How do we educate in the future?

Responding to an ever-changing educational landscape

This paper was published in June 2015. The ideas and recommendations within it are among dozens of suggestions that arose from the Stanford Engineering Future process. Share your thoughts with us at SoEFutureFeedback@stanford.edu.
The Stanford Founding Grant states that our purpose is, in part, to “promote the public welfare by exercising an influence in behalf of humanity and civilization.”

Education remains fundamental to realizing this purpose. However, changing student demographics, increasing demand for engineering courses, and innovations in online and individualized learning require us to revisit how we approach education.

It is also clear that engineering itself is changing. Specifically, engineers increasingly encounter problems that require solutions beyond any one discipline’s boundaries. Many of the most important real-world opportunities require integrated expertise across many technical areas. Additionally, alumni and employers especially value students who, in addition to being outstanding technologists, have strength in ethics, creativity, operational strategy, organizational leadership and other “soft skills.”

1See Stanford’s Founding Grant regarding “the Nature, Object, and Purposes of the Institution”
Create an Engineering 2.0 major.

We recommend developing a new schoolwide undergraduate engineering major. The major should combine fundamental engineering concepts with practical examples and project-based design challenges. The concepts and challenges should draw from the full diversity of engineering fields. Particular care should be taken to avoid teaching fundamental engineering concepts in isolation or in watered-down settings. New cornerstone courses should be cradle-to-grave, longer-term, project experiences as well as student-identified design and learning opportunities.

We recognize that introducing a new major is a significant undertaking that requires careful design and approvals at many levels. A successful program should be extraordinarily well received by Stanford students and their employers, and would create an example for other universities. While we expect that such a major might be attractive to students who pursue nontechnical careers after graduation, we expect the "Engineering 2.0" major to be as technically rigorous as any departmental major.

Revisit science and engineering core requirements.

We recommend that the current science and engineering core required of all engineering majors be examined and revised. We see opportunities to:

- Remove duplication of material across science and engineering courses.
- Enable and encourage students to develop deeper competencies beyond their majors.
- Further improve or better adapt core science courses for engineering students.

Such a curriculum revision would require significant effort, but it is needed to ensure that we are providing the best possible education to our dynamic student population.
Develop schoolwide maker spaces.

Open-ended, learning-by-doing opportunities realized in part through maker spaces are essential to instilling confidence and fostering creativity in our students. Several departments are now overwhelmed by their success in providing students with such opportunities. We recommend that SoE provide school-level support for such spaces, ensuring that they serve more than one department, are multimaterial (i.e., physical, digital, chemical and biological), and fully support independent student work in addition to teaching and research. A short-lived task force is needed to develop specific proposals for the types of spaces needed as well as strategies articulating both operational needs and goals.

Improve online materials and learning.

We are a leader in online learning with resources such as the Stanford Center for Professional Development, Stanford University High School Online and the Office of the Vice Provost for Teaching and Learning. We can significantly improve how we partner with the teams behind these resources to realize our educational mission. One short-term goal, inspired in part by Stanford’s ClassX and the Institute for Computational & Mathematical Engineering’s Just-in-Time Online Learning Tools, is for the school to support and encourage all faculty in developing a 15-minute online learning module on a topic of their choice each year.

The school also should specifically encourage and support all instructors in making all course materials freely available for people outside Stanford to access and use. In addition, we should position our online educational materials so they support and encourage students to engage in overseas and other off-campus experiences.
RECOMMENDATIONS

Engineer with examples (online).

The world is full of challenging and interesting engineering problems that require engineers to overcome real complications and constraints. Providing an online mechanism for people outside Stanford to share real-world challenges from which students can learn and contribute to solutions would be tremendously compelling to students and help Stanford better fulfill its purpose. We recommend that SoE enable its members to engage and collaborate with people outside Stanford, allowing our community to learn from the world as much it learns from using online tools.

Go from trailing to leading on diversity.

The diversity of our students now exceeds that of our faculty. To quote one alumnus, “Faculty diversity is the only area in which Stanford Engineering seems content to be merely average.” The importance of diverse role models in front of the classroom cannot be underestimated and will become increasingly important as we seek to engage a still more diverse global community. We should redouble our efforts to improve faculty and staff diversity.