From 2020 vision: Engineering education that honors the whole

I pen these words under the specter of great suffering. If scientific predictions are accurate, this guest editorial will be published in a time of global catastrophic loss of lives and possibly collapse of systems we have taken for granted. I hope we discover that the power of collective, caring human action and nature's resilience transcend the limits of our scientific models. At a minimum, we will find ourselves in the wake of a planetary interruption in “business as usual.”

Many are not surprised by this moment, a moment when the global-scale environmental volatility, technologically amplified by our consumption of fossil fuels, visibly maps into our socioeconomic existence. The coronavirus has illuminated a simple truth for us that decades of warnings could not: Our fates as living beings are inextricably interconnected through air, water and our habits of commerce; we have been participating in a living (or dying) commons, whether we believe it, accept it or decry it as a hoax.

An invisible messenger proclaims the truth. Our frail powers of assertion, no matter the depths of our personal convictions, do not control Nature. Nature is life itself. Contrary to the belief of Francis Bacon, the father of the western scientific method, Nature is not a female who hides her secrets from men, “something to be vexed and tortured [to] . . . continue [as] the compliant slave of man” (White, 1968). Nature has responded to our efforts to dominate with a terrible mercy: a forced disruption so we might see with perfect vision all that our busy-ness obscures.

In our sudden stillness, systemic inequities appear in stark relief. The most privileged are sequestered, safely working in our homes, while others must work outside the home, even if sick. Those at work are those whose work is deemed essential to society. Ironically, they receive minimal wages for their essential services. For some, the pandemic threatens their lives; many will tragically lose. Simultaneously, the natural world retrieves some of its vitality in only weeks of our economic stillness (Gardiner, 2020; Rust, 2020; Watts & Kommenda, 2020).

We see clearly now, that “problems” do not exist in Nature; they are man-made. And because we live in an engineered world, I cannot help but soberly recognize this pandemic moment as among the fruits of my well-intentioned, engineering education labors. As William Perry, the chair of the NAE Grand Challenges Committee, suggested in 2008, our greatest engineering challenge in the 21st century is to save the world from the perils that our 20th century technology has enabled (Faculty News, 2008). The idea of engineering as a savior regrettably feeds hubris (Bauschpies, Holbrook, Douglas, Lambrinidou, & Lewis, 2018), yet points to something true about responsibility. Because our world is more a dynamically complex system than a simple one, what we are experiencing emerges from our collective human action rather than from a single bad actor; we are active participants, and technology undeniably functions as a lever that amplifies consequences, intended or not. What are we in engineering education to learn from this moment?

I am aware that privilege enables me to reflect on this question rather than being consumed in a fight for my or my community's survival. With humility, I soberly invite the reader to spend some of our privilege with me, reflecting on what could be. I invite you to imagine that 2020 is indeed the year of perfect vision. Let us go into the future. From this future, we can look back on what we saw in 2020 and how these insights put us on a transformational path to a shared planetary existence of thriving for all.

1 | THE FUTURE, FROM A 2020 VISION

What we saw in 2020 caused a great awakening. We first noticed that our engineering education, while useful in an economy based on human-created scarcity, was insufficient to process the feelings that emerged: fear, panic, grief. . . .
Our legacy engineering education was a practice in overriding our feelings and needs, the needs for rest, meaning, joy. It was a practice in surrendering our need to understand why or why not or for whom for the sake of “getting things done,” things that were deemed important by an authority whom we did not question. We recognized this pattern of chronically suppressing emotions as the basis of trauma and dis-ease and wondered if our education system was contributing to the wide-scale prevalence of mental illness among college students (Blanco et al., 2008; Danowitz & Beddoes, 2018; Holmes & Silvestri, 2016).

All we held sacred to an engineering education—SAT scores, letter grades, degree requirements, ourselves as experts in a face-to-face classroom—revealed themselves as nothing more than sacred cows, sacrificed in our sudden realization that public health is now our top priority. (What was our top priority before?) Our enforced remote delivery revealed the existing inequities that were hidden in the bubble of our campuses (Strauss, 2020); some students continued unimpeded while many did not have reliable internet access (Sampathkumar & Shwayder, 2020), functional computers, or a room of their own to work in. Many were entangled in the emotional and psychological distress of sudden family unemployment and siblings needing care. We watched the unfolding patterns of the pandemic mirror that of our classrooms, with those impacted by systemic, chronic inequities being at the greatest risk of losing livelihoods and lives.

As if awakening from a dream, we noticed our attention as engineering educators had been largely commandeered by private economic advantages: our employment, graduates’ employment, corporate needs. This was not exactly the same as our espoused commitment to place service before profit and the welfare of the public above all other considerations (NSPE, 1957). The promise of economic benefits compelled us to create monolithic Industrial Advisory Boards to mold “relevant” curricula. And the privatized benefits for a global minority, including us, were indisputable. In 2020, we suddenly wondered, though, how could curricula enable an exchange of goods and services that honors the health and well-being of all when they are shaped by legacy ideas designed to consolidate profit for a few? Is it possible to serve public good through means intended to create private benefits? We wondered if our universities were embodying such systems of inequity (Bauman, Davis, & O’Leary, 2020; Rhoades & Slaughter, 1997), requiring tuitions that only the wealthy could afford (Institute of Education Sciences, 2020).

These 2020 insights caused engineering educators to abandon the belief that engineers alone knew what is best for engineering education. Our initial stages of change were not easy; many sought to maintain a sense of normalcy, without examining what and who is served by business as usual. Others clung to assertions of what could and could not be; yet each day of our collective refrain from business as usual taught us that very little was in fact necessary. We saw that the things we were attached to were based on fear, the fear of losing our identities. And while we saw we were not wrong for feeling afraid, we realized this fear diminished our ability to create learning experiences that enabled students to bring forth the world they wanted to live in.

In an act of profound surrender, we embraced Einstein’s prescient truth: new thinking is essential if humans are to transcend a technology-enabled self-destruction (Einstein, 1946). We opened our minds and hearts to authentically learn from those viewed as “outside” of engineering. We set out to create an engineering education that honored the dignity of all people, one that strengthens our humanity and whole intelligence, a learning that values feeling as essential to our professional commitment to place the public welfare above all other considerations, a learning that supports our human desire to make meaning, to ask why or why not or for whom, laying the foundation to recognize, show up (Riley, Foster, & Karlin, 2020) and dissolve inequities (Major, 2020) in service to the public welfare—for the conditions of thriving require that each is afforded their human rights, including fair treatment by the social systems they encounter (Prilleltensky, 2012).

2 | OUR BOLD ACTS OF CHANGE

Our first move was to deeply listen to those who had been historically marginalized. Industrial Advisory Boards were reborn as Societal Advisory Boards, diversely populated by lay people and experts from all walks of life. This time, however, we came together with mutual respect for one another’s lived experiences. The message was clear: people desired to live in healthy communities with meaningful livelihoods for generations to come. We began to take seriously the desire for processes and systems that nurtured communities and their surroundings. We created partnerships with communities and colleagues in the social and environmental sciences and began growing new economies—economies that honored the dignity of all people and their communities and were based on a circular use of resources that was harmonious with natural systems—exchanges of goods and services that created local, resilient food sources and right
livelihood for all the community. By removing the boundaries that normally separate us, we were able to see that we have the technology to co-create carbon-negative systems that are just and meet human needs; what we did not have before was a collaborative spirit or openness to alternatives. We worked with communities to bring these businesses to life, simultaneously drawing down the excess anthropogenic CO₂ in the atmosphere and restoring the planetary balance.

From neuroscientists, we learned that our legacy engineering curricula were reinforcing neurological substrates that undermined our ability to fulfill our aspirations to serve society (Jack et al., 2013; Jack, Dawson, & Norr, 2013); these neurological substrates were in fact conditioning us to resist new ideas and robbing us of our capacity to feel, to build friendships and make meaning. These practices of prioritizing technical rationality (Habermas, 1971), we discovered, were fostering what was known as implicit bias—in its essence, a neurological conflation of one’s learned point of view with what one believes to be reality (Dunham, Baron, & Banaji, 2008; Greenwald & Krieger, 2006). Together we created curricula with practices (Lazar, 2014) that supported a holistic neurological development and psychosocial well-being. Enriching engineering curricula and broadening what it means to engineer led to a life-giving influx of students who represented the larger society. These students infused the profession with creativity and vigor.

In the early stages of our redesign, many believed it impossible to make room in engineering curricula for more holistic learning, such as practicing mindfulness (Creswell, 2017; Rieken, Schar, & Sheppard, 2016), growing empathy (Walther, Miller, & Sochacka, 2017), developing social responsibility (Canney & Bielefeldt, 2015) or learning in transdisciplinary settings (Vanasupa et al., 2014). With 2020 vision, we came to recognize this belief as an artifact (rather than a fact) of our narrowly developed neurological substrates, grounded in feelings of identity threat (Jetten, Postmes, & McAuliffe, 2002). Our newly adopted practices enabled us to suspend our state of fear and examine evidence. Surprisingly, we discovered that in 2020, the learning requirements for a bachelor’s degree in engineering were at least five times the requirements for the same degree in the 1970s. In the United States, the dramatic expansion in required engineering science content of texts and curricula was traced to the engineering academy’s pursuit of research funding (Seely, 1999) from agencies that demanded educationally relevant results. From this insight, we worked with our students and societal advisors to co-create a holistic taxonomy of competencies and neurological development required to engineer in a natural world of dynamic complexity. Of course, fundamental scientific principles made our list. However, we viewed Nature as a collaborative partner rather than something to dominate. Our list included the ability to care for and empathize with others, essential to a profession that begins and ends with people. It also included the ability to manage our neurological states so that we might effectively metabolize and work with emotions rather than suppress them. It included an appreciation for beauty and nature, to feed our ability to imagine attractive and just alternatives to the systems that we currently have—an ability termed “social imagination” by Maxine Greene (Spector, Lake, & Kress, 2017).

Our conscious choices to embrace a disposition of discovery produced far-reaching positive effects. The most dramatic was the emergence of a great diversity in engineering undergraduate curricula that drew from the strengths and needs of their local and regional communities. These changes aligned with the engineering profession’s priorities to indeed serve the public welfare above all other considerations. In short order, the engineering profession and professorate naturally shifted to embody the society it serves, fulfilling our elusive goals by collaboratively growing a future where all are treated fairly and empowered to thrive.

3 | BACK TO THE PRESENT, OUR 2020 VISION

I suppose envisioning a future that could be may occur as an idyllic rambling. My view of what is possible has grown out of reflective dialogs with colleagues and co-learners over the last 12 years, many of whom have helped me to unfold here a view of what is possible.

When we have asked ourselves what there is to do now, it is often correlated to the future we envision. Like many, I am convinced that the future is not likely to be an extension of the past—it appears non-linear and volatile. What can we do to prepare for such a future? Do we need more science and math? Better technology? What are the conditions for resilience?

What we know is that crisis tears the social fabric of a community, so what we can do now to prepare is build social fabric. For, with deep gratitude and humility and through communities, I have come to experience that the essence of resilience is simple, abundant and available to us all: loving kindness. What would an engineering education look like if it were built on such a foundation?
I myself can sense the anxiety that arises when I imagine re-envisioning and redesigning engineering curricula. I say to myself, “I don’t have time for that.” (What exactly do I have time for?) I can see my discomfort is the recognition that if I want to fulfill my professional commitments, I cannot do it alone. In a culture that values individualism, admitting that “I” am not enough carries a shame that my engineering education has not prepared me to process. And I suspect I am not alone.

Let us come together and see that our service to humanity calls us to transcend egoic needs to be seen as self-sufficient experts. Let us authentically listen to those who have historically been silenced—we who possess unearned societal benefits have something to learn. Let us have courage and drop our defenses; what is true will not need defending. Let us, engineering educators, administrators and researchers, step onto a path of creating together the means of living and being that ensure planetary health and human livelihood for generations to come. If not now, when?

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Linda Vanasupa

Franklin W. Olin College of Engineering, Needham, Massachusetts

Correspondence
Linda Vanasupa, Franklin W. Olin College of Engineering, MH252, 1000 Olin Way, Needham, MA 02492.
Email: linda.vanasupa@olin.edu

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