The engineering field is booming these days. Society regards it as an essential part of innovation, and colleges promote a degree in it as an entry into a fruitful, sustaining career. The humanities, by contrast, are in peril, with fewer students each year.

We want to bridge this divide and help create a system where the two areas are not separate but are essential to each other. One of us began his studies in art and is now dean of an engineering school, and the other is an expert in Russian literature who originally planned to study physics.
We know that engineering and the humanities differ not just in subject matter but in the very kinds of thinking they encourage. So the question is not just what information from each domain might be useful to the other, but also what each could learn by imagining the world in a whole new way.

In the United States, we are uniquely positioned to bring these two cultures together because, unlike in Europe and South America, students here are expected to learn much more than their specialty. This makes interdisciplinary interactions involving the left brain — analytical, convergent, and quantitative skills associated with science and engineering — and right brain — artistic and humanistic abilities — easier to achieve. Doing so will result in much more talented and versatile engineers and humanists, but it will require vast changes at every level.

By its very nature, engineering is creative and directed to human uses. All too often, however, engineering education postpones or overlooks both. Instead, it is presented as a process of absorption, followed only much later by the production of something new.

Students master routine solving of well-understood problems. Textbooks present current knowledge as timeless truths, as if they had been handed down by divine revelation. Students are told to be creative only at the very end of their studies, in a senior thesis or a design project. Imagine if poets were trained to identify meters but to suspend actually using them to create a poem for several years.

 Fortunately, teaching in engineering has evolved significantly over the past decade or so, though not in all places and not all at the same rate. Instead of simply passing on knowledge, the best programs now try to foster experiential learning. Teams rule, and in place of homogenous courses with all engineers in the same discipline, new courses pull together teams from multiple disciplines, including many outside of engineering.
In the arts and humanities, creative and metaphorical thinking come into play early on. Basic literature courses do not teach mastery of a body of material — not just because there is no such body but because it isn’t clear what "mastery of material" would mean. Literature does not aspire to transfer information per se; one must get personally involved.

From the first day of class, the good literature professor does not try to transfer knowledge about poems but models the process of imaginative interpretation of a poem. Good literature lectures are a form of improvisational performance exhibiting what it is like to experience a story, a novel, or a great painting, and arrive at an interpretation. That is the real lesson, not the interpretation itself.

What if more engineers contemplated their work similarly? By the same token, if humanists understood how scientists and engineers think, and if they were not mystified by mathematics, experimentation, and the testing characteristic of those disciplines, they would appreciate their own distinctive ways of thinking and grasp opportunities to contribute something distinctive.

The Russian Formalist critic Victor Shklovsky argued that art demands we reverse the usual process of learning. When we acquire a skill, we normally practice it until it is automatic. Learning is, in this sense, a process of familiarization. But sometimes it is important to experience something that has long grown familiar as if for the first time.

Or, as Shklovsky explains, we need to defamiliarize the familiar: "The purpose of art is to impart the sensation of things as they are perceived and not as they are already known. The technique of art is to make objects ‘unfamiliar.’"

Acquiring the habit of overcoming habitual perception is one process that brings engineering and the arts together. It is how great writers impart human experience in new ways, and it is how engineers innovate. Technology does not
proceed along a preordained single path, as one might suppose from a textbook or problem-solving approach. Like literature, engineering sometimes works not by satisfying recognized needs but by creating the needs it satisfies. And that is also like literature: Tolstoy did not satisfy someone’s need for a novel called *Anna Karenina*.

But Tolstoy did provide his readers with a glimpse into Anna’s inner life. Similarly, engineering thrives by going beyond the technical into the realm of its human users. More and more, engineering education is recognizing the importance of understanding devices, systems, and processes in terms of the people who use them.

At the heart of human-centered design is empathy, and empathy is what literature, above all, is good at teaching. When you read a great novel, you identify with a character, experience what she is experiencing, follow her thoughts and feelings moment by moment from within. You do this with people of a different culture, age, gender, social class, nationality, profession, and religion. You do it with several characters in the course of one long novel, and not just once, but countless times, until it becomes a habit. Empathy creates better people and better technical innovations for people to use.

So how do we ensure that more skillful innovators emerge from academe?

Boosting enrollments in STEM is not enough. An educational system that merges humanities and sciences, creating whole-brain engineers and scientifically inspired humanists, fosters more than just innovation. It yields more-flexible individuals who adapt to unanticipated changes as the world evolves unpredictably.
But it is easy to see why existing systems encourage the opposite. One reason is funding. Most doctoral students in engineering are paid to go to school, with funding provided by government grants. The demand for results, the expanding list of compliance mechanisms, and the gravitational pull toward meeting narrow program goals create a closed system that allows little time or attention for ancillary pursuits. This process discourages whole-brainers from even applying.

Alternative graduate programs should cultivate the whole-brain experience that is more often seen at the undergraduate level. One avenue is to provide courses that bring different modes of thinking, rather than moving students in parallel, noninteractive tracks. At our institution we have encouraged that kind of thinking in courses that link engineers with artists, both within our university and with the School of the Art Institute of Chicago.

It should not be rare to have graduate students in science and engineering in literature, philosophy, and history of science courses. It should be the norm. It is in the augmentation of possibilities — the things we never knew existed — where remarkable opportunities exist at the intersection of engineering and humanities. The possibilities are vast.

*Julio M. Ottino is dean of the Robert R. McCormick School of Engineering and Applied Science, and Gary Saul Morson is a professor of Slavic languages and literature, both at Northwestern University.*