

WIP: Focusing on Values: A Ten-Year Retrospective

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Values in Engineering Education

Character development of engineering undergraduates is an important component of their education. In the School of Engineering, we create intentional supports and experiences so that we do not unintentionally support values we have not chosen to uphold. There is a hidden curriculum in all engineering institutions, an unintentional set of messages that is transferred alongside the technical and professional curriculum to students as they navigate their undergraduate pathway [1]. Recognizing potential aspects of the engineering hidden curriculum and intentionally developing an explicit curriculum that is shared by faculty and students can reduce strain on undergraduates, particularly those who are more likely to be harmed by the unstated expectations of the hidden curriculum such as students of color and women [2]. To that end, the School of Engineering has eight core Values that are taught, recognized, and celebrated in engineering undergraduates throughout their university experience.

Explicitly describing the values of a program is not a new concept. Students will learn what engineering values are as part of their undergraduate engineering career. If faculty do not explicitly consider these values as part of the education of their students, then students are likely to learn unintended values. Character education, including values, virtues, and other affective components are prioritized [3]. Values Thinking is one of the four top-level ways of thinking in the Framework for Applying Ways of Thinking in Engineering Education [4]. The Framework defines Values Thinking as recognizing external and internal value systems and having the ability to navigate these when making decisions and developing engineering solutions.

Purpose

This study has two purposes. First, at our ten-year milestone, we are taking a look back to evaluate our program. We are looking back to see where we have been, what successes we have had, what opportunities may have been missed, and creating a foundation to look forward. This work will support our strategic plan for the next ten years of the program. The second purpose is to share our journey with others as an example of one small institution's work. Some of our experiences may be of interest to others who are working to implement or further leverage values in their institution. We are publishing this to have a formal public record of the evolution of our program's values and how we have integrated these values into our student experiences.

This stage of the study is a review of the evolution of the Values during the ten years of the program. Future work will compare the implementation of the Values with other instances of value- or character-focused education as well as situate the work in the existing literature more directly. This initial publication is to share the development as it stands without ad hoc justification that would provide a veneer of depth that was not present during the initial development and implementation period.

Methodology

This study is a retrospective case study. In a retrospective case study, a significant event or situation has occurred that is worthy of analysis and the timeline of events is reconstructed after the events have occurred using a variety of supporting data [5]. Longitudinal data, including first-person accounts and historical data, are collected without premeditation and are used to develop an understanding of the significant event or situation.

In case study research, a variety of data sources are used to develop an understanding of a case, which is a situation or event of interest. These data sources are used to create a detailed description of the case and can include descriptions of the case from the researchers, interviews of those involved in the case, demographic and other numerical data to describe the case, and content or artifacts related to the case. Further analysis of these data can be done, including thematic or content analysis of qualitative data and statistical analysis of quantitative data to support the overall description of the case [6].

Data included in this study are first-person perspectives of the faculty authors, documents from courses and co-curricular activities, artifacts, meeting minutes from faculty meetings and retreats as well as Student Advisory Council meetings, and social media and press releases. We develop a timeline of events, share how the Values are presented and integrated, and provide faculty and student responses to the integration of the Values. In this paper, the data is presented to support the narrative and is not analyzed further.

Development

The School of Engineering values were developed over a six-month period. The founding faculty, Dean, and lab manager developed the Values during weekly meetings and an all-day retreat. An initial brainstorming session on the phrase “When thinking about the undergraduate Engineering program, what values come to mind?” resulted in 47 different words or phrases (Values V1). In the following meeting, each word or phrase was reviewed and the attendees voted on whether it should be considered a value for School of Engineering graduates. Twenty-five concepts remained, eleven with one vote, nine with two votes, three with three votes, and two with four votes (Values, V2). This process of brainstorming and voting was repeated at the Annual Retreat, resulting in twelve values (Values, V3). The list was further refined to eight incorporating institutional expectations and combining some values within the definition of others, such as including valuing diversity and collaboration within Community (Values, V4). This version of the Values was sent to the External Advisory Board for feedback and discussion and remained the final version.

Table 1. Values Selection

Values V1	Values V2 (Votes)	Values V3	Values V4
Ethical	Collaborative (4)	Service	Community
Innovation	Values diversity (4)	Leadership	Ethics
Personal responsibility for lifelong learning	Integrity, ethical (3)	Professionalism	Excellence
Helpful, useful, able to solve problems	Leader (3)	Ownership	Ownership
Genuine	Willing to make mistakes, persevere (3)	Ethics	Professionalism
Hard working	Innovation (2)	Proactive	Relevance
Identify with engineering, with legitimacy	Adaptable (2)	Excellence	Resilience
Flexible, adaptable	Strong communicator (2)	Collaboration	Service
Figuring out what is needed	Proactive (2)	Innovation	

Confident	Reliable, dependable (2)	Reliance	
Service mindset	Missionary minded (2)	Service	
Team worker	Forward thinking (2)	Technical proficiency	
Collaborative	Imaginative (2)		
Humble	Confident (2)		
Happy, positive	Compassionate (1)		
Strong communication skills	Know self-strengths and weaknesses (1)		
Be adults, wiser, show wisdom	Global thinker (1)		
Missionary minded – no project beneath them	Service mindset (1)		
Compassionate	Genuine (1)		
Value diversity	Helpful (1)		
Inclusion	Lifelong learner (1)		
Smart	Problem solver (1)		
Integrity	Engineering identity (1)		
Global understanding	Expanded horizons (1)		
Expanded horizons	Hands on skills, fab confidence (1)		
Hands on skills, fabrication confidence			
Apolitical, solving problems w/o political affiliations or agendas			
Kind			
Leadership skills			
Forward thinking, problems of tomorrow			
Realistic thinkers vs dualistic			
Mentoring mindset			
Able to explain engineering to family members that makes sense to non-engineers			
Willing			
Creative			
Know self strengths and weaknesses			
Willing to change			
Proactive			

Imaginative			
Ownership			
Fun			
Willing to make mistakes and still participate			
Vulnerable			
Resourceful			
Reliable, dependable			
Able to maintain a sense of humor			
Relentless, perseverant, does not give up easily			

After selecting the final eight values, they were reaffirmed by faculty, the External Advisory Board, and the Student Advisory Council during the School's initial ABET application during meetings in March and a final faculty reaffirmation at the annual retreat in May of 2020.

Our Values

The final eight Values are posted on the website [7] and are featured on a large poster hung in the main stairwell of the engineering building, shown in Figure 1.

Rather than simple definitions, the Values have descriptions presented to the students in their summer orientation as well as at events that focus on the Values throughout their time at the University. These descriptions are presented here, as found in the 2024 Summer Orientation PowerPoint slide deck:

Community. We work *together* to learn, create, grow. We treat one another with respect and professionalism. We are conscious of our biases and work to create a welcoming, supportive environment for every student, faculty member, staff person. We work to understand the communities we serve. We engage with our local community in outreach and service. We engage with the global engineering community in our state, our nation, the world.

Ethics. We abide by the highest ethical standards in our work and dealings. We acknowledge the responsibility for the safety and lives of others which depend on our decisions and actions. We seek to prevent and mitigate harm. We work to understand and account for externalities in design. We acknowledge the obligation to consider impact of design on others.

Excellence. We strive for excellence (not perfection) in our work and endeavors, acknowledging that it is deserving of our best efforts. We strive to cultivate a sense of personal

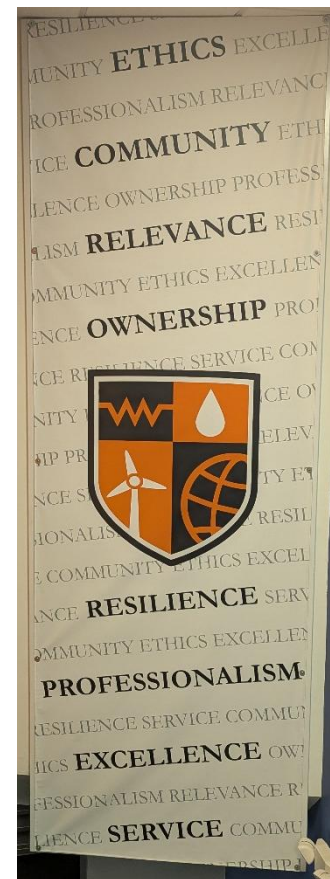


Figure 1. Core Values Poster

excellence – an intrinsic motivation to continue seeking out opportunities to grow, learn, give our best effort.

Ownership. We take ownership and personal responsibility of our education: our learning, attitude, quality of work, professional development, growth in and outside the classroom, technical and non-technical skills, interpersonal skills, ethics and professionalism - our own transformation into one worthy to carry the name “Campbell Engineer”.

Professionalism. We acknowledge that engineering is a *profession*, not a job. We are held to a higher standard, a higher purpose, a higher code of conduct, which transcends ourselves and reflects the reputation of the engineering profession as a whole, and upon which society depends for its well-being and advancement.

Relevance. We will work to understand the relevance of our work, to push beyond superficial understanding. We will advance our understanding of relevance through involvement in professional organizations, internships and projects. We will strive to apply our knowledge and skills to make a difference in our world.

Resilience. We acknowledge that problems and failure provide opportunities for insight and improvement if we maintain an open mind and a positive attitude. We will not be afraid to try, we will not be deterred by failure, we will not give up. We will learn, grow and try again.

Service. We acknowledge that engineering is a service discipline, that service demands humility and requires partnership with those we serve, that engineering provides us with both the ability and responsibility to leave our world a better place than we found it.

In addition to the descriptions of the Values, a slide titled “Parting Thoughts...” includes additional bullet points on why the Values are important:

- Our Engineering Values have never been more important than they are today!
- They will prepare you to cope with this crises [sic], as well as those that are to come.
- They will help us work together to keep each other safe and healthy, as well as help each other survive and thrive.
- They will help you the next four years and beyond, in your career and in your life.

Implementation

Students are introduced to the Values during their summer orientation before classes start. These Values are reinforced through a number of experiences throughout their first year, both inside and outside of the classroom. Faculty also review the Values periodically, discussing ways to provide more connection to the School of Engineering Values in their classroom offerings.

Successful Implementation

In a PowerPoint in their first-year seminar course, students are told that “All jobs and professions reflect values,” “Engineers, as members of a profession, are bound by the ethics and values of

our profession,” and “Developing an understanding of your values and beliefs inside and outside of professional contexts is important to becoming a member of the profession.” They are reminded of the School of Engineering Values, then led through a discussion-based class to determine what values they currently hold, what values they want to hold, and how these connect to their future engineering career. They are also asked to write a short reflection essay:

This week, we discussed the values and how things are going so far in putting them into practice in the new School. Of the eight Core Values, which is most important to you personally? Explain why and relate the Value to your own values, past experiences, or other relevant thoughts. Why does this value resonate with you personally? How could your own values and experiences contribute to the expression and growth of this value in the Campbell University School of Engineering?

Part of this class is helping students to recognize that their values can shape their actions and should be considered when determining what kind of career they are interested in; for example, not all students would be interested in working for the defense industry if that does not align with their values. They are reminded that the School of Engineering Values are not just found in the classroom, but in their everyday actions and interactions and embedded in the choices that they make. This sets the groundwork for Values-informed course expectations, discussions from faculty, and awards given for both in and out of class Values-informed behavior.

The School of Engineering curriculum includes awards based on the Values at a number of points throughout the curriculum. These awards are celebrated and students are recognized both in and out of class for exemplifying the Values to promote adoption and practice of the Values by the students [8]. The first integration is in the first-year design course. At the end of course Design Expo, a presentation of student projects is judged by industry professionals. In addition to general scoring rubrics for their technical work and communication, judges are asked to nominate teams for any awards that they appear to be eligible for based on the text below. All awards are given, though not every team will get an award as there are often more teams than the number of awards in the first-year design course. When awarding teams, the text for each award is read along with the rationale for how the team met the award criteria.

Award Text:

Design Exposition Awards

Judges are requested to help us identify deserving projects for eight awards, each based around a Campbell University Engineering Core Value. For all awards, it is expected that teams nominated will have pursued a project of appropriate scope and challenge to the best of their ability in addition to the written criteria. All awards are given each year and judges are encouraged to nominate teams for more than one potential award if their work potentially spans categories.

‘Camels Build Community’

Community Core Value Award

For a project that has a connection to a local or global community such that the work of the project contributes to or strengthens that community.

‘Camels Do It Right’

Ethics Core Value Award

For a project that employs engineering ethics in the design process via sustainability, astute navigation of stakeholder power differences, or equitably sharing the benefits of engineering.

‘Camels Strive for Excellence’

Excellence Core Value Award

For the project with the highest level of overall excellence in the pursuit and presentation of the Design Project.

‘Camels Own Their Learning’

Ownership Core Value Award

For a project where the team took ownership of a challenging project and successfully pursued it, demonstrating independent responsibility for learning and results.

‘Camels Are Professionals’

Professionalism Core Value Award

For the project with a prototype best reflecting professional dedication and skill.

‘Camels Keep It Real’

Relevance Core Value Award

For the project with the concept and prototype most suitable for commercialization.

‘Camels Never Quit’

Resilience Core Value Award

For the project best reflecting the core value of resilience in overcoming challenges and learning from failures by carrying a difficult project through to the end, even if the result was not as originally envisioned.

‘Camels Serve Others’

Service Core Value Award

For the project with the highest potential to have a positive impact on the world, were the project to be further developed and put into use.

These awards are repeated for senior capstone projects. Not all awards are given as there are typically fewer teams in the capstone design course.

In addition to the awards given for design projects, students are recognized by faculty and peers in the middle years, often called the “valley of despair” as they are typically heavily lecture-based courses, bookended by first-year and capstone projects [9]. Sixteen awards are given, one for each Value for second year students and one for each Value for third year students [10]. These awards are given on St. Patrick’s Day, connecting to the patron saint of engineering at this religiously-affiliated institution [11]. From an email to the student and faculty listserv: “Camel Engineers! It’s time to **nominate your peers who are second- and third-year students for one**

of our Campbell Engineering Awards! The awards are given to students who demonstrate our values (ownership, relevance, resilience, community, professionalism, ethics, service, and excellence).” Students and faculty are then instructed to fill out a form to nominate second- and third-year students (defined as students who have passed the first-year sequence and have not yet taken the capstone sequence). A short form requests the student’s name, concentration if known, the Value they are being nominated for, and a short rationale for the nomination as well as the name and email of the nominator. An excerpt of the rationale is read at the award ceremony. Students commonly nominate their peers for these awards, recognizing the Values in action around them. Nominations are reported at faculty meetings; if there are any awards that do not have nominations, faculty are asked to nominate students for those awards so that all sixteen are consistently given. Faculty input is requested at meetings if there is not a clear awardee for any award as well. Awardees are given certificates and shamrock pins to commemorate their achievement.

All of these awards are recognized and celebrated through plaques hung in the main hallway outside of the Makerspace and main office, as seen in Figure 2. Students are sometimes seen taking a look at the past winners and discussing which awards they might be nominated for. These awards support recognition of the Values inside and outside of the classroom. They also allow for a way to celebrate students that does not connect to grades but to their effort and actions, promoting behaviors like ownership and professionalism that are sought after by employers.



Figure 2. Core Values Awards Plaques

Student Response

Students participate in the award nomination process and proudly wear their shamrock pins to career fairs and formal events. Many students are excited when the nomination stories they have written for their peers are read during the award ceremony. Awardees wear their pins proudly, attaching them to their suit lapels at the fall Career Fair, formal events like the Tau Beta Pi (honors fraternity) induction ceremony, Senior Design presentations, and any other time they are representing the institution.

Student feedback is solicited through the Student Advisory Council (SAC), which meets twice a year in April and November. In 2017, the SAC was asked about the Values and one member noted that they were heavily promoted in first-year courses but not seen in second year courses. In 2023 and 2024, the SAC took a deep dive, reviewing each Value and discussing what is going well and what could be improved. This discussion spanned three meetings, discussing Community, Professionalism, and Ownership in April 2023, Relevance, Service, and Ethics in November 2023, and Excellence and Resilience in April 2024. For each Value, students had more points related to what is going well than what could be improved. Many of the improvements focused on peers, including increased student involvement in PD and Service activities, reduced cheating by peers, interaction across student cohorts, and increased student engagement in professional organizations. Other potential improvements, like faculty alignment and more “hopeful” talk, have been relayed to the faculty during faculty meetings.

Faculty Response

Faculty appreciate the Values. They provide common language and expectations for students across the curriculum and in extracurricular situations. Faculty often use Value-laden language when discussing concerns related to academic dishonesty or students not meeting expectations, however they consistently feel that beyond the first year programming, they fall short of integrating the Values in classes. In the second year of the program, one of the concerns from the Student Advisory Council was a lack of values appearing after their first-year courses. During the follow-up meeting, faculty affirmed their desire to integrate the Values more transparently; one faculty member added Values-based language to their syllabus for one class at this time. Currently, most syllabi do not reference the Values; this is an area of improvement that has been discussed mid-semester at a number of meetings but not widely acted upon. At the faculty retreat in May 2020, faculty again discussed “How to integrate value(s) in my class(es) this year?”

Faculty recognize the Values in student’s actions. From one faculty author’s reflection:

I have seen the effects of teaching values to freshmen play out in students’ actions in subsequent years, particularly when those values are modeled consistently by upperclassmen. One clear example of this occurred within the School of Engineering’s Human Exploration Remote Operations (HERO) team, which competes annually in the NASA Human Exploration Rover Challenge.

In addition to designing and building a remotely controlled rover according to competition guidelines, the HERO team is required to complete technical reports and conduct outreach activities that include meaningful engagement with the community. Although the School of Engineering regularly hosts outreach events, I informed the team that if they wanted to use these events to satisfy their competition outreach requirements, they would need to design the activity themselves and ensure it met NASA’s criteria.

One team member stepped into the role of outreach lead and immediately began brainstorming ideas with the team. Throughout the process, the students met with me regularly to seek advice and feedback, but I did not complete the project for them. Instead, they assumed responsibility for planning, building, and testing the activity while balancing coursework and their other HERO responsibilities.

A month after receiving the assignment, the team presented me with their completed outreach activity, titled “Bumper Car Bash.” They provided a detailed materials list, pre-made popsicle stick cars, competition rules, and presentation slides to guide the activity. The slides clearly connected the activity to the Engineering Design Process, ensuring that participants were not only building “bumpers,” but also learning about design, failure, and iteration.

The HERO team took complete ownership of this activity and worked diligently to bring it to completion. Notably, the current outreach lead participated on the team as a freshman the previous year and learned from upperclassmen the importance of not only accepting responsibility but also following through and completing assigned tasks well.

Conclusion

The School of Engineering has chosen eight explicit values to prioritize the character education of their undergraduate students: ownership, relevance, resilience, community, professionalism, ethics, service, and excellence. These Values were developed by the founding faculty and staff and have been reaffirmed by faculty, students, and the members of the External Advisory Board. Faculty have seen students exemplify these Values both in class when they are aware that they are expected to, and in extracurricular activities. Students recognize the Values in themselves and others through discussions, reflections, and nominating others for awards based on the Values. In taking a look back at the first decade of the program, there are still places where the Values can be more strongly integrated. Some faculty choose to use the Values as part of rubrics or class discussions in upper-level classes, but this is not consistent. There has been discussion of requiring a portfolio or reflection on the Values as part of capstone or graduation requirements as well. Taking a look back at the development and integration of the eight Values into the School of Engineering provides a strong foundation and validation of the choices that have been made thus far and a foundation for future work. Character development of engineering undergraduates is an important component of their education. In the School of Engineering, we create intentional supports and experiences so that we do not unintentionally support values we have not chosen to uphold.

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