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How engineering design education will be everywhere and nowhere in 2040

In the future, engineering design principles will underpin a new educational model that empowers students to solve problems and learn skills for the sake of improving their world.

"The future has arrived—it's just not evenly distributed yet."
-William Gibson

A few months ago, I watched something amazing happen: in the span of ninety minutes, I observed groups of students with no formal engineering training construct functional prototypes of customized video game controllers. The devices were simple— composed mainly out of cardboard, duct tape, conductive tape, electrical wire, and a microcontroller— though impressive given the time constraints and lack of previous knowledge. Considering that the students learned a basic version of the engineering design process and then implemented it in a collaborative context, a teacher might view the activity as a considerable pedagogical success. Yet, it was not the practical ingenuity or learning outcomes that astounded me; it was the fact these students had just designed custom pieces of technology for a nine-year-old girl who was born with only five fully-functioning fingers. The prototypes were symbolic of something more meaningful and personal—the ability for students to solve problems and to design a better world *right now*.

"Let me tell you about when I had to go to school…"
From Western Union President William Orton's 1876 declaration that the telephone has "too many shortcomings to be seriously considered as a means of communication" to the assurance by Steve Ballmer, former Microsoft CEO, in 2007 that "there's no chance that the iPhone is going to get any significant market share", history is littered with confident and utterly incorrect predictions about technology. That is why, when considering the future of engineering design education, I will proudly avoid making claims about the "obvious" impending downfall of immersive AR-headsets or the "undeniable" mainstream adoption of 3D (or 4D!) printer technology. Instead, I will imagine something even more extreme: a transformation of the education system that hinges on engineering design practices.

In the year 2040, school as we know it will exist solely in our cultural (and digital) memory. Young people will ask their parents questions like "Did you really have to sit and fill out paperwork for eight hours a day?", "What did a test grade mean?", and "If you never solved real problems, then how could you tell what you actually learned?" The physical and psychological constraints of the classroom will be as foreign to them as writing with a quill and ink is to us. In the coming decades, going to a literal space, referred to as a "school", where content experts disperse knowledge through didactic lectures will not be merely anachronistic, as it is now, but simply unnecessary. It is not an unreasonable assumption that in the coming decades the internet will become the dominant medium for finding, creating, and sharing knowledge. University-sponsored MOOCs, Khan Academy, and an endless supply of YouTube "How-To" videos suggest that this is already the case.

Most academic subjects, like Beginning Spanish, Calculus, or American History, are highly organized sets of facts, concepts, and narratives. Although students benefit from in-person discussions and group study, it is easy enough to imagine mastering English Literature without ever

stepping foot into a lecture hall or even out of one's bedroom. Yet, engineering design is different. Like the sciences, engineering is about interacting with the physical world, and like the scientific method, engineering design is a process. To know it is to take part in it; to master it is to successfully implement a design in the world. This takes us back to our original group of designers-in-training.

A vision of education, redesigned
The scene described earlier should be given greater context. The students mentioned were in middle and high school, not college. They came from diverse, but generally underserved, socioeconomic backgrounds. Many of them had not taken any upper-level science or engineering classes, and some of them were considered "at-risk". The game controller activity was not presented as a competition with an extrinsic reward, but as a legitimate real-world scenario that could improve someone's life. Perhaps most notably, rather than taking place in a classroom, this happened at a community-oriented makerspace.

In full disclosure, I worked at this space and helped design activities such as these. That being said, I never stopped marveling at students' focus, persistence, and creativity during these design challenges. I also never tired of hearing teachers say things like "I have never seen them work so well together!" or "Student [X] is never this engaged!" I have long believed that schools should function differently; in working with hundreds of students on simple challenges like the one described, I began to envision a radically different educational system, one that focused on empowering students, not wearing them down or "weeding them out".

We've spent many decades telling young people they can change the world-- that "they are the future" -- yet giving them essentially none of the tools to affect that change. **Engineering design principles, combined with digital fabrication skills, have the potential to motivate student learning, not for the sake of distant goals like graduation or finding an occupation, but to solve real, immediate, and personal problems.** Given certain dire predictions about AI automation, the student of 2040 might not even be thinking in terms of a particular job, but instead be reoriented to addressing specific problems that span a wide range of traditional disciplines and skillsets.

A long way to "even distribution"
This vision, while requiring no new technological advancements, is still a very hypothetical future. In reality, the students I worked with were on field trips and perhaps never did any design-based activities after their trip to the makerspace. Their teachers were often unaware of design thinking as a valuable educational topic and their schools often did not provide extracurricular resources to design, prototype, or build. The activity we ran was, in a sense, just a simulation, since the would-be recipient of the game controller was presented through a video and never saw most of the prototypes.

Physicist Michio Kaku has noted that "we don't use the word 'electricity' anymore because electricity is everywhere and nowhere at the same time". In the future I envision, engineering design education does not happen in only one course or simply in the realm of engineering. Instead, it becomes a guiding principle for new kinds of educational institutions that encourage students to master hands-on skills, collaborate with peers, and create solutions to improve their world. In this future, engineering design is as ubiquitous as electricity, as indispensable as water, and as evenly-distributed as air.