# STEM Education by 2040: Change the Ecosystem, Impact the World

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## A Tale of Two Students.



**Tale 1**

"You take a class. You pass. You earn your credit, you dump the info and you move on. You follow the cycle, because if you don't, you will lose…The sad thing is that until now, education to me has been a joy. But now - after my first year in general engineering - it steadily feels like a machine cranking out good little students who go out and forget why they even started studying to begin with."

*Shared by a first-year college student in 2018 who, although performing well academically, quit college after her first semester.*

**Tale 2**

"I am a genetics major taking part in a community resilience internship. I would not have thought two months ago that broadband coverage and South Carolina mapping would interest me or be something I could succeed at. However, I feel like I have developed a wealth of knowledge in a range of subjects, improved my communication skills, gained new interests, and I am hopefully contributing to a successful solution to a very significant issue."

*Shared by a rising senior college student in 2020 who is working on a community-engaged project.*



When we recently asked our students what STEM education should be like in 2040, they first critiqued their current educational structure for its overreliance on memorization and convergent tasks directed at getting the right answer. Like the student in tale 1 indicates, there is no joy and no purpose. Every one of the students then went on to extoll the benefits of project-based learning for improving their critical thinking, communication skills, and leadership and for providing access to new knowledge and interests. Like the student in tale 2, they want to make a difference in impacting society. This is what STEM education should be.

## A New Model: The Academic Collaborative Ecosystem

COVID-19 has brought into question the relevance and value of campus-based academic institutions. The widespread move by prestigious institutions toward online learning puts them in direct competition with the online and for-profit institutions that do it much cheaper. Knowledge

dissemination will no longer be a primary selling point. As a new normal emerges in the coming semesters, we expect to see a shift away from professor-as-font-of-all-knowledge and toward student engagement. We believe that a further shift in STEM education is needed within the next twenty years so that by 2040, institutions are fully integrated with communities and industry, with the diverse professoriate that they enable, and with the students that they prepare for careers and experiences.

Our vision and that of the students we serve coalesces around a model shown in the figure below. In responding to the National Academies call for ideas, we believe that our submission addresses a system-wide state that does not currently exist at scale. Rather than the current educational model of courses as discrete units of knowledge, we need to re-envision STEM education as an academic collaborative ecosystem (ACE) to harness burgeoning skills for the good of society. Students would receive mentoring on real world projects starting in the first year of college rather than being thrown to the wolves in senior capstones as commonly practiced now. As our students tell us, this ecosystem approach opens up an array of improved learning opportunities via relevance and engagement.

Although improved student learning is the driver, the ACE model also addresses evolving faculty needs. STEM fields are not generally reflective of the demographics of the overall population. Efforts to diversify STEM will continue to fail unless they also address the system that rewards isolated genius over collaborative teaching and scholarly endeavors. We hear this frustration from many faculty colleagues, especially women and minority members. Some believe they are stuck in a system that only rewards scholarship of discovery, having sought tenure or promotion and been denied due to the nature of their work. Other faculty have stated that their institutions do not



Students:
Relevance via real world projects
Mentoring relationships
Connected with communities & careers
Start early (1st year students, not just capstone)
Leadership & civic engagement opportunities
Multi-disciplinary education to mimic real world

Community & Industry:
Uneven capability & capacity
Unmet needs – research, engineering & technical, social programs, financial literacy, grant assistance
Limited funding
Cultivating new employees & workforce

Academic Collaborative Ecosystem (ACE)
Harnessing Skills for Good

Faculty:
Applied teaching & research to meet societal needs
Support relationship building & collaboration
Address reward structure
Improve equity & diversity

Academic Institutions:
Fulfills needs of community & industry
Recognized for engaged faculty, research & students
Recognized as a good community partner
Better prepares students for careers
Establish sustainable funding model

offer the supportive infrastructure to engage the world as a scholar and teacher. In *Scholarship Reconsidered*, Ernest Boyer speaks to the work of the professoriate, which includes not only scholarship of discovery, but also the scholarly pursuits of integration, of application, and of teaching. Academic institutions that shift to embrace the Boyer model better contribute to an ecosystem of academic collaboration by supporting a diverse and equitable faculty, and vice versa.

Many communities (neighborhoods, local, regional, state, international, or virtual) are lacking resources that could be mitigated through partnerships with academic institutions. Likewise, leaders of industry are highly concerned about the readiness of the general population (including recent college graduates) for the workforce. Applying academic learning outcomes to real world, community-based and/or industry-driven problems and scenarios is a crucial component of the ACE model. For example, we recently partnered with leaders in a low-lying South Carolina county on flood preparation. The county administrators wanted to plan ahead to have 5-6 strategies for temporary housing that they could quickly deploy in case of a flood disaster, rather than just relying on FEMA. We connected the administrators with the professor of a 3000-level Technical Writing course, where the students worked in groups to prepare community resilience documents for flood preparation. The students in the course were going to be writing technical research papers anyway, so in redirecting their efforts toward a community need, the county got a leg up on their planning, the students knew that their work would be used, the faculty member enjoyed teaching highly motivated students, and the institution lived out our land-grant mission. With the ACE model, vignettes like this one should become the standard rather than the exception.

The figure also details a number of transformations possible within the institutions themselves, forged through the union of students, faculty, communities, and industry. Change is much needed. As an instigator of change, the National Academies could fundamentally advance academic institutions' future impact, building an ecosystem of academic collaboration.