exist that are more normative than descriptive. These sources are especially important when moving from a course-level description of liberal education programs to a higher-level, outcomes-based description. Two sources are used in this study, the National Leadership Council for Liberal Education and America’s Promise’s College Learning for a New Global Century (herein referred to as the LEAP Report) and the American Society of Civil Engineers’ (ASCE), Civil Engineering Body of Knowledge for the 21st Century, 2nd edition, Draft 8 (herein referred to as BOK2).

The LEAP Report challenges schools, colleges, and universities to fulfill the promise of a liberal education in a “new century marked by increasing global complexity, interconnectedness and
rapid change.” In rethinking general education, the report addresses long-held assumptions about liberal education, namely:

- That liberal education is not about careers or practical economic benefit.
- That liberal education is only the province of certain departments in the arts and sciences and through narrow categories.
- That liberal education is only for breadth in the first two years of college.

The report recommends the following essential learning outcomes:

- “Knowledge of human cultures and the physical and natural world through study in the sciences and mathematics, social sciences, humanities, histories, languages and the arts.
- “Intellectual and practical skills such as: inquiry and analysis, critical and creative thinking, written and oral communication, quantitative literacy, information literacy, teamwork and problem-solving.
- “Personal and social responsibility including civic knowledge and engagement (local and global), intercultural knowledge and competence, ethical reasoning and action, foundations and skills for lifelong learning.
- “Integrative learning including synthesis and advanced accomplishment across general and specialized studies.”

Fundamental to the process for change is one important point that is in keeping with the present study’s focus on outcomes and objectives:

“[I]t is time to challenge the idea—tacitly but solidly established in American education—that simply taking a prescribed number of courses in liberal arts and sciences is sufficient. Rather, new steps must be taken to ensure that study in these core disciplines prepares students to engage with the ‘big questions,’ both contemporary and enduring.”

Despite its focus on learning objectives, the LEAP Report does not shy away from identifying curricular areas and pedagogical techniques that are important for liberal learning in the 21st century, couched in such a way as to promote an integrative view of liberal education:

- “Science, mathematics and technology
- “Cultural and humanistic literacy: knowledge of the world’s histories, American history, philosophical traditions, major religions, diverse cultural legacies, and contested questions.
- “Global knowledge and competence: understanding of economic forces, other cultures, interdependence, and political dynamics, as well as second-language competence and direct experience with cultural traditions other than one’s own.
- “Civic knowledge and engagement: rich understanding of the values and struggles that have established democratic institutions and expanded human freedom and justice, and direct experience in addressing the needs of the larger community.
- “Inquiry- and project-based learning: multiple opportunities to work, independently and collaboratively, on projects that require the integration of knowledge with skills in analysis, discovery, problem solving, and communication.”
In 2004 ASCE published its first attempt at defining the Civil Engineering Body of Knowledge for the 21st Century. In this first edition (BOK1) ASCE defined 15 outcomes necessary in the education of a civil engineer, paralleling and also augmenting the eleven outcomes required by EAC-ABET. Of the 15 outcomes, the ones most relevant to a general education foundation are:

“The civil engineer must demonstrate:

- the broad education necessary to understand the impact of engineering solutions in a global and social context (EAC-ABET h)
- an understanding of professional and ethical responsibility (EAC-ABET f)
- an ability to communicate effectively (EAC-ABET g)
- an ability to function on multi-disciplinary teams (EAC-ABET d)
- a recognition of the need for, and the ability to engage in, life-long learning (EAC-ABET i).”

Although these are program outcomes for the assessment of civil engineering curricula, it can be argued that a strong foundation in the liberal arts can contribute to the achievement of these outcomes and engineering programs would do well to leverage and integrate liberal arts values in their curriculum. Strong connections can be seen between the LEAP Report and BOK1 especially in the areas of communication skills, ethical reasoning, and a breadth of understanding of human knowledge that places the life of a person in a larger civic and global context.

The second edition of the Body of Knowledge, released in draft form in 2007, contains significant changes, including the addition of 13 outcomes as well as requirements for the level of achievement of these outcomes using Bloom’s taxonomy, organized according to achievement at the bachelor’s level, the graduate level, and experience before licensure. In the context of liberal education, the outcomes from BOK1 have been retained but several significant additions have been made. These include:

“Humanities: **Formulate** applicable criteria grounded in the humanities and **use** them in the development of a solution to engineering problems appropriate to civil engineering.

“Social sciences: **Formulate** criteria from the domain of social sciences and **use** them in the development of solutions to engineering problems appropriate to civil engineering.

“History and heritage: **Explain** contributions of significant individuals, events, and developments that occurred in the history of civil engineering and the impact they have on the profession.

“Globalization: **Analyze** engineering works and services in order to function at a basic level in a global context.”

The outcomes are further explained in the BOK2 report appendices. While these particular outcomes have not been adopted in the 2007-2008 EAC-ABET civil engineering program criteria, they do give interesting insight into possible future trends both in accreditation and ultimately in licensure. The addition of outcomes in the humanities, social sciences, history and heritage, and globalization formalizes the importance of a liberal education, in a similar way that specific outcomes in mathematics and basic sciences recognize the importance of these subjects.
as one of the foundations of an engineer’s education. There is much to admire in this formalization. It requires engineering educators and advisors to help students make connections between their liberal arts courses and the challenges that they will face as engineers. It also requires that advisors help students make informed decisions about liberal arts courses beyond what will fit into their schedule at the time (c.f. similar criticisms by Stouffer and Russell). While suggestions from BOK2 are a start, some caveats should be observed. In the commentary on the humanities and social science outcomes, ASCE recommends two courses in humanities and two courses in social sciences. Such a focus on courses, although helpful in defining expectations, might narrow the field of vision for schools that are not prone to take a more interdisciplinary or more creative approach to liberal education. As the ASCE commentary readily admits, some courses may be considered to belong either to the humanities or to the social sciences. And with a focus on an application level of achievement, a student’s choice in liberal education courses might be limited by a civil engineering program, with the possibility that a student’s genuine interest in liberal arts courses outside of the required set could be stifled, alienating students with a broad curiosity about the world, perhaps the kind of engineers we need in the profession.

Methods

The researchers wanted to gather four different categories of data to obtain an overall picture of the state of liberal education in schools with engineering programs. First, the number of credits required in general education courses versus the number of credits required for graduation with a degree in engineering was examined to see if the sample of schools used for the present study is comparable to the schools studied in previous surveys. Second, the outcomes and goals of the liberal education programs were examined to determine any emerging consensus of themes. Third, individual courses and curricular groupings of courses were examined to see how the liberal education outcomes are supported by actual coursework. Fourth, the outcomes and objectives of engineering programs were examined to observe possible connections between the institution’s objectives and the program’s outcomes.

The reviewers considered only EAC-ABET accredited engineering programs and further narrowed down the list of programs to examine by using the 2007 edition of America’s Best Colleges by U.S. News & World Report. Criticism of the rankings provided by U.S. News & World Report is well known and it is acknowledged that the rankings are based on peer perceptions as well as data that cannot be easily correlated to the quality of the general education curricula as measured by actual student outcomes. However, the U. S. News rankings are widely known and serve to narrow the list of programs to review without bias from the reviewers. Presumably, the U. S. News rankings also help to address the issue of “quality,” even if purely on the basis of peer perception.

U. S. News has several sets of rankings including rankings of National Universities, Regional Universities with Master’s Programs, Regional Colleges with Bachelor’s Programs and Best Undergraduate Engineering Programs. Because the University of Evansville is considered a regional university with a master’s program (ranked 11th with Baldwin-Wallace College in the Midwest region), the reviewers chose to further limit programs to similar universities and programs, thus eliminating comparison with the National Universities.
There were 46 schools considered as the best undergraduate engineering programs. The reviewers considered the top 12 schools shown in Table 1. Rankings in this category were based solely on peer assessment.

Table 1. Best Undergraduate Engineering Programs according to *U.S. News and World Reports*.

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<th>Rank</th>
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<td>1</td>
<td>Harvey Mudd College</td>
<td>Rose-Hulman Institute of Technology</td>
<td>Cooper Union</td>
<td>U.S. Military Academy</td>
<td>U.S. Naval Academy</td>
<td>California Polytechnic State University, San Luis Obispo</td>
<td>Bucknell University</td>
<td>U.S. Air Force Academy</td>
<td>Embry Riddle Aeronautical University (Florida)</td>
<td>Milwaukee School of Engineering</td>
<td>Villanova University</td>
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To augment this list of schools and also to see how schools with a broader reputation outside of engineering conceive of general education programs, Master’s Universities and Bachelor’s Colleges were also examined. Only the top ten and the top five in the master’s and bachelor’s institutions, respectively, were considered and of these the reviewers examined only those with EAC-ABET-accredited programs. As a result a total of 33 schools were examined with respect to their general education program. They encompass both public schools (7 schools or 21%) as well as private schools (26 schools or 79%). Among the seven public schools, four are military institutions. Like the University of Evansville, fifteen of the private schools (or 58% of the private schools or 45% of all schools considered) maintain some degree of religious affiliation. Only eight schools (or 24%) can be considered primarily technical in nature, offering no degrees in the humanities. The schools range in size from an undergraduate body of 17,000 (Cal Poly SLO and San Jose State) to 1200 (Carroll College) full time students. Some of the schools that were considered in masters and bachelors categories also appeared in the ranking of undergraduate engineering programs. The schools are listed alphabetically in Table 2.
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<tr>
<th>Institution</th>
<th>Study Focus</th>
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<tr>
<td>Bradley University (CE)</td>
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<td>Bucknell University (CE)</td>
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<tr>
<td>* California Polytechnic State University, San Luis Obispo (CE)</td>
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<tr>
<td># Calvin College (MI) (E with a concentration in CE)</td>
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<td># Carroll College (MT) (CE)</td>
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<td>* College of New Jersey (ME)</td>
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<tr>
<td>* Cooper Union (CE)</td>
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<td>@ Embry Riddle Aeronautical University (Florida) (CE)</td>
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<td># Fairfield University (CT) (CE)</td>
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<td># Gonzaga University (CE)</td>
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<td>@ Harvey Mudd College (E)</td>
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<td>@ Kettering University (ME)</td>
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<td># Loyola College in Maryland (ES)</td>
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<td># Mercer University (E)</td>
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<td># Messiah College (E)</td>
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<td># Ohio Northern University (CE)</td>
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<td>@ Rochester Institute of Technology (ME)</td>
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<td>@ Rose-Hulman Institute of Technology (CE)</td>
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<td>* San Jose State University (CE)</td>
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<td># Santa Clara University (CE)</td>
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<td>Swarthmore College (E)</td>
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<td>* &amp; The Citadel (CE)</td>
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<td># Trinity University (TX) (ES)</td>
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<tr>
<td>* &amp; U.S. Air Force Academy (CE)</td>
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<td>* &amp; U.S. Military Academy (CE)</td>
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<td>* &amp; U.S. Naval Academy (ME)</td>
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<td># University of Portland (CE)</td>
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<td># Valparaiso University (CE)</td>
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<td># Villanova University (CE)</td>
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* Public institutions
# Schools with a religious affiliation
@ Primarily technical institutions
& Military institutions
The present survey relied on published on-line catalogs that outlined both general education requirements as well as engineering requirements. To compare results to the BOK2, only civil engineering degrees were examined. If a school did not offer a civil engineering degree, then a mechanical engineering curriculum was examined. In some cases, only an engineering or engineering science degree was offered and this was the program examined. In general education, only those courses outside of math and sciences were counted, assuming that engineers easily meet most general education requirements in these areas. In addition, the accounting excluded both health requirements and senior capstone courses as part of general education, even though the University of Evansville has both requirements for all its undergraduate students.

To gather data about goals and outcomes, researchers examined the descriptions of liberal education that are written in college catalogs, bulletins, and websites. Unfortunately, not all schools lay out a direction and focus for their general education programs beyond the fact that certain courses in certain areas are required. The researchers looked primarily in the sections in catalogs and bulletins that pertained to programs referred to as either the core curriculum, general education or liberal learning/education. If such discussions were not found in these sections, the researchers resorted to reading descriptions found in the catalog or website of the division that is responsible for general education (in the case of two schools). In the case where these two sources yielded no information, the researchers turned more generally to the university’s mission statement or statement in educational philosophy (in the case of three schools). In all other cases, schools discussed their vision for general education in the expected sections of their catalog or bulletin.

Researchers parsed the sentences found in official documents and categorized similar themes to create an emerging picture of the collective wisdom of these institutions of learning. For example, Swarthmore College’s discussion distills the essence of liberal education in a few powerful phrases:

“The purpose of a liberal arts education is to help students fulfill their responsibilities as citizens and grow into cultivated and versatile individuals. A liberal education is concerned with the development of moral, spiritual, and aesthetic values as well as analytical abilities. Furthermore, just as a liberal education is concerned with the cultural inheritance of the past, so, too, it is intended to develop citizens who will guide societies on a sustainable course where future culture will not be compromised in the development of the present. Intellectually, it aims to enhance resourcefulness, serious curiosity, open-mindedness, perspective, logical coherence, and insight.”

As will be evident in the process of parsing and categorizing, it might be easy to miss the coherence and eloquence of the original statement, which has clearly been carefully wrought by faculty committed to liberal education. So with due apologies to the faculty at Swarthmore, their statement has been parsed as follows:
help students fulfill their responsibilities as citizens and grow into cultivated and versatile individuals

<table>
<thead>
<tr>
<th>Concerns and Values</th>
<th>Categorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerned with the development of moral, spiritual, and aesthetic values as well as analytical abilities</td>
<td>Moral and ethical development</td>
</tr>
<tr>
<td>Concerned with the cultural inheritance of the past</td>
<td>Our heritage</td>
</tr>
<tr>
<td>Develop citizens who will guide societies on a sustainable course</td>
<td>Citizenship/Commitment/Service/Leadership</td>
</tr>
<tr>
<td>Where future culture will not be compromised in the development of the present</td>
<td>A changing/uncertain future</td>
</tr>
<tr>
<td>Enhance resourcefulness, serious curiosity, open-mindedness, perspective, logical coherence, and insight</td>
<td>Disposition/Attitudes/Characteristics</td>
</tr>
</tbody>
</table>

Once parsed, these statements can be grouped in a spreadsheet according to common statements found in other institution statements:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Categorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help students fulfill their responsibilities as citizens and grow into cultivated and versatile individuals</td>
<td>Citizenship/Commitment/Service/Leadership</td>
</tr>
<tr>
<td>Concerned with the development of moral, spiritual, and aesthetic values as well as analytical abilities</td>
<td>Moral and ethical development</td>
</tr>
<tr>
<td>Concerned with the cultural inheritance of the past</td>
<td>Our heritage</td>
</tr>
<tr>
<td>Develop citizens who will guide societies on a sustainable course</td>
<td>Citizenship/Commitment/Service/Leadership</td>
</tr>
<tr>
<td>Where future culture will not be compromised in the development of the present</td>
<td>A changing/uncertain future</td>
</tr>
<tr>
<td>Enhance resourcefulness, serious curiosity, open-mindedness, perspective, logical coherence, and insight</td>
<td>Disposition/Attitudes/Characteristics</td>
</tr>
</tbody>
</table>

Clearly other researchers will find other categorizations so it might be argued that the groupings used in this research are simply idiosyncratic. In some cases, statements will be applicable to several categories. For example, “concerned with the development of moral, spiritual, and aesthetic values as well as analytical abilities” could be parsed further so that “analytical abilities” could be categorized under the heading of “Skills.” In all cases, the protocol has been to use categorizations that relate most directly to the LEAP Report and to keep large phrases in
tact as much as possible to keep some of the nuance found in the original phrasing. In the case of the phrase “concerned with the development of moral, spiritual, and aesthetic values as well as analytical abilities,” it is counted in three different categories: “moral and ethical development,” “critical thinking skills” and “aesthetic judgment.”

In a similar way, the authors examined engineering program outcomes and objectives with respect to their relationship to liberal learning. The statements of outcomes and objectives were in general easier to find given the EAC-ABET requirement that these outcomes and objectives be publicly available (usually in the form of a webpage). In addition, these statements were easier to parse and categorize as, true to engineering form, these outcomes were usually stated in simple declarative statements arranged in a bulleted list.

The stated engineering program objectives and outcomes for each institution were listed and combined into logical clusters using BOK2 as a guide for criteria. Depending on how objectives are stated for each institution, some overlap may have existed. One example may be in the categories of global and societal issues versus contemporary issues. At several of the peer institutions, objectives contained a reference to both of these clusters separately, while at other institutions, often only one or the other may have been directly addressed. To capture the distinction between these two clusters, they were kept separate. It should be pointed out that the category “Other” was used to capture objective data that did not clearly fall into an already listed cluster.

Finally, course requirements were examined to look for connections between goals and implementation. Some course titles were fairly clear in indicating course content. Some institutions clustered course requirements in groupings of electives. For example, the University of Evansville has a cluster of courses called “American Traditions” that includes courses in American history, government, and literature. In a few cases, the researchers had to examine the actual course descriptions, when available.

**The Data**

Figure 1 shows trends in the proportion of humanities and social science courses that are required as part of the general education or core curricula of the schools under study. The average is 22.3% with a standard deviation of 6.9%. The University of Evansville falls very close to the average at 20%, with 20 schools having the same or better percentages. The national average of 22.3% is very similar to the 20.5% figure cited by Stouffer and Russell.
From the goals and outcomes of the liberal education programs, the themes that emerged were categorized into two broad areas: general skills and attitudes of a college-educated person and more specific areas for development in the life of a student. Of the 33 schools under investigation, 23 or 70% of the schools explicitly referred to the goal of developing skills and/or attitudes in their graduates, as shown in Figure 2. Of these, eight schools identified both intellectual skills and attitudes as being important characteristics of their graduates. Of the specific area for development through the liberal education program, the most common was in the area of civic responsibility, as shown in Figure 3.

**Figure 1.** Histogram of general education courses for the 33 schools in the study.

**Figure 2.** Summary of skills and attitudes. Numbers represent schools reporting the specific skill or general attitude. The chart represents a total of 24 schools. In some cases schools referred to skills necessary for an academic life without specifics. These schools are counted under the category of “general skills.”
In a similar way the outcomes from the engineering programs (for civil engineering or non-civil engineering majors) have been classified with respect to relationship to liberal education goals and the results are presented in Figure 4 below. Not surprisingly, communication skills play a significant role in the engineering outcomes of the institutions being studied.

Other program outcomes (not shown in Figure 4) include design/problem solving, math and science application, research and experimentation, contemporary issues, professional growth and responsibilities and “other” (for example, “well-publicized reward system” or “entry level competency”).
Finally, actual courses required and course clusters were examined and fell into some natural groupings that related to both school’s outcomes as well as the outcomes recommended by the LEAP Report and BOK2. The clusters examined were “Oral and Written Communication,” “Civic Responsibility,” and “Multicultural Competency.” The results are summarized in Figure 5.

![Figure 5](image_url)

**Figure 5.** Clusters of courses required in liberal education programs. The three clusters are summarized by the bars for “Oral and Written Communication (30 schools),” “Civic Responsibility (18 schools),” and “Multicultural Competency (15 schools).”

**Discussion**

*Proportion of the curriculum*

Using the University of Evansville as a standard for the total number of hours to graduate with a degree in civil engineering (134), the national average percentage of 22.3% represents 30 semester hours of Humanities and Social Sciences. The practical test of significance is whether the percentage requires the addition of a three-hour course to the curriculum, assuming that there
There is essentially no difference between public schools (22.0% average) versus private schools (22.4% average), which represents a difference of one credit hour from the average for all schools. Among schools with a religious affiliation, the average percentage for humanities and social science courses was 23.3%. Again, this represented only a difference of one credit hour from the average for all schools. Military schools did not differ significantly from the average, with 21.9% of their courses devoted to humanities and social sciences.

The largest differences were seen in programs from technological institutes versus programs that offered only engineering or engineering science in their curriculum. For technological schools, the average percentage of humanities and social science courses was 19.8%, representing a difference of 5 semester hours. For the seven schools with just engineering science, the average was 28.0%, or a difference of 8 semester hours. In both categories, there are outliers in each group. Harvey Mudd is a technical school that offers only engineering science. Their graduates take 30% of their courses in the humanities and social science. On the other hand, Mercer University, which also offers engineering science in addition to other engineering degrees, devotes only 12% of its curriculum to the humanities and social sciences.

The question of percentage can also be approached from the perspective of hours allowed by EAC-ABET. A common perception is that accreditation severely limits the choices that schools allow its students. In the past EAC-ABET required a minimum of 12.5% of a program’s curriculum to be devoted to general education. In the current EAC-ABET self-study questionnaire, Table I-1 (Basic-Level Curriculum) indicates that a minimum of 32 hours should be devoted to math and basic sciences, while a minimum of 48 hours should be devoted to engineering topics. For a 134-hour curriculum, this leaves a maximum of 52 hours for general education and other topics (about 39% of the curriculum). Alternatively, EAC-ABET allows programs to satisfy a minimum of 25% coursework in math and basic sciences with a minimum of 37.5% coursework in general education and other topics. According to this criterion, schools could theoretically devote up to 37.5% of their coursework to general education.

Institutional Liberal Education Outcomes and Goals

Consonant with the LEAP Report and the current EAC-ABET Criterion 2g and BOK2, communication skills (oral, written and also visual) were commonly identified as a critical skill (16 of 20 schools that considered skill development). Nearly as common was the development of critical thinking skills (15 of 20), which was identified using such phrases as: critical thinking; cultural discernment; analysis and synthesis; evaluate information; think clearly, draw sound conclusions.

The identification of attitudes to develop in students is not particularly common in the schools in the research pool. However, in the development of the whole person, one can imagine that attitude can fuel the passion for deep and wide intellectual inquiry. The inclusion of attitudes in educational outcomes is gaining ground in professional education, as evidenced by BOK2. A wide array of attitudes was identified by even this small pool of schools: diligence, patience,
honesty and integrity, charity, hope, self-reliance, habit of reflection, appreciation of beauty, resourcefulness, curiosity, open-mindedness, perspective, mutual respect, and honor. Given the wide array and the small number of schools, there were only a few overlaps among the categories of attitudes. The overlapping attitudes were: charity, self-reliance, mutual-respect, honesty, open-mindedness and sensitivity, appreciation of diversity and appreciation of beauty, and integrity.

Several schools specifically claim for themselves the duty of educating not just for a profession, but also for a life beyond one’s career. Given the pace of change in the world, higher education cannot focus on graduation and the first few years past graduation. Three schools explicitly recognize the need to “adapt to the changing workplace of the 21st century” and even to “capitalize on opportunities” presented by change. Swarthmore challenges its students to make “sustainable” choices that do not compromise the culture of the future. Schools recognize this rapid pace of change and articulate the need for intellectual skills and attitudes that will last for a lifetime of learning. Nine schools explicitly state this as a goal for their students. Phrases used by schools recognize that education does not end on graduation day (“appreciation of learning as a foundation for continuing inquiry,” “education as an indispensable, life-long process,”), that their education is the best chance for growth in a changing and interconnected environment that graduates will encounter (“provide the skills necessary for a lifetime of intellectual growth in a global society,” “intentional learners’ who can adapt to new environments […] and continue learning throughout their lifetimes”), and that the knowledge, skills, and attitudes will serve their personal enrichment for their whole lives (“development of increased self-awareness,” “lifelong quest for understanding oneself and one’s place in the world,” “provide intellectual enrichment for a lifetime.”). This need to engage in life-long learning is found in EAC-ABET (Criterion 2i), BOK2 and the LEAP Report.

To engage and excite the students, not only must knowledge be passed on, but the eternal questions must be engaged, as suggested by the LEAP Report. These questions have concerned humankind for ages, and thus bring the student out of themselves and in communion with peoples past, present, and future. Six schools have the explicit goal of challenging their students to confront these fundamental and challenging questions. The University of Portland perhaps provides the best example of the core questions humanity has faced: “Who am I and why am I here? How does the world work and how could the world work better? What is the value of difference? What is the role of beauty, imagination and feeling in life? Who or what is God? How can one relate to God? What is a good life? What can we do about injustice and suffering?” Other phrases include “understanding of social problems faced past, present and future,” “informed understanding of the world in which they must act and live,” “an appreciation for the great moral issues of our time,” “address complex issues and problems using disciplined analytic skills and creative techniques.” In many ways these questions are relevant to EAC-ABET Criterion 2h, understanding the impact of engineering solutions in a global and societal context.

Engaging these questions entails having a foundation in their heritage(s) and their traditions where these questions have been debated and where students might gain perspective by standing on the shoulders of giants. Nine schools recognize the benefit for taking what can be described as an historical approach. Bradley frames its general education program as an examination of
“the best that civilization has produced.” In some cases the traditions refer directly to the traditions that a university calls its own. (Mercer: “Demonstrate an understanding of themselves in light of the values and traditions upon which the University was founded.” Santa Clara University: its “Catholic and Jesuit traditions.”) However, as the University of Portland points out, it is necessary to “critically examine the ideas and traditions of Western civilization.” Ultimately, that sense of connectedness with their heritage can lead students to take responsibility for their civic ecology. The LEAP Report explicitly suggests this outcome, while a concern for history is found not in EAC-ABET but in BOK2, under the outcome related to history and heritage, with a particular focus on the history and heritage of civil engineering.

But these questions cannot be answered from the narrow perspective of just one discipline or department. Such questioning benefits from interdisciplinary perspectives. Schools recognize that students need to be able to see the interconnectedness of knowledge domains that can be brought to bear on these complex and eternally challenging questions. Six schools recognize the importance of making these connections. One of the six, Messiah College, takes it a step further to consider not just horizontal integration but also vertical integration where “service, leadership, and reconciliation are addressed at increasingly complex levels as students progress through the program.” Such an approach can help to address the challenge of developing liberal education past the first two years of college.

These perspectives need not be confined to the college of arts and sciences but can and must include perspectives from the professional schools where the practice of knowledge proves its utility. Three schools explicitly emphasize the importance of students understanding the impact of their profession on the world. This interaction between professional education and liberal education ranges from the impact that technology has on society to acknowledgement that there is such an interrelationship. This outcome harks back to EAC-ABET Criterion 2h, but also to the outcome of working on multi-disciplinary teams (EAC-ABET Criterion 2d) and in many ways to the BOK2 outcomes in humanities and social sciences, outcomes in contemporary issues and their relationship to engineering, and outcomes in public policy, business, and public administration, all of which point to the need to incorporate disciplines outside of civil engineering in the formulation of solutions.

Perhaps the strongest conviction expressed by a majority of the schools is the importance of liberal education to the foundation of democracy. As noted in the LEAP Report, civic knowledge and engagement is identified as one of the key areas of 21st century learning. The report recommends “a rich understanding of the values and struggles that have established democratic institutions and expanded human freedom and justice, and direct experience in addressing the needs of the larger community.” As they state on page 22, “Democracies are founded on a distinctive web of values: human dignity, equality, justice, responsibility, and freedom.” But democracies are not necessarily utopias and hard questions also need to be confronted: “How do we prepare citizens to address the growing and destabilizing divisions between those with hope and those who still live on the margins of our own and other societies?”

As with 25 schools (75.8% of the study schools), Bradley University expresses this idea simply when it states that “The purpose of liberal education is to develop students who are able to understand and participate in society as responsible human beings.” In this statement are two
different goals in the education of citizens: the realization that the individual is a member of society (identification with a group) and that membership requires responsible action (for the good of the group, sometimes over the needs of the individual: sacrifice and service). Eighteen schools emphasize the social nature of man using phrases such as citizenship, good/informed/engaged/democratic citizens, responsibility, values, role, concerned members, cares about others, takes one’s place in the world. Fifteen schools emphasize the implications of membership in a democracy, using words and phrases such as service, commitment to respond to the needs of others, create a just world, commitment to promote justice, active role, participate effectively, leadership, guide societies on a sustainable course, agents of positive change, contribute to the good of the world. Nine schools have both goals, the need to recognize membership and the imperative to respond to society’s needs.

According to the LEAP Report, civic engagement is part of a larger outcome of personal and social responsibility, and is paired with intercultural knowledge as well as ethical reasoning and action. Indeed, in a democratic society composed of various cultures, races, ethnicities, gender identities, economic backgrounds, and national origins, citizens require an understanding of the value of diversity. But increasingly, citizens of the United States are impacted by a world that does not necessarily have the same values. Ten schools (30.3%) have goals that address awareness and appreciation of diversity and globalism. Schools use a wide range of phrases such as diversity, diverse backgrounds, the other, other viewpoints, cultures and traditions, cultural understanding, cultural diversity, intercultural, multicultural, gender diversity, global awareness, global community, and global perspective. Of these, the term “intercultural” implies the porosity of the borders that often seem to wall off cultures from each other.

Underlying all civic engagement in a diverse world is the need for ethical reasoning and judgment. Fourteen schools (42%) have goals related to moral and ethical development. Some schools explicitly use the language of ethics (ethical framework, behavior, choices) while others use the language of morals (moral development, moral responsibility). Others frame their goals of ethics and morals in the context of examined values, a system of values, and an awareness of values. Others couch the ethical dimension more specifically in terms such as “respect for human dignity,” “truthful behavior,” “honesty,” and “rights.”

It is interesting to note that of the 14 schools with an ethical component, only five schools have a religious affiliation, that is, less than half of the 14. However, the language used to describe the spiritual goals of their general education programs implies a foundation for making choices oriented towards what is just and good. The University of Portland wants its students to “examine faith, its place in one’s own life and in the life of others.” Taken together, all 15 schools with religious affiliation have goals related to either ethics and values or spirituality and faith.

Although both EAC-ABET Criterion 2f and BOK2 refer to professional responsibility and ethics, there is no outcome that necessarily captures the same sentiment as the term “civic engagement” as used in institutional statements as well as the LEAP Report. The profession does ask its students to act ethically and also to consider societal impacts, but not with the same sense of direction or mission found for example in the Obligation of the Engineer from the Order of the Engineer: “When needed, my skill and knowledge shall be given without reservation for
the public good. In the performance of duty and in fidelity to my profession, I shall give the utmost.” In BOK1, ASCE suggested specific attitudes in its outcome on attitudes (Outcome 15 on leadership attitudes). The suggested list included commitment and consideration of others, attitudes that could lead to something like “civic engagement.” However, BOK2 backed away from suggesting a list, leaving the outcome on attitudes rather generic: Demonstrate attitudes supportive of the professional practice of civil engineering.

While the focus of this section of the discussion has been the development of the student in a social context, it is also important to note that schools have identified goals that relate to the development of the individual as a whole person, in mind, body and spirit. Sixteen schools (48%) have goals related to personal development, the life of the mind, and spiritual awareness. Personal development is couched in terms that range from success in a student’s chosen profession to students “embarking on a conversation that transforms the heart as it opens the mind.” The life of the mind is celebrated in language that emphasizes “intellectual excellence,” “habits of free inquiry,” and developing “an intellectual being who can think clearly, accurately, and dispassionately.”

And it is fitting to take a step back from the concerns of outcomes, criteria and assessment to remember that educators should not lose sight of the individual engineering student and her development. Clearly the outcomes in EAC-ABET and in BOK2 are intended to prepare engineering students for a successful start in the engineering profession. It could be argued that helping a student develop a deeper self-awareness is someone else’s responsibility (perhaps someone in the humanities). However, BOK2, in its Outcome 22, recommends that students be able to demonstrate the ability to “assess personal professional and ethical development.” This type of connected-introspection can certainly start with courses in the liberal arts and be integrated within the engineering curriculum to produce engineers who are not simply laborers in the field, but are truly professionals in the best sense of the word.

While the focus of this discussion has been on commonalities and relationship to the LEAP Report and BOK2, it is worth noting that there are some areas where schools do stand out with respect to explicitly stated goals. The Rochester Institute of Technology is the only school with a goal that requires their students develop a “critical awareness of the impact of the interactions between society and the environment.” Swarthmore expresses a similar concern in a broader way by invoking the word “sustainability.” In a world where the work of engineers has a major impact on the environment, one would expect more schools to require greater awareness of the environment.

Course Clusters

Both communications skills and civic responsibility are the two most frequently cited liberal education goals in the schools studied. A survey of courses and course clusters also shows that schools have invested in developing the courses necessary to meet these goals.
Oral and written communication:

Twenty-six colleges have at least one separate writing course, usually required in the first year of college. However, several schools offer an academic First-Year Seminar that is integrated with the liberal education requirements. These seminars focus on the critical skills of reading, writing, and critical thinking, as opposed to first-year introductory courses specifically for the major (such as Introduction to Engineering) or orientation to college life. Thus, three of the seven schools that do not require a separate composition course do require a writing-intensive course in the first year of school. Only five colleges require students to take writing-intensive courses or else have a program for writing across the curriculum. One of these five also has a separate writing course. Eight schools require a course in speech or oral communication, sometimes in a course that combines written communication. Taken all together, only three schools in the set of 33 do not require at least one separate class in oral or written communication.

Civic engagement:

In identifying schools that address the issue of personal and social responsibility, attention was turned to clusters in the area of social and civic institutions, ethics and values, and more broadly engagement and responsibility. Among the cluster categories are: Ethics; Values and Contemporary Issues; Philosophy, Religious Studies and Applied Ethics; Social Change in Historical Perspective; American Institutions; US Government and Constitutional Development; Law; Leadership; Political Science; Economics; Civic Responsibility, Self & Society; Social Issues; Cross-Cultural Engagement; and Engaging a Pluralistic World. Eighteen schools out of the 33 use such categories, with some very unique approaches that specifically deal with the outcome of civic responsibility (see College of New Jersey for Civic Responsibility, Calvin College for Engaging a Pluralistic World, and Messiah College for Cross-Cultural Engagement).

If Calvin College and Messiah College are any indication, schools with religious affiliations can be uniquely positioned to marshal the forces of academia to ask the “big questions,” as the LEAP Report puts it. Religion courses which seek to understand man and woman’s place and mission in the world can contribute to the outcome of students engaging and embracing their responsibility as members of a local and global community. Including schools that have this kind of religion requirement increases the number of schools that address the issue of civic responsibility from 18 to 24.

In the area of diversity and global learning:

Only 14 schools require a subject in the cluster of diversity and global learning. Only six schools require proficiency in a foreign language. Because these two requirements are both met in the case of five schools, in total only 15 schools explicitly state that they seek to develop students with global and multicultural competencies.
Engineering Program Outcomes and Objectives related to Liberal Education

From the survey data, it can be seen that more than 75% of the surveyed schools addressed teamwork, communication, and lifelong learning, which support the BOK2 criteria and are consistent with the LEAP Report. Communication, at 29 institutions, was the most commonly stated objective, closely followed by lifelong learning, at 27 institutions (81.8%). Beyond what is suggested by BOK2, more than 50% of the surveyed schools address global societal issues, ethics, and professional growth in their stated objectives. More than 25% of schools also maintained objectives regarding contemporary issues and leadership. It is surprising to see that only 9% of engineering programs list citizenship as a program outcome when nearly 76% of the institutions list that as a liberal education goal. Finally, nearly all of the schools (97%) listed one or more outcomes unique to their institution, some outcomes related to liberal education and some to technical education.

Summary and Conclusions

In the context of the particular need that prompted this research, the University of Evansville compares well with other similar and higher ranked institutions in terms of proportion of liberal arts courses required, the types of courses, and outcomes and goals. However, the University still intends to go through with the arduous process of designing a new general education program, in search of a signature program that will generate more enthusiasm and commitment across campus. Given the data just gathered, it is quite possible that the outcomes and goals of the new liberal education program will look very similar to other programs. But there is hope that the conceptualization and the articulation of the program could very well embody the unique vision at the University of Evansville to produce a signature program, perhaps by building upon its national ranking in international education experiences. This uniqueness among schools is certainly evident in the many eloquent statements regarding the goals for the general education programs across the country, and even in the wide variety of engineering program outcomes.

And schools with strong liberal arts programs need not worry that engineering programs will necessarily constrain their creativity. Some differences in proportion of humanities and social sciences can be seen between the survey by Ratcliff (which included schools without engineering programs) and the survey by Stouffer and Russell (which included only schools with engineering programs). However, as the current survey shows, even among schools with engineering programs, some institutions require more liberal education courses than cited by Ratcliff. One could argue that in the development of liberal education programs in schools with professional components, the competing demands of different departments can stimulate the design of creative liberal education programs.

As with any design problem, identifying the goals is an important first step, and it is here where engineering and non-engineering programs can find common ground. This survey shows that many of the same goals and objectives expressed by the National Leadership Council in the LEAP Report are mirrored by both ASCE’s BOK2 and ABET’s Criteria for Accredited Programs. The BOK2 in fact represents a significant step in codifying the importance of the humanities and social sciences in an engineering education. And like the LEAP Report, it even mirrors some of the concerns regarding the integration of liberal arts courses throughout the
curriculum, moving the required courses beyond the basic levels of achievement in Bloom’s taxonomy. This should certainly be the focus of any future survey of liberal education courses.

Perhaps the biggest challenge to meeting the outcomes and goals of the various liberal education programs is the development of courses to meet these goals. As the LEAP Report suggests, educating students to be able to integrate knowledge from different domains throughout their four years in college may require departure from the traditional approach of autonomous introductory classes that are intended to service both the requirements of the major as well as the requirements of a liberal education program. In this area BOK2 tacitly acknowledges the status quo by using a simple requirement of two humanities courses and two social science courses and placing the burden of integration in engineering courses (as suggested in senior capstone courses or in transportation and environmental engineering courses). However, the LEAP Report highlights various innovative ways of integrating liberal education courses throughout all four years. These methods include first-year seminars that are multidisciplinary introductions to critical reading, thinking, and writing; writing across the curriculum, where communication is taught not just in a freshman composition course but reinforced in course work required in the major; and a senior capstone course that draws connections with previous work in the liberal arts. Indeed, the current survey shows that various schools are using these new approaches and course structures specifically for their liberal education requirements. However, as those involved in the process of redesigning an institution-wide curriculum can attest, systemic changes are the most difficult to implement, given that they are often constrained by issues related to the elimination of existing faculty lines, new faculty hires, and an overall resistance to change on the part of some faculty. Lest those involved in liberal education reform lose hope, engineering educators can certainly turn to some of the many successful programs for ideas, inspiration, and even hope.

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