**(STEM) Students Must Be Taught to Fail**

**Failure will teach students to take the risks necessary for innovation**

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[Image]

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Within minutes of losing the presidential election, the Republican party was back on its feet, and preparing for the 2014 election cycle. In that way they were like most competitors. Star running backs, for instance, are tackled a dozen times in an ordinary 60 minute football game. Because falling is part of any competitive game, coaches teach their athletes how to fall in ways that prevent permanent injury and make it easier to get up and back into the game.

As a mechanical engineering professor at Northwestern University, I believe that that's precisely what we should be teaching our students in STEM (science, technology, engineering, and mathematics) subjects: how to fail. Right now, we do not explicitly teach our students how to fail so that they can get right back up. That's in direct conflict with our goal: to prepare students to play competitively upon graduation. If our students are going to stop deadly pandemics, solve the energy crisis, and cure world hunger and poverty, they will have to be prepared to fail, over and over—and more important, they will need to know how to learn from those failures. STEM innovator Albert Einstein recognized that falling is an inevitable part of innovation; he's quoted as having said, "A person who never made a mistake never tried anything new." Another STEM innovator, Marie Curie attributed her success the fact that, as she put it, "I was taught that the way of progress was neither swift nor easy."

But STEM educators are teaching our students the opposite. We give them well-defined problems that we know they can solve. When we hand-deliver "neatly structured problems on platters," as one of my students puts it, we deprive them of the experience of dealing with the messiness of authentic, real world problems. As a result, they gain false confidence in their ability to play the game. But none of them will graduate into perfectly packaged problems and painlessly derived solutions.

Here's one of the critical reasons STEM educators don't teach falling: because we ourselves are out of practice. To gain admission or be hired at top-tier universities, we have been on a winning streak, earning awards and top grades with ease. We follow the rules to get ahead. We have often forgotten how to fall, much less how to teach others to fall. If we do fall, we carefully hide those failures from students and colleagues to preserve our reputations. As classroom experts, we rarely venture afield to remember what learning by trial and error feels like. Too often, we don't take on research projects that would put our prestigious positions at risk. We take on neatly scoped projects that we know can be done and published. Much of the time we have become entranced with being experts rather than learners—and thus have distanced ourselves from the students we hope to teach.

Of course, the football metaphor fails at a certain point. The injuries that come from falling in the sciences are psychological rather than physical. But they may be still more insidious for precisely that reason. When a first year student fails her first quiz in her first semester engineering class, the damage could drive a talented student out of the field. She may just stop showing up for a class. Another student's confidence may crumble slowly, pushing him from that topic for the rest of his life. Some might suggest that such failures are an essential part of how we select professionals who can succeed in the STEM fields. But do we truly want to lose good students, meanwhile alienating citizens, consumers, and future taxpayers who will need to appreciate the urgency of STEM pursuits?

So what shall we do?

As STEM professors, let's get back into the game and learn to fall again. Let's start class with stories of the epic failures that led to great successes in our field. Let's invite our students into our labs to tackle problems that we don't know can be solved and to share our successes and our failures. By doing so, we may not only gain empathy for our students and be better teachers, but we may also take more of the risks necessary to really innovate in the fiel?]

Once in the game, let's regularly try to fall—and when we do fall, let's be ready to admit it publicly. The taboos associated with failure mean we often avoid talking about it—and, consequently, avoid reflecting on it to think what we can do differently next time.

One of my most memorable moments as a student was my esteemed professor at an elite university showed me all of his rejection letters from all of the major publishing outlets. The rejection letters questioned his expertise and the value of his contribution. The letters were dated from the beginning of his career to the present year. At first, I was shocked that such a perfect scholar still received rejections to this day. And then I felt empowered knowing I could receive those letters and still go on to make an impact in the world.

By telling our students stories of how we failed and then got back into the game, we will model the most successful approach to STEM subjects far more effectively than if we simply tell them the final score. The result will be students who understand that the answers to today's pressing challenges demand a trial-and-error approach.

Failure is inevitable and a healthy sign of trying to solve these problems. Without a coach by your side, failing alone can hurt—and it can be much harder to get back up. As Einstein is also supposed to have said, "Setting an example is not the main means of influencing others; it is the only means."