The Role of Extracurricular Activities in the Education of Engineers

Odesma Dalrymple¹, Demetra Evangelou²
Purdue University, Department of Engineering Education
West Lafayette, IN 47906

Abstract - The need for reformation of the engineering curriculum taught in most American colleges has been a big topic of discussion, as is evident by the number of journal articles and conferences dedicated to the topic. The terrorist activities that occurred on September 11, 2001 have brought a greater awareness of the vulnerabilities that exist in the world, particularly America. This awareness has lead to the re-examination of the roles of engineers in the society. Emerging from this re-examination is a growing need for renaissance engineers and renaissance engineering education, which is not being satisfied by the current undergraduate engineering curriculum. The reform initiatives currently underway, such as the introduction of an Engineering Education discipline, are ongoing processes, with visible long term impact. However, to bring about more immediate results, alternative complementing ideas can be considered. One such complementing alternative involves the use of extracurricular activities to fill the current gaps in the undergraduate engineering curriculum. Before this alternative can be considered viable, we must explore the role of extracurricular activities in the professional preparation of engineering students. The purpose of this paper is to examine students’ perceptions of the role of extra curricula activities in their professional preparation; we present preliminary results.

Index Terms – ABET Learning Outcomes, Extracurricular Activities, Phenomenological Study, Renaissance Engineer.

INTRODUCTION

The term polymath refers to a person who excels in multiple fields, particularly in both arts, and science [1]. A more common term for such a person is “Renaissance Man,” which is the coined description of Leonardo da Vinci. Leonardo, a man of Italian origin, lived during the Renaissance period and is renowned for his accomplishments as an architect, engineer, sculptor and painter. Adapting the term Renaissance to the Engineering domain, the term Renaissance Engineer can be used to describe an engineer, who in addition to mastering the technical competencies required of the profession, also has a command of other disciplines beyond those of mathematics and science. The value that Renaissance Engineers, such as Benjamin Latrobe, a premier American engineer in the early 19th Century and accomplished watercolorist; John Rennie, famous British builder of canals, and proficient on many instruments; and Lillian Gilbreth, first female professor at Purdue University’s School of Mechanical Engineering, and mother of modern management; have brought to the Engineering profession are unquestionable. However, the debate on the need to develop engineering curriculum that is focused on producing Renaissance Engineers continues.

MODERN DAY RENAISSANCE ENGINEER

At present, there is limited published material dedicated to defining the modern day characteristics of a Renaissance Engineer, his/her role in society, and required education for his/her development. Akay makes a compelling argument for the need for renaissance engineers in a post 9/11 world [2]. He believes that modern day engineers need to heed to society’s needs for answers and ideas on the role of technology in the world. In order to fulfill this obligation, they will need knowledge that exceeds the technical competencies of the profession and extends to issues of globalization and its implications. Akay argues that specialization is effective only during times of social stability; however, with the increase in terrorist activities, engineering practitioners that can cross disciplines and understand the big picture are more useful than their specialized counterparts. Akay defines the renaissance engineer as a globalist; possessing the ability to think and strategize creatively. He/she understands the holistic needs of society through the study of politics, world history and economics, in addition to science and engineering; He/ she is better equipped to apply his/her technical skills to solving problems because he/she understands the context in which the problems exist.

EDUCATING A RENAISSANCE ENGINEER

With respect to the required education needed to produce a renaissance engineer, Akay, suggests an individualistic approach, where the engineering education is customized according to the talents and needs of the individual student [2]. This approach refutes the notion that all engineering students be required to pass a significant number of classes, of similar type, in order to fulfill graduation requirements. The nationwide curriculum reform that Akay and other like

¹ Odesma Dalrymple, Doctoral Student, odesma@purdue.edu
² Demetra Evangelou, Assistant Professor, evangeloud@purdue.edu
minded engineering educators are recommending will be an ongoing process with long term impact. This process can be complimented by exploring alternative ideas with possibly more immediate results. One possible alternative is the use of extracurricular activities that can be pursued outside of the scheduled class time. Since involvement in extracurricular activities is usually based on the intrinsic interest of the participant [3], it can serve as an avenue for the individual to develop his/her interests and talents, independent of the engineering curriculum.

**EXTRACURRICULAR ACTIVITIES**

Extracurricular activities found its niche in the American college system during the nineteenth century. It refers to the wide range of activities not covered in the college curriculum, and take place outside of the regular scheduled class time. Among the first types of extracurricular activities pursued on the American college campuses were literary societies, debate clubs, athletics, and Greek letter fraternities and sororities [4]. Involvement in these activities was voluntary; and not a requirement for graduation, although many colleges today use it as criteria for admission. Motivation to participate stemmed from the inherent interests of the students [3]. The nature of the impact of extra curricular activities on academic achievement is debatable. There is evidence to support the notions that it can both complement and subvert the academic curriculum depending on the type of activity and the priority it is given by the students. The definition of extracurricular activities that will be used for the purpose of this study is adapted from Mahoney, Cairns, and Farmer [3]. An activity is considered extracurricular if it satisfies the following criteria:

1. Not a requirement for graduation.
2. Voluntary participation
3. Structured; participants meet regularly in a context specific to the activity
4. Requires effort; it must pose some measure of challenge to the individual engaged in the activity.

The four aforementioned characteristics are critical for the promotion of interpersonal and skill building competencies, educational success and inspiring challenging life goals.

**NATURE OF THE IMPACT**

Numerous research studies link involvement in extracurricular activities to overall positive student development. In a study done by Huang and Chang [5], the nature of the relationship between academic and co-curricular involvement, as well as the optimal amounts and combinations of academic and co-curricular involvement required for cognitive growth in college students was investigated. A total of 627 third-year students at 14 universities in Taiwan were surveyed. A positive linear relationship was found to exist between academic and co-curricular involvement. Contrary to the belief that students that expend a lot of time and energy on co-curricular activities do not have much time and energy for academic pursuits, the study found that the highest levels of academic involvement were attained by those that had the highest levels of co-curricular involvement.

Taking into account that the student population at institutions of higher education comprises adolescents as well as adults, the study performed by Graham and Long Gisi [6] investigated the role college involvement plays on the intellectual development of adult undergraduate students. The results continue to support the findings of the previous study. Graham and Long Gisi assessed the role of four different types of student involvement; (course and other related learning, college organizations and activities, on- and off-campus work, and off-campus community or cultural activities) on four types of academic development (intellectual development, problem solving, scientific reasoning, and career development). The results showed that the more hours that adults were engaged in course and other related learning activities as well as college organizations, the greater their reported learning outcomes.

There is a belief that involvement in school-based extracurricular activities results in students with adult oriented values of school. However, this belief is countered by studies done by Rigsby and Mc Dill [7]. According to Rigsby and Mc Dill, adolescents already possessing adult values with respect to school are more likely to participate in extracurricular activities. However, this type of argument may not be productive because it leads to discussions around “the chicken and the egg” concept. Which is the leading occurrence; extracurricular involvement or the possession of adult values? Burnett [8] also argues that students engaged in extracurricular activities are more likely to demonstrate positive academic outcomes because the criterion to participate in many extracurricular activities depends on requirements such as minimum GPA and / or performance in tryouts or auditions.

In the study conducted by Broh [9], data from the National Education Longitudinal, study of 1988 was analyzed to determine the impact of participation in extracurricular activities, primarily sports, on high school achievement. The results showed that while some types of sporting activity lead to improved academic achievement, others lead to diminished achievement. The study however failed to take into account the impact of other types of activities that students may be involved in as well as student characteristics. The benefits of involvement in extracurricular activities to increased social capital was also discussed, and used to complete the link to academic achievement. The study showed that participants in interscholastic sports have a value system that corroborates with the American educational system. It is believed that this value system is developed as a result of the intensified social ties with teachers, staff, school administrators, parents and other students. These social ties along with the value system are seen as advantageous to student educational pursuits. However, since the nature of the forged social ties between students and academic teachers / staff is not known, nor the content of the discussions between both parties, there is no conclusive reason why this occurs. One school of thought is that the forged social ties "encourage behavior that conforms to school expectations and norms, which in turn allow students

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to succeed in school.” A contradicting thought states that the social ties lead to teachers having leniency in grading, which results in inflated grades [10].

**Benefits of Extracurricular Involvement to Engineering Education**

Brown, Flick, and Williamson [11] describe social capital as a crucial part of engineering education. They present arguments supporting the need for universities to exert resources for the development of students’ social capital. Social Capital refers to the collective value of all ‘social networks’ (structure between actors, mostly individuals or organizations), and the inclinations that arise from these networks to do things for each other,” According to Brown, Flick, and Williamson [11], “social capital has been positively correlated with low crime levels, high educational attainment, retention in college and K-12, and perhaps most intriguing for engineering education, innovation and productivity in knowledge-based firms.” Industry is placing increased pressure on colleges and universities to prepare students not only to perform the technical aspects of the job, but also for the workplace culture. The workplace culture is very different from that of the academic culture. Where as collaboration, group goals, and information sharing, characterize the workplace culture; independence, and competition reflect the academic culture. Companies such as ALCOA are expending significant resources to develop opportunities to promote greater social capital. ALCOA corporation recognized that stairwells became a place where many of the employees spent time talking to each other. They utilized this already developed culture to encourage more interaction by creating broader stairwell landings with coffee machines and space to visit. [12]. According to the ethnographic report conducted by the U.S. department of Commence, it was estimated that 80% of organization learning is informal. Social capital plays a big role in the communication and training mechanisms of industry. Although there are a number of engineering educators that are utilizing teaching practices that promote social capital such as cooperative learning, and service learning [13], there is also potential for social capital to be developed through extracurricular activities.

**Mapping the Benefits of Extracurricular Activities to ABET Outcomes**

Strong ties can be shown between the benefits of extracurricular activities and the learning outcomes stipulated by the ABET Engineering Accreditation Commission. (U.S. accreditor of college and university programs in engineering) The following is an extract from the “Criteria for Accrediting Engineering Program.” This document was approved by ABET board of directors on November 1, 2004, and is the guiding document for 2005 through 2006.

Engineering programs must demonstrate that their students attain:

a) An ability to apply knowledge of mathematics, science, and engineering

b) An ability to design and conduct experiments, as well as to analyze and interpret data

c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d) An ability to function on multi-disciplinary teams

e) An ability to identify, formulate, and solve engineering problems

f) An understanding of professional and ethical responsibility

g) An ability to communicate effectively

h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i) A recognition of the need for, and an ability to engage in life-long learning

j) A knowledge of contemporary issues

k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Based on the definition of extracurricular activities adapted from Mahoney, Cairns, and Farmer [3], a diverse number of activities ranging from involvement in engineering professional societies to sports are included. Collectively, extracurricular activities can provide opportunities to further promote all of the ABET decreed learning outcomes. It is expected, however, that some types of activities will have a greater impact on engineering related learning outcomes than others.

**Research Methodology**

A phenomenological study was undertaken, the goal of which was to understand the perceptions of engineering students as it pertained to the role of extra curricula activities in their professional preparation. In-depth interviews were conducted with engineering juniors and seniors who had been involved in extracurricular activities at some point during their college experience. The interview protocol was designed to answer the following questions:

1) What types of extracurricular activities do engineering students get involved in?

2) What are their motivations for getting involved?

3) How do they perceive the contribution of their extracurricular involvement to their attainment of the engineering learning outcomes outlined by ABET?

**Interview Protocol**

A semi standardized open-ended interview protocol was developed. All informants were asked the same questions; however, the sequencing was altered, depending on the response given, to promote a more conversational discourse. To capture students perceptions on the contribution of their
extracurricular involvement to their attainment of ABET learning outcomes, they were asked to indicate whether or not their involvement in extracurricular activities impacted on their achievement of the outcome. For the purpose of the interview, the ABET outcomes were rephrased using more simplistic language, and they were identified merely as outcomes, with no reference to ABET (Table 1). If the student indicated that their involvement in extracurricular activities impacted on their attainment of the outcome, they were probed further to determine:

a) Which activity / activities impacted on the outcome?
b) How the activity / activities led to the attainment of the outcome?
c) Whether or not attainment of the outcome was impacted by any of the engineering classes taken?
d) Between the extracurricular activities and the engineering classes, which had a greater impact on the attainment of the outcome?

**TABLE 1 – REPHRASED ABET OUTCOMES**

<table>
<thead>
<tr>
<th>ABET Learning Outcome</th>
<th>Interview Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to apply knowledge of mathematics, science, and engineering</td>
<td>Ability to use knowledge of mathematics, science / engineering</td>
</tr>
<tr>
<td>Ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>Ability to create or carry-out tests, activities or experiments; Collect things from these tests, activities, or experiments, and try to understand their meaning</td>
</tr>
<tr>
<td>Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>Ability to create things to meet certain real life specifications</td>
</tr>
<tr>
<td>Ability to function on multidisciplinary teams</td>
<td>Ability to work well with others not in your major discipline</td>
</tr>
<tr>
<td>Ability to identify, formulate, and solve engineering problems</td>
<td>Ability to spot and solve engineering problems</td>
</tr>
<tr>
<td>Understanding of professional and ethical responsibility</td>
<td>Know how to act professionally, be ethical, and do the right thing</td>
</tr>
<tr>
<td>Ability to communicate effectively</td>
<td>Ability to communicate well</td>
</tr>
<tr>
<td>The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>Ability to increase scope of knowledge to understand world, environmental and social problems</td>
</tr>
<tr>
<td>A recognition of the need for, and an ability to engage in life-long learning</td>
<td>Ability to stay informed and continue to learn new things through out your life</td>
</tr>
<tr>
<td>Knowledge of contemporary issues</td>
<td>Understand current issues.</td>
</tr>
<tr>
<td>Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>Ability to use current technology and practices necessary for engineering</td>
</tr>
</tbody>
</table>

**PARTICIPANTS**

The choice of participants was guided by the literature. Previous studies recruited upperclassmen based on the rationale that student growth takes a while to happen and stabilize; thus, it is more likely that upperclassmen, as opposed to lower classmen, will have more measurable student development. For this study, undergraduate engineering students of junior / senior classification, that are currently or have previously engaged in extracurricular activities while at college, were recruited. These students are more likely to have attained most of the ABET engineering learning outcomes than freshmen or sophomores.

**RECRUITMENT**

The recruitment process was two fold, and consisted of interactions with professors and students.

- **Interactions with Professors** - Engineering classes geared towards upperclassmen (students of “junior” status and higher) were identified, and the associated professors contacted via email. The email contained a brief overview of the research initiative, and a request to recruit participants from their class, at the end of a class session, before the official dismissal time. Once the request had been granted, arrangements were finalized with the professor to be present at a class session.

- **Interaction with Students** - At the end of the class session a brief overview of the research initiative, and requirements for participation were presented. Interested students that fit the participant criteria were asked to provide contact information on a sign up sheet. All students that signed up were contacted and asked to indicate a date and time when they will be available to participate in a 45 minute interview. Students that responded favorably were scheduled. No incentives were provided to encourage participation.

**RESULTS**

**Participants Interviewed** – A total of 29 students were interviewed. Tables 2 – 5 show the distribution of the participants with respect to gender, classification, GPA, and discipline.

**DISTRIBUTION OF PARTICIPANTS**

**TABLE 2 - GENDER**

<table>
<thead>
<tr>
<th>Gender</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>66</td>
</tr>
<tr>
<td>Female</td>
<td>34</td>
</tr>
</tbody>
</table>

**TABLE 3 - CLASSIFICATION**

<table>
<thead>
<tr>
<th>Classification</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior</td>
<td>31</td>
</tr>
<tr>
<td>Senior</td>
<td>69</td>
</tr>
</tbody>
</table>

**TABLE 4 - GPA**

<table>
<thead>
<tr>
<th>GPA</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥3.4</td>
<td>46</td>
</tr>
<tr>
<td>≥3.0 &amp; &lt; 3.4</td>
<td>29</td>
</tr>
<tr>
<td>&lt; 3.0</td>
<td>25</td>
</tr>
</tbody>
</table>

**TABLE 5 - DISCIPLINE**

<table>
<thead>
<tr>
<th>Discipline</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautics and Astronautics</td>
<td>3.25</td>
</tr>
<tr>
<td>Agricultural and Biological Engineering</td>
<td>6</td>
</tr>
<tr>
<td>Biomedical Engineering</td>
<td>3.25</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>15</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>24</td>
</tr>
<tr>
<td>Construction Engineering</td>
<td>3.25</td>
</tr>
<tr>
<td>Electrical and Computer Engineering</td>
<td></td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>12</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>24</td>
</tr>
<tr>
<td>Nuclear Engineering</td>
<td>6</td>
</tr>
</tbody>
</table>

**OVERALL IMPRESSION**

Collectively, links were made between all ABET learning outcomes and the involvement in extracurricular activities. However, at times, it was difficult for informants to differentiate between opportunity and attainment; did their extracurricular involvement contribute to the attainment of the
outcome, or did it provide them with opportunities to practice
the already achieved outcome? With respect to, “the ability to
apply their knowledge of math science and engineering,” most
informants felt that their extracurricular involvement provided
opportunities to practice the application of the knowledge,
rather than contributed to the development of the ability.
However, with respect to, “the ability to communicate
effectively,” the reverse was observed.

MAJOR EMERGING TRENDS

Thus far very preliminary analysis has been undertaken, solely
using field notes. The emerging trends reported in this section
will continue to be refined with future in-depth analysis.
The four major emerging trends are reported below.

- **Involvement in Extracurricular Activities**
  - Continuation from High School – Many of the
    informants reported prior involvement in extracurricular
    activities while in high school. For these informants it
    was a natural progression to continue to remain engaged
    at college; some even continued with the same or similar
    activities. This was particularly true for students that
    devoted a lot of time, even prior to high school, mastering
    a skill such as playing an instrument or sport.

- **Support for Female Students in a Male Dominant Field** – Most of the female engineering students reported
  involvement in either a sorority, women cooperative
  house, Society of Women in Engineering, or Women in
  Engineering Program. For these women, there was a need
  to find an environment that balanced their academic lives,
  where they were mainly surrounded by men. With regard
  to the students that are/were involved in the Society of
  Women in Engineering and the Women in Engineering
  program, the aforementioned organizations provided
  mentoring and a support system that specifically
  encouraged them to continue their engineering pursuits.
  The Sororities and women cooperative houses that
  informants are / were affiliated with do not have high
  representation from women in engineering. Thus, they did
  not directly encourage continued pursuits of the
  discipline; in fact, some reported difficulty explaining the
  demands of the engineering curriculum to their fellow
  members. However, involvement was effective in
  developing confidence and leadership skills which were
  transferable to their academic lives.

- **Developing Communication Skills** – For all informants,
  extracurricular involvement impacted on their ability to
  communicate well. More than 90% of the informants
  indicated that their extracurricular involvement was more
  instrumental in this regard than the engineering
  curriculum. Although the curriculum required all students
to take a Fundamentals of Speech Communication course,
and make class presentations, extracurricular activities
were more effective because they provided more
opportunities for the students to refine their
communication skills. Many expressed that effective
communication was the basis of their extracurricular
activities, and the inability to communicate well would be
detrimental to the progress or success of the activity. This
was particularly true for students that held executive
positions in organizations and participated on team sports.
There were a few informants that differentiated between
interpersonal communication and technical
communication. These students expressed that with
respect to their ability to communicate technical
information, the curriculum had a greater impact.
However, their extracurricular involvement impacted
more on their interpersonal communication skills.

- **Leadership Abilities** – Although informants were not
  asked about the development of leadership skills many
  mentioned the ability and confidence to lead as outcomes
  of extracurricular involvement. This was particularly true
  for informants that held leadership roles in organizations.
  They felt these leadership skills would be attractive to
  future employers and make them more effective in
  industry.

PRELIMINARY FINDINGS

**1) What types of extracurricular activities do engineering
students get involved in?**

The table below lists the types of extracurricular activities that
the informants reported being involved in, and the percentage
of informants that engage/engaged in the activity. If the
motivation for getting involved in the activity was related
to engineering, a tick is placed in the “Eng” column.

<table>
<thead>
<tr>
<th>Type of Extracurricular Activities</th>
<th>%</th>
<th>Eng.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band/Orchestra</td>
<td>14</td>
<td>✓</td>
</tr>
<tr>
<td>Community Service Organizations</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Cultural/Ethnic Organizations</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Engineering Academic Honor Societies</td>
<td>24</td>
<td>✓</td>
</tr>
<tr>
<td>Engineering Clubs/Organizations</td>
<td>38</td>
<td>✓</td>
</tr>
<tr>
<td>Freshman Orientation Programs</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Health Related Organizations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Professional Engineering Societies – Student Chapters</td>
<td>38</td>
<td>✓</td>
</tr>
<tr>
<td>Religious Organizations</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Research (Voluntary Basis)</td>
<td>7</td>
<td>✓</td>
</tr>
<tr>
<td>Resident Hall Organizations</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>ROTC</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sororities and Fraternities</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Sports (Competitive)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sports (Intramural)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Sports (Recreation &amp; Club)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Study Abroad</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
2) What are their motivations for getting involved?

Table 7 lists the ten most identified motivations for getting involved in extracurricular activities.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Become more attractive to potential employers – Resume builder</td>
</tr>
<tr>
<td>2</td>
<td>Create a balance</td>
</tr>
<tr>
<td>3</td>
<td>De-stress</td>
</tr>
<tr>
<td>4</td>
<td>Desire to give back</td>
</tr>
<tr>
<td>5</td>
<td>Fulfill an intrinsic interest</td>
</tr>
<tr>
<td>6</td>
<td>Like to volunteer</td>
</tr>
<tr>
<td>7</td>
<td>Maintain prior involvement from high school</td>
</tr>
<tr>
<td>8</td>
<td>Meet people</td>
</tr>
<tr>
<td>9</td>
<td>Personal development</td>
</tr>
<tr>
<td>10</td>
<td>Take mind off school work</td>
</tr>
</tbody>
</table>

3) How do they perceive the contribution of their extracurricular involvement to their attainment of the engineering learning outcomes outlined by ABET?

a) An ability to apply knowledge of mathematics, science, and engineering - Overall most informants did not feel that their extracurricular involvement impacted on their ability to attain this outcome. However, those that participated in engineering competitions such as Concrete Canoe, ChemE Car, Quarter Scale Tractor; and engineering research felt that these activities provided them with the opportunity to practice this skill. All informants felt that the engineering curriculum helped them attain this outcome, particularly their design classes.

b) An ability to design and conduct experiments, as well as to analyze and interpret data – Many informants shared experiences of planning activities, lessons and events. Sometimes they had to conduct an evaluation and collected and analyzed data as a result. The level of analysis done was often described as elementary, and hence not a major contributor to the attainment of the outcome. Lab classes were identified as instrumental in their development of this ability.

c) An ability to design a system, component, or process to meet desired needs within realistic constraints … – Many informants felt that their experience in planning activities, lessons, and events, which was provided through their extracurricular activities, contributed to their attainment of this outcome, however most felt the curriculum had a greater impact.

d) An ability to function on multi-disciplinary teams – Most engineering programs have little or no opportunities for students to work with students from other departments. Even the general education classes that all students are required to take often promote independent work. With the exception of activities that are linked to the informant’s major, most extracurricular activities have a diverse membership. Informants reported that working with people from different disciplines in their extracurricular activities has contributed to their attainment of this outcome.

e) An ability to identify, formulate, and solve engineering problems – Attainment of this outcome mainly comes from the engineering curriculum, however, for those informants that felt that their extracurricular involvement was also a major contributor, the absence of a professor’s guidance and the freedom to consider numerous options were among the top reasons offered in support of their claim.

f) An understanding of professional and ethical responsibility – Professionalism meant different things to different informants. Some of the expressed characteristics of professionalism are: respect for others and their opinions, knowledge of subject area, diplomacy when expressing disagreement with the ideas of others, business attire and etiquette, and ability to know when to be serious and when to be more casual. Informants identified the contributions of both extracurricular and the curriculum as being most significant in the attainment of this outcome.

Most informants did not view ethics beyond the confines of academic dishonesty which is greatly emphasized by the university, and constantly reinforced by professors. As a result many identified the curriculum and family upbringing as the significant contributor to the attainment of this outcome.

g) An ability to communicate effectively – More than 90% of the informants identified extracurricular involvement as the major contributor to the attainment of this outcome. The basis of most of the extracurricular activities is communication.

h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context – The responses for this question varied significantly among the informants. At this time further findings can not be reported.

i) A recognition of the need for, and an ability to engage in life-long learning – All informants felt that lifelong learning is important. Contributors to this sentiment came from a variety of sources including family, co-op, professors, life experiences, and involvement in extracurricular activities.

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1 Refer to Table 1 for a mapping of ABET outcomes to interview questions

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j) A knowledge of contemporary issues – The responses for this question varied significantly among the informants. At this time further findings can not be reported.

k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice – All informants unanimously agreed that the curriculum was the most significant contributor to the attainment of this outcome.

SUMMARY

Engineering students that engage in extracurricular activities, have the potential to become renaissance engineers, from the perspective that it gives them the opportunity to master a skill not necessarily connected to math, science or engineering. However, with respect to Akay’s definition and concept of the renaissance engineer1, further analysis, particularly of the informants’ responses to ABET outcome “h” and “j” will need to be done.

Thus far the preliminary analysis indicates that extracurricular involvement has played a role in the education of the interviewed engineering students. In fact, it has contributed to their professional preparation because it assisted in their attainment of the ABET learning outcomes which are indicators of their preparedness to work in the profession.

LIMITATIONS

The identified emerging trends and findings are based solely on a preliminary analysis of the field notes. Further analysis will proceed, resulting in the refinement of the current conclusions and the discovery of additional trends.

This study was designed to capture the perceptions of students; however, perceptions may not always mirror reality. All informants indicated a desire to either work in an Engineering Industry or pursue a graduate degree in engineering or business after graduation. Possible future works may entail the development, distribution and analysis of evaluations performed by either employees or graduate advisors to determine their perception of the student’s preparedness for work in the profession. These may provide a means of situating the informants’ self-perceptions.

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REFERENCES


1 Refer to section titled “Modern day Renaissance Engineer”