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Higher education is notoriously hard to change. Despite the fact that the world into which students are graduating has altered radically, and continues to change at an ever-increasing rate, higher learning remains stuck in an essentially nineteenth-century industrial model in which the most important goal is knowledge transfer. But in today's environment students are more and more called on to construct their own knowledge, cross disciplinary boundaries, and use their learning to make an impact in the world.

Many educational leaders believe lessons from Olin College of Engineering, an unusual educational start-up barely 20 years old, may provide a path forward not only for science, technology, engineering, and mathematics (STEM), but also for higher education writ large.

Olin was different from the start. It was founded in 1997 through a \$460 million grant from the F. W. Olin Foundation—at the time, the largest grant ever to higher education. The foundation did not want just to establish another elite engineering college; it wanted the new institution to be a pioneer in changing the way engineers are taught. Olin was to be a clean start, a sort of educational petri dish in which new approaches could be tried out, unencumbered by traditional curricular structures, pedagogical methods, and departmental silos.

The Olin model emphasizes project-based, experiential learning. Olin's focus also includes teaching students how to learn independently and how to master the skills needed to discover knowledge and make an impact instead of relentlessly focusing on problem sets and math equations. Olin consciously styled its education after educational best practices and research into how students learn, insights that drove it away from traditional lecture-based learning and toward team projects and real-world problems. The goal: to better prepare students for the twenty-first century workplace and the global engineering challenges they will face.

Lessons From the Olin College Experiment

Other higher-education institutions may be able to learn a lot from an unusual educational start-up in Massachusetts.

Fast-forward two decades and the small Massachusetts school has been named one of the top leaders in engineering education globally. Olin has always had a dual mission: to educate students, and to act as a laboratory so that other institutions can learn from its educational successes and failures. To that end, here are some lessons learned.

Lesson #1: Involve students in codesigning their own education. At Olin, one of the first big lessons came on the heels of a barely averted disaster. The first class was supposed to start its education in the fall of 2001. Thirty thousand brochures had been printed and sent out to college-bound seniors advertising that date. Unfortunately, as can happen, construction delays meant the college would not be able to open that fall. How to deal with this dilemma? A decision was made to bring a smaller group of 30 new students to campus as “Olin Partners.” They would be part of an experiment. The Partner Year would not count toward an Olin degree, but rather would offer the students a unique opportunity to help design a new curriculum and launch the college. In turn, the faculty would have a small cohort of students with whom they could test some curriculum ideas. The Partner Year gave Olin the opportunity to experiment and to fail, a freedom not available when students have paid tuition and expect to earn credits toward a degree. The college received nearly 700 applications for the 30 spots.

Fifteen male and 15 female students arrived on campus that fall to join the founding faculty and leadership team in creating and testing the curriculum that would form the basis for the Olin College learning experience. As the Olin Partners arrived on campus, the faculty needed to answer two questions related to engineering education: what does it mean to be an engineer, and what does every engineer need to know? The faculty wanted to know if the traditional math and science prerequisites found in most engineering degree programs were necessary before students had a chance to build something. They conceived of a project that would allow the Olin Partners to design, build, and demonstrate a technical device right from the start, before they had even taken a college class.

They settled on having the students build a pulse oximeter, which measures the pulse rate and oxygen content of blood. The students would work in teams, and they were given five weeks to research, design, build, and test this medical device through self-directed learning. Faculty or staff and off-campus resources would be available to answer questions. The initial plan was to end the project after the allotted time, as almost everyone on campus believed the students would not be successful. The students completed the project and at the end of five weeks had a working pulse oximeter.

This was an eye-opening experience, not just for the students, but for the faculty who had believed, based on their own experiences, that years of math and science courses were necessary to pull off this kind of engineering feat. Importantly, what was observed was that the students’ working in teams,

building a project from scratch and exceeding their own expectations, resulted in visible enthusiasm for engineering.

As a result of the early experiments, the curriculum began to decouple content knowledge and technical courses from the dominant definition of engineering and consider engineering as a way of thinking, not a body of knowledge. Equally critical, the Partner Year established the importance of the student voice as a fundamental pillar of the Olin educational program.

Lesson #2: Watch out for “opportunity overload.” When the full cohort of students finally arrived on campus in the fall of 2002, the curriculum was still relatively untested. Faculty were eager to try out new curricular approaches. As the first semester progressed, though, it became apparent that the students and faculty were experiencing stress under a workload that was unrealistic.

The faculty and administration, realizing their error, brought in bouncy houses and carnival games and urged the students to drop what they were doing and go have some fun. While the students played, faculty worked on revising the curriculum to make it more manageable for the students.

Lesson #3: Assessing fit is crucial. Olin learned early on that its approach to engineering education is not for everyone—and that applies to both students and faculty. In a recruiting environment where Olin could have filled its classes with valedictorians and top-SAT scorers, it needed a way to assess which students had the creativity and entrepreneurial spirit that would be needed in its design-based and self-actuating curriculum. Enter Candidates’ Weekend, a required weekend of activities held annually for top admission candidates, where they could experience how different Olin’s design-based curriculum is and demonstrate teamwork and creativity.

Pleased with the success of Candidates’ Weekend for determining good student fit with Olin, the college decided to hold a similar event for faculty, bringing together 16 candidates it was thinking of hiring over two sessions in a week in early spring. The college tried hard not to make it a competitive experience. That effort was helped along by the fact that the candidates were from different fields, so they didn’t feel they were in a competition for a “slot” on the faculty. The college was very pleased with the hires it made with this process, which had the added benefit of producing a higher yield of candidate acceptances of offers of employment.

Lesson #4: Sustaining continual innovation requires ongoing commitment. Each year Olin holds a faculty retreat that includes a review of the effectiveness of its educational model. Through extensive discussion, faculty develop proposals for improvements based on all available assessments. This process has already resulted in significant change and reinvention of several aspects of the educational model.

The faculty have also established a standing committee on curricular effectiveness to continuously monitor and suggest improvements in the educational program. As a result, Olin renews and replaces its courses at a very high rate.

Even this, however, isn't always enough to achieve a robust internal culture of continuous improvement. The college must deal with constant pressure to conform to conventional educational models, along with budgetary demands that strongly favor avoiding risk and extra cost and the need for reliable metrics to drive decisions in many areas. Olin is not alone in facing these challenges.

When Olin College was brand new, it had no identity, no legacy programs, nothing to lose by trying new ideas. Openness to change was relatively easy; it didn't cost very much in terms of letting go of cherished programs or ideas. As the college grew, however, it established several programs it now considers essential to its institutional identity, programs that it would find hard to change or eliminate. These include Candidates' Weekend, the Design Stream (courses instilling design thinking), Expo (twice-a-year celebrations of student learning), and SCOPE (the senior year capstone project in which students work in multidisciplinary teams to develop innovative solutions to a partner company's real-world problems). As a result, it is a much more difficult proposition today for Olin to imagine rethinking its educational model than it was early on because it would require considering the elimination of many successful programs.

It is for this reason that the establishment of a strong internal culture of continuous improvement is so challenging today, despite Olin's commitment to developing this culture and creating an institutional framework to encourage it. The risk is high that as time passes the college will find it increasingly difficult to embrace substantive change. This is particularly true when the change needed will result in an increase in effort and time to teach a subject that is currently taught in a manner that is less demanding.

To combat this institutional inertia, it is essential that the college work to establish and improve its metrics for assessing outcomes. If the college can develop such a metric or metrics, there is great potential for guiding not only Olin's internal program development but also for influencing other institutions. For example, a metric that could reliably assess the effectiveness of design education or creativity in engineering could be both useful and influential. **Lesson #5: Open the doors and spread the word.** As the college gains experience, Olin is also sharpening the focus of its mission to extend its learning model to other institutions. Toward that end, Olin has developed the Collaboratory, which is dedicated to stimulating transformational educational experiences with and for other institutions. Since the Collaboratory's creation in 2009, more than 2,000 educators from 750 academic institutions and 50 countries have come to Olin to learn from its experiences. Olin encourages these faculty visitors to construct their own approaches to education by experimentation with fresh approaches that conform to the unique institutional environments and constraints at their home institutions.

The results so far are encouraging. The Collaboratory

has been the inspiration for changes in faculty behavior at dozens of other universities. Olin has influenced thought leaders in educational innovation and faculty practice, and transformed the learning experiences of thousands of students worldwide.

There remain doubts, though, about the scalability of Olin's learning model and the extent to which it may be influential in larger universities. To explore this, Olin College entered into a partnership with the University of Illinois at Urbana-Champaign, a large research university. The initial results from this project were positive, as about 1,500 entering freshmen experienced a major change in their learning model. Olin and Illinois faculty worked side by side to develop pilot courses at Illinois. The results have been sufficiently successful for Illinois to expand the project to include hundreds of additional students. Still, in a learning environment of 44,000 students, it was a modest program.

To further test the scalability of its model, Olin initiated long-term collaborations with other schools, including the University of Texas at El Paso, an institution that serves a very diverse student body, and Insper, a leading center of education and research in Brazil. The Insper collaboration began at Olin's Summer Institute, a weeklong interactive workshop for faculty teams engaged in curricular change. Insper wanted to create an innovative engineering program because Brazil struggles with high dropout rates for engineering students. Faculty from both institutions traveled back and forth to collaborate on curriculum development. Olin acted as a consultant but did not impose content and courses. Some courses were modeled on Olin's, but with unique and necessary changes. Most of the work was conducted by Skype and email, but there were also in-person meetings, and four Olin students traveled to Brazil for several months to help prototype the curriculum.

Although many of these marquee partnerships have been in engineering education, not all those who engage with Olin are STEM-focused. Institutions of all kinds—from K-12 to liberal arts—have found value in the educational principles that permeate the Olin education: design-based team learning, entrepreneurial thinking, intrinsic motivation, and the empowerment and autonomy of students to construct their own authentic understanding through experiential learning.

Because the heart of Olin's innovation is focused on *how we teach*, those outside engineering are looking to Olin for inspiration in how to innovate in higher education more broadly. I am excited to see where this takes us, as new opportunities present themselves to inspire innovation in teaching and learning methods in many fields in the next 20 years, while we continue to focus on engineering education as the platform for experimentation on our campus.

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