

A Vision for the STEM Faculty of 2040

In 2040 the national context for higher education will differ in substantive ways from that which shaped higher education today. Representing the Center for the Integration of Research, Teaching, and Learning (CIRTL), a community committed to preparing the future national STEM faculty, we offer a vision of higher education in 2040 that will make very different calls on that future faculty, including how they understand diverse learners, facilitate learning, and collaborate with others in academe and beyond to create effective learning contexts, opportunities, and outcomes.

Visioning the future of STEM higher education without talking about preparing faculty would be like talking about K-12 education without talking about preparing the teachers. And yet too often the preparation of STEM faculty is taken for granted as an outcome of disciplinary education. Here we use “faculty” to mean all instructors in higher education, in the academy and beyond.

What should undergraduate STEM education look like in 2040 and beyond to meet the needs of students, science, and society?

In the post-World War II environment, basic assumptions and values emerged that have shaped higher education for the past seven decades. Today, we are arguably at the beginning of the next major sea change in the nature of higher education.

Several factors and circumstances are driving this change in processes, structure and culture. First, we have seen a “tipping point” in the understanding and practice of STEM undergraduate education. Research developments have expanded knowledge of how people learn, and experiments to advance STEM undergraduate learning have provided evidence-based findings and practical examples of new and effective approaches to teaching, curriculum, and problem-based learning that connects education with the workplace. Second, the intense public scrutiny and engagement with racism of the past several months are part of a broad social justice movement that has ignited new efforts to create more diverse, inclusive, and equitable learning environments that welcome and support the success of the full population. Third, the COVID crisis and the related pivot to remote learning across U.S. higher education institutions has highlighted and accelerated the movement toward technology-enabled access and learning. Fourth, higher education will need to respond to increasing national demands for value-added impacts on lifelong career outcomes. Fifth, higher education will be less insular, with more integration between education and other sectors (e.g., business, government, community-based organizations). Finally, the economic precariousness affecting higher education institutions will likely result in a reshaping of the organizational landscape.

These factors, and others, will result in major cultural, structural, and organizational changes in higher education. STEM teaching and teachers must change too.

What will teaching in undergraduate STEM education look like in 2040?

Since the beginning of higher education, faculty were primarily called upon to convey content knowledge. In 2040 faculty will need to serve broader priorities. They will continue to bring their disciplinary expertise, but their student learning outcomes and modes of teaching will include:

- o Preparing STEM practitioners for an array of work situations.
- o Fostering awareness and commitment to equity, diversity, and inclusion in classes, workplaces and organizations.

- Developing professional skills — critical thinking, communication, collaboration and teamwork, ethics, leadership.
- Cultivating learners' expertise in the values and processes of interdisciplinarity.
- Working in an array of contexts—traditional and online classes and labs, workplaces, the community.
- Creating learning communities that foster belonging among diverse individuals and groups.
- Using evidence-based strategies to scaffold learning in support of learners of all backgrounds and ages.
- Using technologies and AI to foster personalized learning and assessment.
- Organizing problem-based and community-based learning experiences that resonate with the lived experiences of diverse students.
- Cultivating partnerships between education, business and industry, community-based organizations, and government.
- Engaging as change leaders in their organizations.

No one teacher will be able to accomplish all of these outcomes. Indeed, the very concept of one teacher, one class, may disappear. We envision that teaching, and student learning, will become highly interdisciplinary and collaborative, and will blur the current boundaries of the academy.

Similarly, those who will comprise the faculty will change, as traditional disciplinary faculty join with those who work in other career sectors, those who design learning experiences using games and other technologies, or those engaged in social justice initiatives. While there will still be faculty for whom higher education is their entire career, others will integrate STEM teaching within their careers. Alongside colleges and universities, other sectors (e.g., in industry, health fields, military) will also develop advanced learning experiences. Learners will move in and out of formal learning across their lifespans.

What should we do now to prepare?

The most important change in the faculty of 2040 must be in its demographics. The teachers of STEM must reflect the nation. Extensive research shows that underrepresented students must have exemplars to help them visualize belonging and succeeding in STEM-related careers. This change is fundamental and challenging. It must accelerate now to prepare for broad impact of higher education in 2040.

20 years from now, today's future- and early-career faculty will be the teachers and leaders in the academy. Equally important, most current undergraduates, graduate students, and post-docs will enter into other workplaces, including health, industry and government; we envision that many of them also will be teachers in the new higher education. We must prepare them all now for that future.

Specifically, current higher education must provide today's students, the future STEM faculty, both disciplinary expertise and skills in:

- Leadership
- Networking, partnership and collaboration
- Interdisciplinarity

- o Understanding of integrating social justice and STEM
- o Mentoring
- o Communication

In rapidly changing times, the combination of these skills will prepare all future faculty to be flexible and dynamic throughout their careers across sectors. Faculty with these skills will be able to vision and lead ongoing change in STEM higher education.

The work of the national STEM faculty impacts directly on the outcomes of all students. The necessary cultural and organizational changes in higher education, both within and beyond the academy, can be most effective when they are rooted in the teachers. Higher education in 2040 rests on the preparation provided now for the next generation of faculty.