Engineering and Social Justice

an interview with **Donna Riley**, Professor and Author

by Rachel Striker Koh

Full Interview Transcript

Dr. Donna Riley is a Professor of Engineering Education at Virginia Tech, having recently left Smith College where she was Associate Professor for 13 years and a founding faculty member of Smith's Picker Engineering Program. She holds a Ph.D. from Carnegie Mellon University in Engineering and Public Policy and a B.S.E from Princeton University in Chemical Engineering. As she puts it, her work focuses on "applying liberative pedagogies in engineering education, leveraging best practices from women's studies and ethnic studies to engage students in creating a democratic classroom that encourages all voices."

As a feminist and a student of mechanical engineering, I find it very difficult to reconcile my distaste for the historical context of my field of study (military weapons) with my fondness for what I actually do every day (cool math). Dr. Riley addresses this discrepancy among many other relevant issues in her book, Engineering and Social Justice (Morgan and Claypool, 2008). The field of engineering is changing in demographic and in application, and Dr. Donna Riley is an essential leader of this effort.

I don't know Dr. Riley personally, but had been following her work and was excited for an excuse to reach out when GWIS Communications proposed this series of interviews. When I contacted Dr. Riley, she was in Washington, D.C. serving as a Program Director at the National Science Foundation in the Division of Engineering Education and Centers. She graciously replied to the following questions via email. -RSK

RSK: First, could you talk about your professional career path? What led you to explore the intersections of engineering and social justice, and subsequently liberative pedagogies in engineering classrooms?

DR: I grew up in Los Angeles and became interested in environmental issues in high school. It was the 1980s and I had a growing concern about US wars in Central America. I attended some events and workshops on a few different social justice issues - a nuclear freeze workshop for high schoolers, for example. I had known three men who died of AIDS in the early 80s so I helped out with an AIDS awareness dance in 1987. That kind of thing. But my primary interest was environmental issues. My father was a chemical engineer, and when I was trying to decide about college majors, considering policy/law or biology/environmental science, he suggested engineering. I was completely naive about engineering's political orientation until much later.

In college I went from a girls' high school that never questioned my ability in science and engineering to Princeton, where I was shocked to discover many of my peers felt that women didn't belong - not just in engineering, but also at Princeton in general. In December of my first year, 14 women were gunned down at the Ecole Polytechnique in Montreal because they were women studying engineering, and my peers made jokes about it or dismissed the shooter as a madman. But I recognized the continuum of misogyny in my experience of sexist microaggressions and the massacre of these women engineers. It radicalized me. The Society of Women Engineers on my campus pretended it didn't happen, but the University Women's Center held a vigil, and I became a Women's Center participant. On a conservative campus like Princeton, we worked in coalition with one another, so my work at the Women's

Center connected me to other social justice issues. I struggled to connect these to engineering.
Meanwhile, I noticed a stark difference between my classes in engineering and my classes in other disciplines. Where other professors would facilitate conversations among class members as a community of scholars, my engineering professors mostly lectured at us while we took notes. Occasionally they would pepper us with questions that were more of a call-response drill, with one right answer you were made to feel stupid for not knowing. I began to wonder then why my engineering classes couldn't be more like the seminar style classes I took in other subject areas. But it wasn't until I became a professor that I really worked on the question.

RSK: Your work with liberative pedagogies is based in a thermodynamics class at Smith College. What of the lessons from a small, women's, liberal arts college can you translate to a Research-I institution like UMass? Would your class structure (syllabus, assignments) look the same if you taught it at UMass?

DR: Much of it would be the same. There are two major differences that I see. The first is class size. In small classes it is fairly easy to use discussion as a learning vehicle. In large classes you need to break the class into groups. The thing I would like to try in a large class setting would be creating learning communities that go deeper than teams but incorporate reflective practices and function in a more radical way in the classroom.

The second difference is that in a liberal arts setting there are often students in the class who read something in another class that relates to what I am doing and so they bring that knowledge into the class and teach their peers about it. I suspect at a school that has fewer open courses in the curriculum one would have to draw on other points of student knowledge, probably relying more on life experience and less on specific formalized knowledge they got in a social theory class - it's very do-able, you just have to know your students and what they bring to the classroom and work with that.

RSK: One way that you implemented liberative pedagogies in your thermodynamics class was to give assignments that used skills that are typically perceived as non-engineering skills, such as reflective writing. In one example, you discuss how a "thermo-to-life" assignment, which asked students to apply thermodynamic principles to everyday life situations from their reflections, was replaced by a collaborative assignment where students examined the role of thermodynamics in hunger, poverty and obesity in the United States. Can you talk about the process of crafting assignments that engage the whole student? How do you assess the success of individual assignments? And how do you balance this with the strict curricular requirements of a class like thermodynamics?

DR: So taking the last question first, it's important to recognize that since 2000, engineering has given up strict curricular requirements and moved to an outcomes-based model where we have to certify that students develop a set of abilities in what's known as "ABET a-k"

So the curriculum is actually a lot more flexible than people think, or than faculty are willing to admit... A-K includes abilities in communication, lifelong learning, ethics, and social context. So I simply address those in my thermo class.

Some of my assignments are student-initiated. For example, I developed a class on the Montreal Massacre because a student approached me and said she had read about the event on the Internet but wasn't sure if it really happened. When I told her it really did happen, she asked why the women's engineering program didn't learn about it. She had a point... so I created a class on it.

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The Hunger, Poverty, and Obesity module also evolved from students. There was a unit in their thermo textbook on "biological

thermodynamics" basically about calories consumed and worked off in exercise. There were a number of end-of-chapter problems the students found offensive... John and Jane go to Burger King and John gets a whopper, large fries, and large Coke, and Jane gets a whopper jr., small fries, and a Diet Coke. Jane weighs X and John weighs Y. How much more time does Jane have to spend on the treadmill to work off her food than John? There were students drinking beer and running on treadmills in some problems, and some guy lost 13 pounds in a week in another problem - not a very healthy example...

So after students pointed this out I started assigning a critique of problems - pick a problem in the textbook, critique it, write your own.... and that led to one of them writing on hunger, poverty, and obesity... and the assignment kept developing like that.

Because I had an NSF grant to do this work, I had a person who ran focus groups with volunteers from the class to determine what the impact was of different assignments. Students also did usual course evaluations mid- and end-semester. I always asked about readings and assignments in specific terms. Some were more popular than others. I also look at what students seem to be getting out of the assignment based on the assignment itself - how reflective were they, what did they learn?

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RSK: In From Persistence to Resistance: Pedagogies of Liberation for Inclusive Science and Engineering, you make an argument for top-down, systemic change in engineering, and say that the traditional approaches like after-school programs for girls can only go so far. Obviously these more traditional, bottom-up approaches (many of which GWIS is taking) do make some impact on the individual and community levels, but I'm wondering if you see places for graduate student organizations like ours to affect systemic change from the top down. What can we do as graduate students to promote institutional change?

DR: So the first most important point is that systemic change does not need to be top down, and in fact most systemic change is not top down but comes from the bottom up. It's about thinking systemically when you plan an action. The analogy people use is the story where the babies are drowning in the river. Someone jumps in and starts pulling babies out of the water. Someone else rushes in to help. The third person runs away, headed upriver. They yell at them, hey! There are babies drowning in the river. And they say, yeah I'm going to stop whoever is throwing them in there.

I think the most important thing grad students can do is share their experiences and act collectively. For example, it's one thing to help someone pass a grueling confrontational daylong comprehensive exam, but it might be better to get together as a group and approach the department about making the whole exam process more humane for everyone. And if you work together you can do that. The more opportunities there are to talk about the kinds of systemic change that would be effective, the better ideas you will generate and more support you will gather for the cause.

RSK: There is a great deal of debate about if and why gender matters in math and science fields. I think (and hope) that most of us have moved passed "if" and are focused on "why". It seems to me that one of your foundational arguments is that we have spent too much time trying to assimilate, trying to meld ourselves to fit into engineering, when rather the field of engineering ought to meld to us. Do you agree with that interpretation of your work? What does this mean for the "why gender matters" conversation? In a broader sense, how about the "why identity matters" conversation?

DR: The point is that the system views meritocracy as gender-neutral, race-neutral, objective. It is not. The 2002 report "Unlocking the Clubhouse" illustrates this point. At CMU they got the number of women enrolled in Computer Science to increase from 7-42% over 7 years by changing the admission requirements and some assumptions they made about students' prior knowledge in intro courses.

Most people would never even consider admitting "less qualified" people! But what CMU considered qualified was prior programming experience, which girls had been systematically shut out of .... We need to take that approach more often, seek out the biases in the system and remove them.

This is related to but also distinct from issues of identity in engineering culture. I think here we need to focus on understanding masculinities in engineering, cultures of whiteness and able-bodiedness and heteronormativity. It is by revealing these cultures within engineering that we can start to examine them and reconstruct new, more inclusive cultures.

RSK: In the preface to Engineering and Social Justice, you noted that you have, in your research, come across many more people doing this type of work than you would have expected. I certainly share that sentiment- in my own searching I've come across far more [information] than I imagined existed on this topic- but I wonder what it is about engineering that keeps those of us who are doing this work so distant from one another in comparison to other fields like medicine and law. Could you offer any speculation on why this might be? Does it have to do with the discipline itself? What about other hard sciences like chemistry and computer science- where do they fall?

DR: I am not sure that medicine and law are that far ahead in terms of social justice -- social work might be an example of a profession more firmly rooted in social justice... but what medicine and law have that engineering doesn't have is an organized and widespread group of practitioners earning livelihoods around social justice... doctors who work in free clinics, lawyers who work in the public interest or who work pro bono are common. Engineers doing the same are far more rare. I think we need to develop a critical mass. I think we don't have a strong organizing skill set that lawyers had in setting up public interest law firms.

The sciences are maybe slightly better off than engineering - witness that most science professional societies have LGBT affinity groups within them, while no engineering professional society has this yet. From the late 1960s through the 80s there was a group called Science for the People that organized around social justice issues. There were some engineers engaged in similar work, but fewer of them. There is a reunion event happening at UMass April 10-13 that you might want to check out.

Dr. Riley's work phenomenally exemplifies ways in which gender biases can be addressed and dismantled in STEM fields. We, scientific people who hold subordinated social identities, have needed her work in reforming engineering education for far too long. Even in this brief interview, she has demonstrated a knack for spinning personal anecdotes and scientific data into powerful, persuasive arguments that are making real change in engineering education.

Examples of Dr. Riley's work has given herein illustrate how addressing gender bias is already a part of the work that we do as women in STEM fields. As GWIS, we are the women who continue to face new gendered hurdles each day we show up to school and work, and the women who will tear them down for generations to come. As we continue to dismantle sexism at UMass and the surrounding community, it is my hope that we can leverage Dr. Riley's brilliant insights in our own classrooms and community.