

## Helping Engineering and Computer Science Students Find Joy in Their Work

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## **Abstract**

As educators, the foremost goal is to graduate students technically prepared to fulfil their degree requirements. While they may be technically competent, certified by a diploma, have we as educators prepared our students to meet the challenges in the workplace, whatever they may be? There are some non-traditional topical areas that should be addressed before these students enter the workforce. We often do not connect work with character qualities such as integrity, loyalty, dependability, or even a religious faith. These qualities, when actively developed in our students, result in a “value added” that will make our students more desirable as employees. Developing a “passion” for the workplace or a strong desire to work for a particular company or sector of the market is also something that can be developed. The challenge is first, to model these qualities in our own work and second, to infuse this mindset into our students so they see the world and their work in a different way. Only then can our students truly be prepared to face the challenges of the workplace. Only then will they experience the joy of work. The hope is for our students to discover what they were gifted to do, something to which they are innately drawn or called. In doing what one is designed to do, the implication is that one will find greater meaning and fulfillment in the work they do, and in so doing, be of greater value to the company or industry for which they work. This paper will explore these “value added” character qualities of a Baylor engineer or computer scientist.

## **Introduction**

The job of an educator at a college or university is to receive incoming freshman students, at whatever their stage in life, and help transform them over the course of four (or more) years into technically competent, responsible adults who will make a positive contribution to society. At the university, these engineering and computer science students study mostly technical topics to fulfil their degree requirements and are certified proficient at the end of their study by receiving a diploma with the university’s name. Employers then recognize the degree, and the university’s name, and assume that the person is qualified to fulfil a particular job suited to that degree and its capabilities. As educators we have a responsibility to develop this technical competence; however, the transition of our students into being a productive adult in this field, beyond technical competency, still lies with the faculty and institution, whose responsibility it is to impart additional qualities that would make these graduates valuable employees.

Often, we do not connect work with character qualities such as integrity, loyalty, dependability, or even a religious faith. These qualities, when actively developed in our students, result in a “value added” that make our students more desirable as employees. Students approaching graduation desire a job. Their parents would like them to find a job as well. At Baylor University, the recent trend is approximately 30% of the students reach graduation without a job. The most common reason given for not having employment is they were busy with their classes and did not have the time to look for a job. The reality is for some students is that they were safely secure in the classes. Looking for a job and anticipating life after graduation can be uncomfortable if students

are not prepared to face this reality. It is the opinion of the authors that some of these students were putting off the inevitable question because they have not fully considered what job to pursue. As educators, we have a responsibility to help all students discover their strengths, seeing what topics in the curriculum a student enjoyed, and then help them see themselves contributing in the workplace accomplishing that particular job. The students do not stop and consider the reasons why they would enjoy a particular job. Bringing a “passion” to the workplace is also something, we believe, that can be developed. Seeing work as an opportunity to make a difference can change our attitudes and the way in which we approach our work. We all should have abilities, skills, and passions for the work we do which provides the purpose and meaning that we bring to our work. The challenge then is first, to model these qualities in our own work and second, to infuse this mindset into our students so they see the world and the workplace in a different way. Only then can our students be better prepared to face the challenges of the workplace. Only then will our students experience joy in their work. Students need to have a passion for their profession and in this paper we will discuss the reasons and preparations that can help students see this connection. It is the desire of the faculty to see their students find meaningful employment, but more importantly, to find this passion for work as they begin their professional journey.

### **Preparation for the Workplace**

The primary focus of any college or university degree program is on the requirements for their degree. For engineering and computer science, the standard used to evaluate programs is set by the Accreditation Board for Engineering and Technology (ABET).<sup>1</sup> ABET accredits approximately 3,700 programs at over 750 colleges and universities in 30 countries. Their Criteria for Accrediting Engineering Programs (CAEP), for example, guides programs on program educational objectives, student outcomes, assessment of these outcomes, and then process improvement/evaluation determining how well the program addresses these criteria.<sup>2</sup> The Student Outcomes a-k have almost universally been adopted by engineering departments to characterize their programs without modification, usually to simplify the accreditation process. Outcome f, an understanding of professional and ethical responsibility, is typically satisfied by a course on ethics, often taught outside the department and from a non-engineering perspective. Outcome h, the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context, is so broad that it is difficult to know how to assess this outcome. Outcome i, a recognition of and the need for an ability to engage in life-long learning, and Outcome j, a knowledge of contemporary issues, are again, both broad and difficult to assess. The difficulty in assessing these outcomes motivated ABET to refine the a-k student outcomes to seven, which will be adopted in the future.<sup>3,4</sup> Much heated discussion is ongoing concerning these changes. From the CAEP, the only curricular requirements for a program such as mechanical engineering are:

“The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.”<sup>2</sup>

Programs are required to have a year of college level mathematics and basic sciences and a year and a half of engineering topics. The general education dimension needs only to complement the technical content of the curriculum. While ABET identifies criteria and outcomes that deal with technical competency and maturing students to an acceptable level of ability, it does not address the issues of mentally, physically, and emotionally preparing students for the workplace. While some formation of character in these areas is done through the university, so much more could be accomplished as part of an engineering or computer science program.

Ethical preparation for the workplace is required by the student outcome “f” which states that a student must satisfy an understanding of professional and ethical responsibility. This is typically approached in the freshman year by exploring the codes and canons of professional societies. The Association of Computing Machinery (ACM) has the following code of ethic and professional conduct, described as General Moral Imperatives<sup>5</sup>:

1. Contribute to society and human well-being
2. Avoid harm to others
3. Be honest and trustworthy
4. Be fair and take action not to discriminate
5. Honor property right including copyrights and patent
6. Give proper credit for intellectual property
7. Respect the privacy of others
8. Honor confidentiality

The National Society of Professional Engineers (NSPE) Code of Ethics for Engineers is similarly stated<sup>6</sup>:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Throughout the curriculum, these topics are often addressed using case studies. These topics should also be emphasized in capstone design classes. The standard of “understanding” does not guarantee that the student has internalized these qualities of character and ethical responsibility. One of the primary dilemmas for students choosing to obey (or not) these fundamental canons is the possibility of losing their jobs. The motivation of fear of losing a job is a negative motivation. These codes/canons are a “minimum” list of guidelines to help engineers face challenges in the workplace. Understanding does not imply that employees will always do the right thing. If these canons are part of a personal, internal ethic, then the engineer/computer scientist will be more inclined to do the right thing for the right reasons.

At Baylor University, the spiritual dimension to a students' formation is extremely important and provides the foundation upon which to build one's life. The spiritual dimension is supported in the university, school, and department's mission statements:

**University:** The mission of Baylor University is to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community.

**School:** The mission of the School of Engineering and Computer Science is to provide a superior education through instruction, scholarship, and service that prepares graduates for professional practice and responsible leadership with a Christian worldview.

**Department:** The mission of the Department of Mechanical Engineering is to educate students, within a caring Christian environment, in the discipline of mechanical engineering. Our graduates will be equipped with the fundamental technical, communication, and teamwork skills to succeed in their chosen careers. They will be empowered by innovative problem-solving creativity and an entrepreneurial mindset. They will be motivated by Christian ideals and a vocational calling to improve the quality of life worldwide.

Religiously affiliated colleges and universities are a consideration for many parents and students when deciding on which school to attend. Forbes published its rankings of the 20 best religiously affiliated colleges in the United States in 2010, for example, stating that these universities provide a first rate education for both mind and the soul.<sup>10</sup> Coudriet, in 2016, chose 25 top Christian colleges and quotes Rick Ostrander, PhD, vice president for Academic Affairs and Professional Programs for the Council for Christian Colleges & Universities, saying

“What our schools tend to do when they talk about ‘career,’ we tend to use terms like ‘calling’ and ‘vocation.’ We believe that God gives students particular talents but also desires. Our goal as Christian colleges is to help students discern where in the world they can be most beneficial, not just success financially or professionally, but where they can do the most good.”<sup>11</sup>

Helping students obtain this mindset is an important step towards helping students find joy and fulfilment in their work. Coudriet also notes that for the 25 Christian schools he profiled, there is a monetary reward for a Christian education. The average mid-career salary for the alumni of the 25 schools he studied is \$94,058, which is almost \$30,000 per year higher than the nationwide median income for ages 33 to 44. This implies that a spiritual dimension/mindset makes a difference in the lives and careers of these students.

## **The Mindset of Work**

There is a difference of opinion and perspective between the world we live in and the higher values we might hold when we consider the term “work”. The western definition of work, according to the American Heritage Dictionary is “A job; employment. A trade, profession, or other means of livelihood.” The implication of this definition concerning jobs appears mostly

negative, carrying the connotation that work is what one must do in order to earn a living, as opposed to something one gets to do in order to earn a living. The term “work” is given a deeper definition at Baylor University, synonymous with the word “vocation.” Vocation carries the implicit definition of the work in which a person is employed, but explicitly includes the notion that the work a person does is something for which they have a strong desire or summons to do. At Christian universities, this second definition is more suited, and should be used as it applies to our students. Our hope for them is that they find what they were designed to do by God, since this design is usually something to which they are innately drawn or called. In doing what one is designed to do, the implication is that one will find great meaning and fulfillment in the work they do.

### **Connecting Work to Who We Are and What We Do**

While a fast and easy answer to connecting us to our work might invariably include the need to make a living and pay bills, it certainly is not the only reason that we work. According to Swarthmore psychology professor Barry Schwarz, in his book, “*Why We Work*,”<sup>12</sup> he asked people who are fulfilled by their work why they did what they do. In his findings, “money almost never comes up.”<sup>13</sup> In the list of non-monetary reasons people provided for doing the work they do is:

- Satisfied workers are engaged by their work
- Satisfied workers are challenged by their work – it forces them to stretch themselves, going beyond preconceived ideas
- Satisfied workers feel that they are in charge – their work offers them to autonomy to learn new things, developing both as a worker and as a person
- Satisfied workers feel their work provides an opportunity for social engagements
- Satisfied workers find their work meaningful

The Christian Bible teaches that there is more meaning in work than simply earning a living:

*Whatever you do, work at it with all of your heart, as working for the Lord, not for men.  
Colossians 3:23*

*Work hard, but not just to please your masters when they are watching. As slaves of Christ, do the will of God with all your heart. Work with enthusiasm, as though you were working for the Lord rather than for people.  
Ephesians 6:6*

In these contexts, the term “work” includes the deeper ideals of vocation and calling. “Work” is not something you must do to survive, but what you *get* to do, using the gifts, talents, and abilities given to you for the betterment of mankind.

### **Importance of Character Displayed Through Faith**

Character is an important dimension of an engineer in their work. This has been recognized in a number of secular engineering ethics books. For example, Harris, Pritchard, and Rabins write<sup>14</sup>

“We have suggested that professional responsibility (obligation-responsibility) can include not only reasonable care, but also good works. Developing certain personal virtues can be crucial in cultivating obligation-responsibility in both of these senses.” This is something that Aristotle, writing about 2300 years ago, would approve. These authors also quote William May in their book: “One test of character is what a person does when no one else is watching. A society that rests on expertise needs more people who can pass that test.”

A virtue perspective on engineering practice can be defended using both secular and faith-based approaches. In her discussion about various ethical theories, Carolyn Whitbeck has written<sup>15</sup> “The notions of a moral rule, and that of virtue...have been explicitly used in a larger range of cultures than has the notion of a right. Virtually every ethical and major religious tradition employs some counterpoint of the notions of virtue and moral rule.”

In their innovative engineering ethics book Seebauer and Barry use a virtue ethics approach to all the major ethical issues an engineer might face.<sup>16</sup> Brad Kallenberg discusses how the issues of engineering design and engineering ethics can both be approached by the same method.<sup>17</sup> Joseph Kotva defends virtue ethics from an explicitly Christian perspective.<sup>18</sup>

Both secular and faith based approaches to engineering ethics have defended the concept of virtue and the importance of virtues to the successful practice of engineering. We at Baylor University have embraced the concept that character is important for our engineering students. We try to model good character for our students and teach good character concepts in our classes. We approach this from a faith perspective; however, these concepts can also be taught from a secular perspective.

People outside of engineering have also used virtue as an approach to education. Former Secretary of Education William Bennett’s book “*The Book of Virtues*”<sup>19</sup> became a best seller with its approach to using stories to teach virtuous concepts. Notre Dame professor Alisdair MacIntyre’s book *After Virtue*<sup>20</sup> describes many of the issues we face as a culture if the concept of virtues is abandoned.

We believe that by embracing the importance of virtue in both professional and personal life we can help our students “pass the character test” and get a purpose larger than themselves. This can in turn bring out joy. This is very consistent with the mission of our university stated previously, which is “to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community.”<sup>7</sup>

## **Character Development**

This character development can occur in the classroom and in extra-curricular and co-curricular ways. This is difficult to do in some engineering classes. We cannot really speak of a virtuous way to solve a statics problem. However, we can discuss these topic in our engineering ethics courses and in any course that deals with design. Our character affects what type of engineering design problems we will work on. It also affects the way we do the actual design details.

For example, we have a relatively new option within our generic engineering program called Humanitarian Engineering.<sup>21</sup> This program is about doing engineering for the benefit of the poor people of the world. The entire motivation for this program is based upon an approach to virtue and character which assumes that those of us who are more privileged have an obligation to use our engineering skills to help others.

There are many co-curricular ways that we can develop character. We have an active group, Engineers with a Mission (EWAM), which leads students on engineering service project trips in developing countries. For example, one of the authors has been with our students to Kenya, Honduras, Rwanda (five times) and Haiti (three times). While similar to the Engineers without Borders organization, EWAM was started to specifically address the motivation for helping the developing world that stems from the Christian tradition. During these difficult trips, we faculty can model character and help our students maintain their character as they face many challenging situations. These challenges can be personal, such as very hot climate and less than ideal living conditions, or include professional, such as the difficulty of obtaining necessary spare parts in a very poor country where you might not speak the local language. Engineers with a Mission also does things locally, such as tutoring junior high students in math and science. A similar group, Computing for Compassion, provides computer-related assistance to local people as well as small non-profits. All these opportunities provide

At Baylor University, all students are required to take two religion classes, Introduction to Christian Scriptures and Introduction to Christian Heritage. Students learn how to interpret the Bible and explore the major themes found in the Bible. The second course is an introduction to Christian life and thought, up to present times, and examines the great texts with an emphasis on Christian doctrine, ethics, witness and institutions. These classes, taken in the freshman year, provide a foundation upon which to build character. Also required in the freshman year is Chapel, a twice a weekly meeting of all freshmen in the main university auditorium where they are exposed to a variety of topics and ideas from around the world. Chapel seeks “to worship, to engage important issues, and to experience wonderful expressions of our Christian faith. Being a present member of the community in worship helps each of us remember our deeper calling and envision a greater good.” Another freshman activity is the Engineering First Year Seminar which incorporates the New Student Experience course to help freshmen transition to the university. It is taught in the first six weeks of the fall semester. This is an opportunity to begin to instill the mindset that is part of the mission of the university. Some topics discussed are embarking on the journey, setting goals, focusing on fundamentals, reflection, strategies for success, and thriving on campus. This course helps students be successful not only at Baylor but in life as well.

After the freshman year, the opportunities on campus are not as structured. Students are still able to participate in any number of co-curricular organizations such as Habitat for Humanity or the university program, Steppin’ Out, which promotes student involvement in community service and seeks to provide opportunities for experiential learning, civic leadership, and social responsibility. On campus, Baylor University has service sororities and fraternities which require service of its members. The Baylor University community puts in thousands of hours volunteer service each year which is a tribute to the mindset of service present in our students, faculty, and staff.



Throughout the curriculum, there are some occasional exposures to vocation and calling relating these topics to the Christian life. They are reminders. There is not a coherent, intentional structure to purposely reinforce the concepts of vocation and calling at present in the curriculum. Opportunities to talk with students in and out of class do occur; however, due to the increasing enrollment, these one-on-one opportunities are exceedingly difficult. Baylor University has also shifted to what is termed “professional advising.” These staff are qualified to advise; but they are people who do not teach engineering or have engineering degrees. While these staff do a great job advising students on the proper classes in which to enroll, they do not have the ability to advise students on career choices. Unless a student takes the initiative to talk with a professor, this does not happen.

Another possibility for career counseling discussed at Baylor University to develop these qualities is to have a senior seminar course, which would be similar to the freshman course, to help our seniors transition to the workplace. Presently, Baylor University does not have such a course, but it is being considered.

### **Character and the Workplace**

Christian character and ethics are an important foundation for many companies. Today there are numerous examples of businesses founded on ethical principles highlighting the importance of character. A partial list is: Keller Williams Realty, AES Corporation, Amity Technology, Ariba Technologies, Inc., Hobby Lobby, The Awaken Group, Bandwidth International, Boise Fry Company, Cereus Partners, Cummings Inc., Backyard Burgers, Inc., Interstate Batteries, TOMS Shoes, Russell Media, Tyson Foods, and Chick fil A.<sup>22</sup> These companies are convinced that the ethic and organization of the business benefit from this foundation of ethical principles, often Christian principles.

Character development in our students at Baylor University makes our students highly desirable to employ and, as a result, Baylor students have the potential to add significant value to the workplace. We suggest that these characteristics, being developed at Baylor University, are exactly those that a great company would desire no matter what the principles upon which the company is founded. For example, when an engineer or computer scientist is interviewed for a job, they might be asked a question like, “Why should we hire you?” When a recruiter asks a question like this, they are trying to evaluate, from the answer, whether or not the candidate would fit well in their organization. A technically excellent engineer might highlight their skills and qualifications for a specific position based on their education and experience, provide examples that illustrate the results they have attained using those skills and qualifications, and demonstrate their knowledge to the recruiter. A technically excellent engineer who has developed character and a sense of vocation/calling might also add to the above by mentioning the characteristics that would inform the work they do for that company – honesty, integrity, trustworthiness, reliability, etc. They would also be communicating the passion they have for working at that particular job. Displaying these qualities is to display the additional characteristics that our Baylor University students would add to the company.

## Conclusion

It is important for students to find joy and be fulfilled in their work. At Baylor University, this is done through a mindset of vocation and calling to engineering and computer science. This passion is developed in the institution, school, and department as part of the university's mission. A large part of the focus is on character and ethics. Character and ethical principles are important to the formation of any engineering and computer science student; however, at Christian universities, and religiously affiliated universities in general, this topic is even more visible. Students, through a variety of activities, develop this mindset, which becomes part of who they are. Having this attitude makes the student a better employee. Seeing their work as an opportunity instead of a job motivates/satisfies the student and brings joy and fulfillment to their life. This is an important goal for Baylor University and one that we are constantly striving to accomplish. We are currently working on a more comprehensive approach to infusing this mindset into our program.

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