Upending Assumptions in Engineering Education | College of Engineering

Matt Jensen

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Published in Utah State Magazine — February 2018 — It doesn't make Idalis Villanueva uncomfortable to confront assumptions. It's her mission to challenge unquestioned beliefs and conventions that a growing number of educators say are obsolete in 21st century engineering classrooms.

Villanueva is an assistant professor of engineering education — an emerging, interdisciplinary field that experts say is long overdue. She and her colleagues have a concise but complicated mandate: improve engineering education outcomes and retention rates for all students. The massive undertaking could make or break the much-needed supply of qualified engineers and computer scientists who will fill tomorrow's top-paying jobs. However, given the current climate of engineering education in the U.S., Villanueva has her work cut out.

USU's Dr. Idalis Villanueva says engineering classrooms are ready for significant change. *(Donna Barry/USU)*

Estimates suggest only about one-half of engineering undergraduate students nationwide complete their degree. Some students change majors; others drop out. Researchers say the reasons are numerous and complicated. Villanueva believes part of the problem is engineering education hasn't changed much since its inception in the mid-1800s.

"We haven't moved the needle," she said. "Too few of us are taking a step back to reflect and ask: What can I do to make a difference? Engineering has a culture, it has norms — things that are assumed to be effective because they've always been that way. But the assumptions behind those norms are never questioned."

Villanueva says engineering classrooms are ready for significant change and says traditional metrics for assessing engineering knowledge need to be revisited. For over a century, multiple choice tests have been the primary tool for assessing knowledge of would-be engineers. But such tests are not always the best method to evaluate learning.

"What constitutes knowledge in engineering? What fundamental assumptions are we making when considering the kind of knowledge required to become a successful engineer?"

She highlights a common, awkward exchange she's witnessed in the classroom.

"Engineering professors don't assess the knowledge of a student who has considerable woodshop or automotive shop experience. In many engineering classrooms, those skills are not considered an important component of engineering knowledge," she said. "In some cases, they're completely dismissed."

The irony, she points out, is that today's educators stress the need for more robust design and problem-solving experience, yet their curricula include few examples of hands-on learning. As part of her research funded by the National Science Foundation, Villanueva is tackling a key source of the many assumptions that show up in the classroom: hidden curriculum, an idea studied in education, business, medicine and social sciences but relatively untouched in engineering.

"Hidden curricula refers to academic rules, social norms, or other knowledge that is obvious to dominant social actors in a particular setting but not necessarily to individuals from diverse social or cultural backgrounds," she explains. "For example, if you are a first-generation student or come from a different cultural background, you may not be aware of the resources and opportunities that will help you succeed as a student. Many students and faculty from non-traditional backgrounds often struggle

with making sense of their environment. They struggle to understand the predominant culture and perspective."

Villanueva herself is a first-generation college student and a rarity in the engineering world — a member of the 0.2 percent of Latinas with doctorates in the field. And that is not because women aren't interested in engineering careers.

Inadvertently withholding information; or not discussing assumptions or explicitly stating expectations creates a power imbalance, she says. When hidden curricula is revealed, it shifts the power dynamic and puts students and faculty on equal ground.

Her research has the potential to reach about 11,000 undergraduate students and 570 engineering faculty around the U.S. Her work could be the foundation of a new model of education built around sharing integral academic rules and information that helps all students succeed.

"Engineering is a beautiful career," she said. "It's a needed career that has potential for enormous change. I see engineering as the next humanitarian career — one focused on collective impact and transformation."

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Direct Researcher Contact:

Dr. Idalis Villanueva, Assistant Professor, Engineering Education, Utah State University | idalis.villanueva@usu.edu | 435-797-0773

Media Assistance: Matt Jensen – Utah State University, College of Engineering | matthew.jensen@usu.edu | office: 435-797-8170 | cell: 801-362-0830 | engineering.usu.edu | @engineeringUSU