



## Engineering and Engineering Education as Spiritual Vocations

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# Engineering Education as a Spiritual Vocation

## Abstract

Spirituality and engineering education are often kept in separate compartments of our lives. They may slip out occasionally for conversations during ethics classes or service learning projects, but speaking – and living – our values of faith as engineers and engineering education researchers is still uneasy territory for many. This paper is a multivocal autoethnographic dialogue between three graduate researchers in engineering education that explores how each individual stands in that uneasy territory. It addresses the intertwining of spirituality with both teaching and research practices in engineering education, investigates the discomfort of conducting such a dialogue in a secularized technical culture, and explores the tensions of multiple and often conflicting perspectives of faith on each topic. The authors are Roman Catholic, Evangelical Christian, and Quaker with a regular Buddhist meditation practice.

## Introduction, method, and definitions

J: This paper focuses on how our personal spiritualities as graduate students in engineering education have influenced our work as teachers and researchers. Prior work intertwining spirituality and engineering education has largely explored the experiences of undergraduate students. This includes discussions of spirituality within engineering ethics courses<sup>1</sup> and the influence of Buddhism on social justice engineering,<sup>2</sup> interdisciplinary courses involving theology and engineering students,<sup>3</sup> and appropriate technology and service learning programs motivated by religious beliefs.<sup>4,5</sup> Additionally, a Christian Engineering Conference is held on alternating years immediately after ASEE,<sup>6</sup> and engineering faculty from religious colleges and universities often reference their faith when describing the context of their teaching work.

However, when we searched, we found that the experiences of engineering teachers and engineering education researchers have not been as well explored. As graduate students, our narratives emphasize our enculturation into the engineering education community as both teachers and researchers; as people of faith, our spiritualities are an important part of our journeys. Prior work<sup>7</sup> has highlighted the importance of personal narratives as ways to express community values by “[providing] a vehicle for scholarly discourse that makes explicit our implicit knowledge, promotes reflective practice, and provides entry points into a community of practice” (p. 1). We present our narratives here as starting data points that illustrate how three particular people reflect upon, define, and practice their spiritualities as engineering educators.

M: In terms of method, this project started as a question over pizza, salad, and the clamor of C’s small children: what did it mean to pursue “engineering education as a spiritual vocation”? It was a conversation that went late into the night and kept resurfacing in subsequent dinner meetings and stolen-moment hallway conversations. After several months, we finally recorded and transcribed one candle-lit, mid-winter dialogue in my kitchen, using that as an opportunity to reflect on our many hours of prior conversation. That transcript became the first draft of this paper. Though the original transcript is barely recognizable in the paper’s current form, we maintained the multivocal dialogue format throughout our revision process.<sup>8</sup>

Switches between the three speakers -- myself (M), J, and C -- are denoted by our first initial and a colon at the start of a paragraph when a transition occurs. Although we each have a distinct voice and express perspectives that are occasionally in conflict, we helped each other refine and rephrase our ideas. This was particularly helpful for forcing us to explain concepts we personally take for granted. It also means the writing attributed to a single person's voice is often that person's stance as clarified and honed by the other two authors, who may not share that stance.

C: Several terms are important to define before starting off. The three of us have agreed to speak of "spirituality" rather than "religion" in this paper because we ourselves identify differently with the terms "spirituality" -- a personal search for the sacred -- and "religion" -- an association with an institutionalized or formalized tradition of worship. We wanted to broaden the discussion to include those that identify themselves as "spiritual but not religious" without excluding those that identify themselves in some way as religious.

For example, J identifies herself as "spiritual," and actively participates in both Buddhist and Quaker communities. However, she identifies neither as religious or non-religious and is discerning what "religion" means within her belief structure. I personally identify as spiritual and on the threshold of religious; my personal journey is moving away from a single institutionalized/formalized tradition of worship (Evangelical Christianity) to searching for that which is sacred in various expressions of worship. M is firmly rooted in religion and pursues her spiritual journey from within Roman Catholicism.

J: It is worth pointing out that all our faith practices have historically been grounded in Christianity, even though I personally do not identify as Christian and do not see Jesus of Nazareth as my personal savior. We have tried to be inclusive of other faiths as well as non-spiritual, naturalistic viewpoints, but the Western, Christianized culture we live in has strongly influenced our discussions.

M: Our intent is to be descriptive of our own positionalities--not prescriptive of where others should situate themselves. This is why we've chosen to write this paper as a collaborative autoethnography<sup>9</sup> with three distinct and sometimes dissenting voices that make it clear that we do not share a unified point of view. Each of us speaks only for ourselves, and not others of our spiritual or technical traditions.

### **Why should we talk about engineering education as a spiritual vocation?**

M: I want to start by playing devil's advocate. I'm used to hearing arguments that spirituality helps bring ethics and social justice into engineering -- in fact, when I read through the Christian Engineering Conference's proceedings, over 25% of its papers since 2009 have focused just on service projects or appropriate technology.<sup>10</sup> That answer has never satisfied me, though; non-theists also do amazing, wholehearted service work without acknowledging the divine as motivation. What difference does it really make that we're having this conversation about engineering education and spirituality instead of looking at these concepts in a secular way?

J: There are multiple answers to that question. One is the critical theory answer,<sup>11</sup> which seeks to point out and question a community practice that is often so common it is overlooked. By

explicitly including spirituality in our discussion of engineering education, we are pointing out that the dominant discourse paradigm in our field is secular even if many engineers are spiritual or religious. Does it need to be that way? Do we realize the choice we're making?

C: A second answer might be to argue for a diversity of perspectives. We can draw a parallel to feminism here. We understand gender better when we explore how phenomena are experienced by women as women, or men as men, or others as the gender they identify with. People of color, people with disabilities, and people from other cultures all have intimate knowledge and authentic insights from unique perspectives that can and should inform our understandings. In a similar way, the experiences of the spiritual are relevant because they are spiritual.

J: We can translate it into secular language, and I think that is what usually happens. I do not talk about "spiritual awakenings" when I write grant applications; instead, I have called them "aha" moments. But by not using spiritual terminology, I am leaving out an essential part of my own experience.

M: By *using* spiritual terminology, this paper becomes potentially uncomfortable to read – and that's a third answer. While writing this paper, we've constantly asked engineering and engineering education colleagues from different faith backgrounds to review it. Every single reader expressed both fascination and discomfort, but their discomfort made them question whether engineering education's commitment to "openness" was just lip service when it came to spirituality. As one of our friends – a Latter Day Saint engineering researcher – said, "if I personally believe it should be ok to incorporate spirituality into the world of engineering education – and I do – why does reading this paper make me so uncomfortable, if all it does is put that statement into practice?" So be forewarned: this paper may not be an easy one to read, but we invite you to sit in that beautiful awkwardness with us.

### **What does engineering education teaching look like as a spiritual vocation?**

#### *Helping students follow their call to holiness*

M: Like many in our field, I came to my vocation in engineering education as a teacher first and a researcher much later. A critical incident happened in my 5th year teaching, long after I was comfortable and fluent in the classroom. During a circuits tutorial, I suddenly had the sensation that something beyond me was teaching through me. I already regularly dropped into flow state<sup>12</sup> with this particular class, but that night was different; although I was agnostic at the time, I couldn't shake the phrase "moved by the spirit" from my mind.

The funny thing was that this "spirit" had nothing to do with increasing student skill or content mastery, which was how I thought about "good teaching" at the time. Instead, I felt like a dancer transported to the side of a master choreographer, watching the movements I was given spur each student into the individual step they needed to take towards the better-self they were becoming in that moment. I walked out of that tutorial shaking. From that moment on, I saw teaching not only as passing on a practice, but as helping people become themselves. In that classroom, the smoke of solder was my incense wafting through the air. When I re-entered Catholicism – cautiously,

with a hermeneutics of suspicion that stays with me to this day – I learned about the “universal call to holiness,” which put the vocation I already knew into words.<sup>13</sup>

It’s odd to say this publicly; will someone see the word “holy” and automatically think I’m trying to convert my class, or using my position of power as a teacher to impose spiritual growth on students who might not believe in spirit? I hope not. I still teach them how to debug Python code, but my real job as a teacher is to help students discover and become themselves, and without a secular translation filter, “becoming holy” is the phrase I’d use.

J: Quakers might say, “getting in touch with their inner light,” while a Buddhist might call it “their Buddha nature.”

C: I would call it “becoming fully human,” or becoming what God intends a person to be. My personal philosophy of education resonates with this idea because I affirm that the purpose of education is to help a person grow and develop in all dimensions, intellectual, emotional, social, etc.<sup>14,15</sup> to be an actualized person and education should be based on values of caring and community.<sup>16</sup>

J: How would your philosophies help engineering students become, as you call it, “more fully human?”

### *Being subversive*

C: I see my call as an engineering educator as a call to be subversive. For example, as a pastor, I was subversive to the culture of self-centeredness, pretense, and apathy that has permeated society. Similarly, as an engineering educator, I can be subversive to the gendered, ethnocentric, heteronormative, and elitist boundaries, narratives, and mindsets that have permeated engineering culture.<sup>17</sup> I can stand against such things in engineering education because the values and attitudes I exemplify for students can have longer lasting impacts than all the information and skills I can cram into a course.<sup>18</sup>

When I taught math at a public high school, I saw that personal growth and development was severely lacking. The current (over)emphasis on standards and accountability crowds out opportunities in these areas for the sake of adequate progress in the measured content. This is similar to the challenge facing engineering education of broadening an already full curriculum to produce a more well-rounded engineer.<sup>19</sup>

### *Using practices from spiritual traditions to design engineering courses*

J: I’ve been inspired by a friend and colleague’s dissertation on teaching engineering to Tibetan refugees in India. She used a curriculum designed around Buddhist principles as a way to honor and integrate the local faith culture.<sup>20</sup> Similarly, I am writing a proposal to teach engineering to Quaker middle school students through a Quaker process. In that tradition, all community activities are done in worship.

M: I'm not familiar with Quaker process. What would that look like for, say, an engineering design project?

J: The first step in the design process would be listening to the inner light for what we call a "leading," or an inner movement to action. Next, we would have to discern the project, making sure that it would live up to our Quaker testimonies of peace, integrity, simplicity, equality, sustainability, and community. Through this process, we would seek unity within the community, a consensus on what we should build. We would also include local experts such as carpenters or working engineers in our process. I would teach engineering topics such as thermodynamic and statics based on the technologies proposed by the students.

It is very much a project-based design method<sup>21</sup> done in a non-hierarchical way. As a teacher, I would not be the project leader, but rather someone contemplating alongside them, guiding the process.

### **What does engineering education research look like as a spiritual vocation?**

#### *A vocational call to engineering education research*

J: I found my call to engineering education as a researcher first. As an undergraduate engineering student, I went to a workshop that addressed air pollution caused by indoor cookstoves used by billions of people in the developing world. There were a lot of policy people present, but not too many engineers. Immediately after that, I went to my engineering class, where the vice president of a large pharmaceutical company talked to us about spending 15 billion dollars to get a drug on the market that saves only a few wealthy people. The desire to bridge that gap between engineering and social issues unleashed a lot of energy in me. It's not that engineers don't care about these issues, I thought; it's because they don't know.

I wrote a letter to my department titled "the need to humanize chemical engineering students." A few months later, my department announced that graduation requirements had changed, and the changes included 3 of my 7 suggestions. Shortly after, I was on a team that won honorable mention in a design competition for the ideal engineering major. I started doing engineering education research for the Center for Studies in Higher Education (CSHE) at the university. It felt like there was this niche, the stars aligned, and I was on the right path.

M: How would you talk about your experience with engineering education research if you didn't need to translate it into secularism?

J: My initial work within engineering education research was a spiritual awakening, and rather intense. The whole experience became overwhelming. I felt like I was saving the world, but it also included a dark side. I started getting panic attacks and had to leave engineering education for a while. It was not until a weeklong meditation retreat, that I felt like I could ground the excitement I experienced in engineering education research. It was only then that I could start applying for graduate programs in the field.

In my second week of graduate school, I was diagnosed with epilepsy. This led to a further intertwining of engineering education and my spiritual vocation. Prior to the diagnosis, I had read *The Spirit Catches You, and You Fall Down*,<sup>22</sup> which described the Hmong cultural view of epilepsy as a sign that someone is destined to be a spiritual leader. This helped me see my diagnosis as a gift that helped me prioritize health and balance during graduate school.

It was extraordinarily difficult, and felt like I was losing control in all aspects of my life. As someone used to working as an engineer, I expected to have structure and control. As I moved into engineering education work, the papers I read became less black-and-white. There was no longer a single answer to put in a box. My professor assured me that this was a common difficulty of engineers moving into education research, but on top of that, I had epilepsy. With each seizure, I would feel like the floor was falling beneath me. Between the two, I had no idea what was happening to my brain.

I had to learn how to be comfortable in the midst of uncertainty. “If we knew what it was we were doing,” says a quote by Einstein, “it would not be called research, would it?” I established a daily meditation practice and read Buddhist teachings on going into the difficult and uncomfortable times rather than running away from them.<sup>23</sup> This helped me transition into not knowing what I was doing with my research.

#### *The role of theology in engineering education research*

C: When I started my PhD, I sat down to talk with a professor who was aware of my recent background as a pastor at a nondenominational Christian church. The professor told me about several students in my program who were very involved in their respective faiths, emphasizing that they were learning to separate out their spirituality and ground their work in theory. She was trying to be helpful and matter-of-fact, but something about that statement didn't sit right with me. I am aware of the subjective nature of spirituality, but when it is based on the academic discipline of theology, why can't I use it to inform my theoretical framework?

J: My pushback is that theoretical frameworks justify the reasons I do what I do – for example, a framework on transactional and transformational<sup>24</sup> relationships for service-learning partnerships affects how I've phrased my research questions, how I collect my data, and how I analyze it. How could you use theology for that?

C: This wouldn't be appropriate for all research – for instance, working from within a positivist paradigm would make it difficult to allow for the subjectivity of theology. However, one of my research interests focuses on social justice in engineering education, and my desire to research that is based on Scripture, not feminist theory or critical theory. It's based on when Jesus said “I was hungry, and you gave me food. I was thirsty, and you gave me something to drink. I was alone and away from home and you invited me into your house. I was without clothes and you gave me something to wear. I was sick and you cared for me. I was in prison and you visited me...anything you did for even the least of my people here, you also did for me.”<sup>25</sup>

That's an example of how I use theology as a framework that influences my practice of living. Similarly, I use theories as frameworks that influence my practice of research. From my understanding, theoretical frameworks guide practice by drawing out guiding principles from

another body of thought, like philosophy or an ideology, in order to apply them to practice or establish goals for practice. In other words, a larger body of thought, like philosophy *or theology*, informs a theoretical framework; in my case, my theology informs my theoretical framework. There is no separation.

M: I've been using my theology to organize and understand my dissertation on engineering and technology faculty, where I deliberately use strange terms to describe what most studies would call "subjects." The usual rhetoric is to say our subjects will do this and that, as if they were manipulable objects. I've written that way before, and I'll do it again; it's convenient and efficient and not ethically wrong in any way.

At the same time, I believe the Catholic teaching that people are emphatically *not* objects, and that we must respect the "transcendent dignity of man."<sup>26</sup> I've chosen to highlight that in this particular study by *not* calling them subjects and trying – imperfectly, but trying – not to privilege my perspective over theirs. My faculty narrators and I have the same access to data and research notes; we trouble each other's metanarratives and analyze each other's work. It's the image Steven Frezza<sup>27</sup> described as *Deus Machinator*; if God is a fellow engineer who co-creates alongside us and pitched his tent among us as one of us,<sup>28</sup> I can try to foster the same dynamic among the people involved in my dissertation, including myself.

C: Precisely. Your theology has influenced how you are conducting your research; you are taking guiding principles from your theology and applying them to this specific situation. I see no difference between what you have done and taking guiding principles from a philosophy or ideology and applying them. And you are being transparent about it.

M: (laughs) In this paper, yes. In everything else I've written on the project, I say that I "come from a poststructuralist paradigm" – that's my secular translation. Either way, I see it as honoring the infinite complexity and dignity of every human being; it's not something we can ever fully explain or capture, but it's something we can highlight and respect.

## Conclusion

### *Engineering education and spirituality share a heuristics-based mentality*

M: While we're on the topic of infinite complexity – in her epilepsy story, J noted the surrender to uncertainty that often accompanies the transition between working as an engineer and working in engineering education. But even our practice as engineers isn't algorithmic -- it's heuristic, based on rules-of-thumb. That's why engineering educators teach students design thinking: we hope they will learn to step beyond the flowchart, think for themselves, and recognize that all our lists and charts are tools for working with the world, not absolute prescriptions for how to do it.

Barbara Sain pointed out that living a Christian life is similar: there are many variables, multiple solutions and no clear "right" answer, and several ways to get "good" results.<sup>29</sup> Engineering and theology both use analogies as imperfect models of systems: an infinite divine can't be described in words, a complex world can't be described in block diagrams<sup>4</sup>. As the Tao Te Ching said:



“The tao that can be told is not the eternal Tao. The name that can be named is not the eternal Name.”<sup>30</sup> And yet we try, because these models are useful to us.

Even for a non-theist, these models can be tools and inspiration for our shared search for truth in all its forms<sup>31</sup> – in fact, I think our ideas are useful for readers who don’t have a personal spiritual practice. Spiritual habits of mind can transfer into technical realms.

### *Reflections on the experience of writing this paper*

C: The process of writing this paper was awkward for me. First, I was hyper-aware of the common perceptions of evangelical Christians as having ulterior motives to preach “the truth” and convert “the lost.” I did not want anyone to feel like I was imposing my beliefs on them or trying to convert them. I reacted by trying to be hypersensitive to the beliefs of hypothetical readers of this paper. It made discussion with my coauthors difficult at times, but was also an exercise in navigating the tension between sensitivity to others’ beliefs and being true to myself. I also saw it as an opportunity to practice inclusion and learn from others that have different beliefs and experiences than my own.

Second, writing this paper as a dialogue took me completely out of my comfort zone. Being in an academic environment, it was a constant struggle to lay down the objectiveness and neutrality of the academic writing style to express my own voice and my personal point of view. This was definitely a growing experience.

J: I exposed vulnerable parts of my journey in this paper like my temporary withdrawal from engineering education and my journey with epilepsy. I risk being judged by others for my stories, and that terrifies me. Now anyone can Google my name and find these things. Yet I still chose to tell these stories. Why?

The first reason is based on Brene Brown’s book<sup>32</sup> that in order to be a whole person, I need to be vulnerable. The second reason is that the struggles I faced are invisible and yet common. By exposing them, I hope to reach others who are facing similar struggles and let them know they are not alone.

M: I feel underprepared for this paper to go out, but I’m willing for it to launch into the world. My nervousness is largely because I only returned to actively practicing my faith about a year ago; it’s a faith I’m still rediscovering in awe. To fix my ideas in print while I’m still standing on wobbly baby legs is to accept a writing process of constant hope and prayer. Prayer is a part of my writing process; for this paper, my prayer has been for the grace to speak clearly and rightly in a way I would be proud to be held to many years from now. I fully expect one of my students or children to spring this paper on me in several decades, and I’m sure I’ll shake my head then at my 27-year-old self – but I also hope I’ll smile.

### *What would you like the reader to get out of this paper?*

J: As a friend was reviewing a draft of this paper, he asked whether we wanted it to be a rallying cry to spread spirituality throughout engineering education. We shook our heads with an

emphatic no. We didn't even have the same goals for the paper. For my part, I wanted readers to take home personal reflections on how spirituality has or has not influenced their own lives in engineering education.

C: I wanted readers to be inspired by our examples to live out their own faith in engineering education.

M: I wanted to write down our positionalities on engineering education and religion for clarity and future reference.

J: Our friend laughed. "Oh, the Quaker wants the reader to sit quietly and reflect, the Evangelical Christian pastor wants to preach [exhort others to action], and the Catholic wants to set forth their creed." It was the perfect note to end on; our spiritual practices shine through even the very writing of this paper in a way we had not intended or realized.

### *About the Authors*

J: Because of the autoethnographic<sup>33</sup> approach, personal background details matter, so we will include them here.

I studied chemical engineering in California and spent two and a half years as an energy consultant before deciding to obtain my PhD. I started exploring Quakerism about 3 years ago and felt strongly connected to this community. There is not a common theology or creed amongst Quakers; while some consider themselves Christian, I do not identify Jesus of Nazareth as my personal savior. I live my life through reflecting on my inner light, and have a regular Buddhist mindfulness practice.

C: My own history includes a BS in industrial engineering and a Master of Education degree focusing on math education. I have worked as an engineer in the manufacturing industry, as an ordained pastor serving a non-denominational, evangelical Christian church, and as a high school math teacher in southwest Texas.

M: I'm the first American-born member of a devout Roman Catholic Chinese-Filipino family. Intellectual honesty led me into vigorous agnosticism for 12 years; the same scientific skepticism led me back to practicing Catholicism midway through graduate school. During my agnostic years, I studied and worked as an electrical and computer engineer in open source software and hardware projects.

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