The Role of Collaboration in Spreading Culture Change in Teaching and Learning

by

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"Your men and women who are teaching are not fundamentally teachers of subjects; they are fundamentally teachers of persons. And the great passion of the teacher should not be the passion of the language that he teaches, or the literature that he teaches, but the passion of the life that he is shaping, with the language and the literature ...[1]"

Summary. In a previous white paper[2], we traced the history of efforts to change the content and pedagogy of engineering education in the U.S. over many decades. In recent years, many institutions have attempted to create innovation in teaching and learning in engineering, including the National Science Foundation. In general, these efforts have met with limited success. Historically, the focus has been on making change to individual courses with an emphasis on extrinsic rewards (usually an external grant). However, there is a growing consensus that a broader change is needed. This change requires a shift in learning culture, not just in course content. In this paper, we make the case that culture change in an existing organization is a difficult and long-term process involving changes in values and intrinsic motivations of the faculty, since all curricular change within a university must originate with them. We also believe that changing values and motivations is complex and uncertain at best, and requires experiences that are personal and emotional, not just cognitive. Repeated immersion in a community with a critical mass of like-minded innovators enables the use of personal example, role-reversal, and peer pressure to open minds and hearts to a possible new set of values and beliefs. This requires the existence of a "collaboratory" where such a community may thrive and influence willing newcomers who seek to become innovators in their own institution. The experiences at Olin College of establishing such a collaboratory are explained and lessons learned are presented, although we are still quite early in our journey in this direction.

The Need for Change in Learning Culture. There is a growing consensus among deans of engineering that it is time to broaden the undergraduate curriculum beyond the traditional narrow focus on applied science and mathematics to include such subjects as design and creativity, teamwork and leadership, entrepreneurial behavior, service learning, interdisciplinary and systems thinking, and global perspectives[3]. David Goldberg has identified "seven missing basics of engineering" in a recent TED talk[4]. We believe that engineering is not fundamentally a body of knowledge. It involves a body of knowledge, of course, but engineering is fundamentally a process. However, the traditional engineering curriculum for generations now has been taught with courses intended to transmit technical knowledge with a surprisingly small percentage of the engineering curriculum devoted to the engineering process through experiential learning.

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1 McDowell, William Fraser, Remarks from an address quoted in the Proceedings of the First Annual Meeting of the Association of American Colleges, Chicago, IL, January 1915.

2 Miller, Richard K., *The Challenge of Spreading Innovation in Teaching and Learning: Why Is It So Hard, and What Can Be Done About It?,* Olin College of Engineering, November 2011.

3 See the description of the Grand Challenge Scholars Program on the National Academy of Engineering website: http://www.grandchallengescholars.org

4 TEDxUIUC, David E. Goldberg, 7 Missing Basics of Engineering, February 19, 2011: http://tedxtalks.ted.com/video/TEDxUIUC-David-E-Goldberg-7-Mis;search%3Atag%3A%22tedxuiuc%22

In recent years, an emphasis on a first-year engineering course involving projects has proven to be successful in many universities, and appears to be spreading reasonably well across institutions. Acceptance of project based learning in this introductory course is growing. Similar efforts are growing to add a course in "service learning," where small groups of students go out into the local community to find opportunities to make a positive impact. The experience frequently provides inspiration and context for students, resulting in more persistence and determination to succeed in the challenging technical subjects. More recently, efforts are growing to add another course to the undergraduate engineering curriculum in entrepreneurship. These add-on courses compete for space in the very crowded curriculum currently occupied with more technical subjects. Furthermore, most current faculty members in engineering were not exposed to these subjects in their own education or careers. This causes obvious difficulty in adoption of such curricular changes, since in essentially every university, the faculty must initiate and vote on any changes to the curriculum. In the end, faculty can only teach what they know.

Beyond adding these courses, newer models of learning are demonstrating the power of design thinking, intrinsic motivation, flipped classrooms, and internet-enabled online learning communities as emerging methods of teaching and learning. The resulting stream of new concepts in learning models seems to be accelerating, requiring major shifts in the culture of teaching and learning in universities. The approach of occasionally making incremental additions to the curriculum to keep up is arguably no longer viable. Furthermore, the public is demanding more emphasis on effective teaching as tuitions continue to rise and students leave college with increasing levels of debt. The time is right to make substantial investments in reform of teaching and learning.

At the heart of the struggle to keep up are the values and motivations embedded in our universities. In recent decades, research funding, publications and graduate education have been valued and respected more than excellence in undergraduate education[5]. New faculty members have been selected for generations based on a narrow focus on their technical competence and promise for future success in receiving competitive research funding. As a result, reaching a consensus among the existing faculty on the need for comprehensive reform in undergraduate education is a very difficult undertaking. The needed changes are often perceived by existing faculty members as a watering-down of the technical strength of the curriculum. In addition, the new areas (e.g., missing basics) are areas that are largely outside the competence and comfort zone of most engineering faculty today. So, if new material is added to the curriculum in these areas, the potential exists that faculty members may be required to teach subjects for which they do not feel qualified. Since the current paradigm assumes that an education consists of a series of courses taught by faculty members who were hired specifically for their expertise in the subject they are assigned to teach, this creates a very difficult gridlock.

However, what if we adopted a completely different paradigm for teaching and learning? What if an education in the 21st century had less to do with transferring specialized knowledge, one course at a time, and more to do with transmitting the **ability to learn independently**[6], in an adaptive and intrinsically-motivated way? (This kind of learning is largely characteristic of graduate education in our research universities today. It is also quite similar to the approach taken in the Montessori Schools in K-12. It is not a new idea.) In that case, the role of the teacher would shift from the provider of expert knowledge, to the coach and facilitator of small teams of independent learners. This is now popularly referred to as a shift in the role of the teacher from the "sage on the stage" to the "guide on the side[7]."

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[5] For example, the US News & World Report ranking of the top engineering programs at major universities are based largely on the strength of the faculty in research and graduate education almost to the exclusion of metrics in undergraduate education.

[6] This shift in the role of the teacher from expert providing coverage of every aspect of knowledge that might be needed for a 40-year career, to a guide through the process of learning **HOW** to learn independently, has been made in other fields many years ago. For example, the New Pathway program at Harvard Medical School pioneered a major shift in learning paradigm that is similar to the one outlined above for engineering, and they did it more than 25 years ago. (Tosteson, Daniel C., et al., *New Pathways to Medical Education: Learning to Learn at Harvard Medical School*, Cambridge: Harvard University Press, 1994.)

[7] King, Alison, 1993, *From Sage on the Stage to Guide on the Side*, **College Teaching**, Vol. 41, no. 1, pp. 30-35.

This model of teaching and learning is quite similar to the dominant model in place now at Olin College and a growing number of other institutions. However, it requires a major change in identity and role of the faculty members involved. No longer are they seen as experts in everything they teach. Occasionally they are in front of a class where the students know more about the details of a topic than they do(!). No longer do they stand in front of a class as the font of all wisdom, omnipotent in their expertise and ability to derive the answers to all questions from scratch at the whiteboard. For those who have spent many years in this traditional role of expert, commanding automatic respect from the class through their lofty academic credentials and command of every detail of the technical subject at hand, this requires a major change in identity and role. It is an emotional experience as well as an intellectual challenge to master the art of teaching in this new, more nuanced approach.

Many, many questions arise in preparing to teach in this mode. For example, if I am not an expert in this topic, why should the students listen to me at all? What do I bring to the role of teacher that adds any value? Why should they respect me? How will I control the class and maintain order if they don't see me as an expert? How will I evaluate their work if I am not an expert in the field? Won't they justifiably challenge my judgment in assigning course grades? How can I motivate them to challenge themselves to learn and excel in their field? Won't this just spiral downward into a sea of mediocrity where amateur teachers attempt to lead inattentive students in subjects they really don't understand? How will we establish and maintain a culture in which aspiring to the highest levels of academic excellence and achievement is the norm, if each faculty member doesn't have a national reputation in the subjects s/he teaches?

While these are all excellent and reasonable questions, the primary answer lies in the quote from nearly one hundred years ago by William Fraser McDowell to an audience of college presidents assembled for the inaugural meeting of the Association of American Colleges: *"Your men and women who are teaching are not fundamentally teachers of subjects; they are fundamentally teachers of persons. And the great passion of the teacher should not be the passion of the language that he teaches, or the literature that he teaches, but the passion of the life that he is shaping, with the language and the literature ..."* Said another way: students don't care what you know until they know that you care. And when they feel that you care first about their professional and personal development, they are more often inspired and empowered to accelerate their learning and exceed expectations. Without the student perception of sincere faculty passion for them and their learning, students are often intimidated by faculty intellectual prowess, rather than inspired by it.

The results obtained to date in student outcomes at Olin College indicate that a learning model based on this new culture works well, and in fact produces exceptional results not just in academic achievement but also in maturity, confidence and intrinsic motivation. In fact, nearly everyone who has visited the Olin campus and spent time one-on-one with our students reports that they can clearly see the impact of this culture first hand. It is direct observation of the effect of the learning model on our students that is most responsible for the growing interest in the learning model at Olin. Some observers have even coined this student behavior as the "Olin Effect[8]."

To spread this new model for teaching and learning requires a major change in culture among at least some of the faculty. It is not about making a change in the course syllabus here and there, or even in the list of courses. It is not about adding a course in X or in Y. It is about changing the role that faculty members play in all courses, in changing their personal identity, their values and motivations, their relationship with students and each other, and their teaching skill set. The result is a learning model that is based on a new culture of learning, not on curricular details. We believe this is what the late Chuck Vest[9] meant when he said[10]:

[8] Goldberg, David, and Somerville, Mark, *A Whole New Engineer*, forthcoming.
[9] President Emeritus of MIT and former President of the National Academy of Engineering.
[10] Vest, Charles M., *Educating Engineers for 2020 and Beyond*, **The Bridge**, Vol. 36, no. 2, 2006.

"…my primary advice regarding engineering education is that making universities and engineering schools exciting, creative, adventurous, rigorous, demanding, and empowering milieus is more important than specifying curricular details…"

What Is Culture? How Can It Be Transferred? Culture is an abstract concept. In the sense we intend here, it is an integrated system of learned human behavior patterns which are characteristic of the members of a community and which are not a result of biological inheritance[11]. This behavior is based on shared values, beliefs and motivations. There is a sense in which culture is manifested in the general and intrinsically motivated adherence to a set of behavioral norms that are extrinsically unenforceable. It results in a set of attitudes and behaviors that are generally recognized within the community as "appropriate" or "inappropriate" in various circumstances.

For the learning culture described in the previous section, there is a strong underlying belief that the institution should be student centric, not faculty centric. The principle that is used to ultimately determine all major policy decisions is what is in the best interest of the students. The community also believes that—in addition to providing a base of knowledge—the purpose of an education is to empower students to learn independently, to inspire them to take initiative to make a positive difference and to help them learn to be persistent and resourceful in facing complex problems while working as an individual or a member of a group with diverse abilities and world views. The role of the teacher is to guide, coach, tutor and mentor students to develop these abilities.

How does one learn and adopt a set of cultural values? While reading and studying the ideas involved may play a role on a cognitive level, it is likely that only through significant immersion and personal experience do beliefs and behaviors like this become internalized. The alignment between the general principles and the observed behavior patterns of many members of the community is important on many levels. However, like learning to ride a bicycle, it is essential to go well beyond an intellectual understanding of the principles to personal experience of failure, persistence, and eventual success, with a mentor at your side, to develop the skills necessary to teach and learn effectively in this alternate culture.

While there is no known algorithm for assuring transmission of cultural values and behaviors, the power of peer pressure to mold and shape behavior is well known. Peer groups are known to provide a strong influence on teenagers. The power of social reinforcement in study groups has also proven to provide a surprisingly strong influence on learning culture and success[12]. Children are deeply influenced by the culture established at home by their parents long after they leave home. Even prisoners held captive for a significant period are known to form a bond with their captors, adopting elements of their values and motivations. There is little doubt that immersion in an environment where a new set of values and motivations are consistently modeled and expected, coupled with personal experience and practice, offers potential for transmission of culture.

The Role of Institutional Collaboration in Transferring a Culture of Teaching and Learning. Given the importance of immersion in an environment where the learning culture is dominant in the process of culture transfer, there is clear potential value in a collaboration between (A) an institution wishing to create a culture change, and (B) an institution in which the desired culture is dominant. First, someone must create a critical mass of faculty and students that live and breathe the new learning culture (B) before it can be transferred. Only after the new culture has been firmly established at (B) is a process of transfer from (B) to (A) possible.

[11] Hoebel, Adamson. Anthropology: Study of Man.
[12] The Posse Foundation identifies minority students with qualities that do not show up in traditional college admission criteria and sends them in groups of ten as a supportive multi-cultural team—a "posse"—to selective colleges and universities where they graduate with remarkable success. www.possefoundation.org.

However, the transfer process is rich with complex challenges, ambiguity and uncertainty. For example, exactly which aspects of the learning culture are essential and which are unnecessary? Is it necessary to adopt all the aspects simultaneously, or can they be introduced in some sequence? How many faculty members from (A) does it take to create a sustainable sub-community within (A) that adheres to the new culture? What is necessary to shield and protect this presumably fragile sub-community from being overwhelmed when they return to (A) to prevent them from abandoning the new culture? How long does it take for the nascent new sub-community to become sufficiently robust that it no longer needs protection? How does the new sub-community then penetrate the traditional culture of the institution and eventually become the dominant culture at (A)? What are the key predictors of success in efforts of this type, and where are the case studies of institutions that have successfully achieved culture change at scale?

It is important to point out that the transfer and spread of culture is much more difficult than the transfer of ideas. Ideas may be transmitted in media such as books, videos, or lectures. But culture requires internalization of values and motivations and the development of skills and behaviors through experience. It requires a change not only in what you know but also in who you are.

Since managing the process of culture change is of great importance in many contexts, including corporate mergers, creation of distinct innovation communities within large companies, and the establishment of large regions known for innovation (such as Silicon Valley), there is rich literature in this field. One of the classic books is Diffusion of Innovations by Everett M. Rogers. This book, in its 5th edition, deals with both the spread of ideas and technologies, such as the internet. It focuses on the importance of word of mouth from colleagues in forming the initial decision, and identifies the concept of "early adopters" and "laggards" in the evolving spectrum of acceptance over time. A more recent book that provides important insights into the spread and acceptance of new ideas and products is Malcolm Gladwell's book The Tipping Point: How Little Things Can Make a Big Difference. This book, published in 2000, explains the spread of acceptance of new ideas and products as analogous to the spread of a virus. Among the informative examples treated in the book is the drop in crime rate in New York City after 1990 through a deliberate process of culture change in the affected neighborhoods.

A quite recent book that provides new insights into the transfer of ideas and culture is Social Physics: How Good Ideas Spread—The Lessons from a New Science, by Alex (Sandy) Pentland of MIT. Social physics is about *idea flow*, the way human social networks spread ideas and transform those ideas into behaviors. Pentland has developed methods of using Big Data to monitor signs of communication and collaboration and the flow and acceptance of ideas and practices. These new tools promise to provide a great improvement in future understanding of the underlying processes involved.

Great collaborations require collaborative leadership—a subset of the overall leadership—that focuses on maintaining conditions for innovation and trust. This focus is aimed at the system, not necessarily the people in the community. A useful metaphor here is that of the symphony conductor who is skilled at, among other things, managing divas. The leader can be in the background, but integrates all the elements that produce collective intelligence and execution.

Furthermore, great collaborations don't just happen. They are carefully designed and managed, like theater. The leadership takes time to set the stage, create the guiding values, sequence the events and topics, select and prepare the leaders, etc., to achieve a desired community outcome. A good example of this is FIRST Robotics[13], which engages students for a relatively short time in group design activities and competitions, but creates a culture that has lasting effects. Its' values include confidant humility and curiosity.

But none of the books above deal with the special conditions within a university, where academic freedom and shared governance are the norm. In universities, faculty hiring is done by peer groups, not managers. Changes to the curriculum require a majority vote of the faculty before they can be launched.

[13] http://www.usfirst.org/roboticsprograms/frc

The focus on individual contributions in research and publications discourages teamwork and collaboration, with a connotation of cheating or inappropriate behavior. And faculty members with tenure cannot be fired or forced to retire. These factors combine to cause a remarkable slowing of the rate of acceptance of major new innovations. For example, the initial introduction of natural science as a core subject was resisted for decades by faculty members at Harvard University. The introduction of "modern languages" (German, French, Italian, Spanish, etc.) was so firmly resisted by the faculty at Ivy League universities that Thomas Jefferson had to start a new university (the University of Virginia) in order to introduce them. And the establishment of land grant universities in the 19th century to provide access to higher education to all social classes was resisted by faculty at elite private universities, requiring the establishment of a new tier of public universities in America[14].

Olin College Collaboratory. In late 2009, Olin College created the Initiative for Innovation in Engineering Education (I2E2), under the direction of Professor Lynn Andrea Stein, to serve as the outreach of the College to the many unsolicited visitors to campus. These visitors, the majority from abroad, had heard about the efforts to establish a new paradigm for engineering education at Olin, and wanted to see for themselves how the project was going. Since then, the number of different visiting institutions continues to grow each quarter and has totaled more than 300. Many of these visitors have a keen interest in establishing a student-centered culture of learning on their campus and they have asked for assistance.

In response to the growing demand, Olin College renamed the I2E2 program as the Olin College Collaboratory to better reflect the activities underway. The Collaboratory has become an important vehicle for collaboration with like-minded faculty members from around the world who are planning or initiating innovations in teaching and learning on their campuses. The goal of the Collaboratory is to serve as a catalyst for change and innovation in learning culture at many universities.

It is important to note that the Collaboratory does not attempt to promote the adoption of courses or projects as they are implemented at Olin. Instead, it encourages faculty members from other institutions to consider a shift in role from lecturer to coach, and from this starting point with full awareness of the student characteristics and resource limitations at home, design a fresh approach to learning for their institution that maximizes student engagement.

In collaborating with other institutions, we are keenly aware that education is a localized, contextualized endeavor. It needs to fit the culture of the surrounding institution; it needs to address the students where they are; and it needs to be owned by the faculty members who will scaffold and structure it. There are examples of curricula packaged up and "exported," but these rarely take hold unless they are also accompanied by exported faculty members, and embedded in (often new) institutions that are culturally able to accommodate them.

Instead, to create curricular change (especially in established institutions), we find it critical to engage in co-design with the faculty members who will ultimately own the new curriculum. In co-designing curriculum, we are, of course, striving for student engagement, and this typically requires a shift in mindset by our partner faculty members. We are also looking to create a *culture* that values student engagement, and therefore focus on the *experience*—including pedagogy, classroom climate, out-of-classroom activities—rather than (exclusively or primarily) the content of the syllabus.

A school that ultimately engages in a serious curricular project with Olin typically proceeds through a few stages: introduction/**encounter**, **immersion**, and **implementation**.

In the introductory encounter, a school visits our campus (perhaps more than once) and experiences the Olin culture. The centerpiece of this visit is our *Campus, Curriculum, Culture* walking tour, a

[14] Markus, Jon, *Old School: 400 Years of Resistance to Change*, Reinventing the American University: The Promise of Innovation in Higher Education, American Enterprise Institute, Washington, DC, June 3, 2010.

student-guided exploration of our curriculum and culture via a directed visit to our Academic Center. Visitors learn about our hands-on project-based curriculum, see our studio pedagogy, and come to understand the spectrum of activities that form our learning continuum (from extra-curricular activities to student-initiated passionate pursuits to faculty- and staff-led co-curriculars to the curriculum itself). The walls and halls of our Academic Center speak volumes about the nature of the Olin experience; our student guides provide living examples of impact. While each visit typically includes conversations with faculty members or academic leadership, it is the student conversations that consistently impress visitors most.[15]

Once a school has come to believe that change of this sort is possible, the next step involves a deeper immersion in Olin culture. Our week-long Summer Institute program is perhaps the most common way in which schools pursue this. During one intense week each June, we immerse faculty participants in bits of Olin curriculum, ask them to reflect on their experiences, scaffold their own curricular design experiences, and provide tools and frameworks to help them to take these ideas home. Initially, participants believe that they are attending the Summer Institute in order to acquire the specific tools and techniques of which Olin's curriculum is formed. However, over the course of the week, they undergo a shift in attitude, increasingly appreciating that it is a change in their mindset that will be the most critical take-home from the program. Chua and Dringenberg[16], who interviewed Summer Institute participants at various points during the week, refer to this as seeking the magical Olin Phoenix, then recognizing that Olin has merely painted our local wildfowl (turkeys), and finally that they can paint their own wildfowl (penguins) when they return home.

Finally, schools with which we engage deeply undertake a longer, more significant process of designing and implementing new curriculum. These experiences often include workshops that Olin faculty members run at the partner institution; experiments in curricular design and implementation supported by consultation with Olin faculty members before, during and afterwards; or even a longer-term embedding of an Olin faculty member at the partner institution or vice versa. Professor Shane Walker (University of Texas at El Paso) describes his progress from observing (on his first visit to Olin, transforming his vision of a different kind of education) to immersing (in Olin's Summer Institute, which gave him some understanding of how that education could be implemented) to executing (during a semester as an Argosy Fellow at Olin, teaching a core course in Transport Phenomena). Although he *believed* (from his visit) that student-centric approaches could work and *knew* (from the Summer Institute) that they did work, it wasn't until he put these methods into practice (with plenty of trial and error) that he really *took ownership* of this approach.

We've seen this pattern repeatedly, including at the University of Illinois (iFoundry), Singapore Polytechnic (several programs), and Creighton University (Energy Technology Program); it is underway now at University of Texas at El Paso (Leadership Engineering), Insper (new engineering program), Thomas More (Community Service Engineering), and Purdue University (College of Technology). To varying degrees, it also describes our experiences with Harvard (SEAS), Cal Poly San Luis Obispo (Materials Engineering), TU Delft (Aerospace Engineering), and even in our Three-College Collaboration with Babson and Wellesley Colleges.

Shane Walker highlights the following important aspects of Olin culture:

- Faculty treat students as collaborators and colleagues in a learning experience.
- Intrinsic motivation—supported through autonomy, mastery, and relatedness—is essential to creating this culture among students and between students and faculty.

[15] Ironically, it is also common for visitors to tell us in advance that they do not need "a campus tour" or interaction with students. We have learned to ignore this, and rebranded these activities precisely to avoid any argument.

[16] Chua, Mel, and Dringenberg, Emily, *The Quest for the Mythical Phoenix: Attendee Narratives at an Engineering Education Faculty Workshop*, submitted for publication.

- Reflection is critical to making the experience meaningful and to learning from it. Failure is an opportunity to reflect and improve, creating more profound learning.

- "*Previously I thought of myself as a technical expert. Now I see myself as a coach."* (Walker) There's a shift in emphasis from what the faculty member does to what the student does and is able to do.

He also emphasizes the importance of regular deliverables, which provide scaffolding and support.

Lessons Learned. Through experience in collaborating with numerous institutions in the past several years and comparing observations with others involved in similar activities, we have developed a tentative list of lessons learned about transferring learning culture in higher education through collaboration. These include:

1. Successful collaborations always start with willing and like-minded potential partners. It is rarely fruitful to reach out to an institution and suggest that they consider working with us to initiate change on their campus.

2. Among willing potential collaborators, pre-requisites for successful collaboration include: (1) alignment of values and purposes; (2) adequate resources to succeed; (3) willing and enlightened faculty leaders on the ground; (4) active support from administration; (5) adequate “chemistry” between partner faculty and Olin faculty; and (6) adequate faculty bandwidth at Olin, including at least one Olin faculty member willing to spend significant time on site at the partner institution. (Collaboration at Olin always involves leadership and engagement from regular, full-time permanent faculty members. We do not hire part-time faculty members to lead and staff such projects.)

3. Realization that the change is not about the curriculum, but the learning culture. Copying a course syllabus misses the point, and rarely results in sustainable change. Successful changes have always involved total immersion experiences and a substantial degree of change in relationship and identity between faculty and students.

4. We suspect that it is easier (perhaps necessary) to do this by attempting a major shift in thinking, not an incremental change to a course or two. Comprehensive change in a small unit rather than incremental change throughout a large unit seems to have a better chance for success.

5. Olin’s comprehensive view includes simultaneous and integrated approaches to changing three fundamental things in undergraduate engineering education. We believe there are problems in all three of these areas: (1) nationally, we are not attracting the right people into the study of engineering; (2) we are teaching them the wrong stuff; and (3) we are using methods that are largely known to be ineffective. When we approach all three at once, culture change is easier, and success is more profound and immediate.

6. Sustainable success requires patience and sustained investment, often for several years. Deans and administrators not willing to make long term investments are very likely to be disappointed in the end. Lasting change always involves significant changes to the learning culture and ultimately, to the degree programs. This institutionalizes the new ideas and approaches in ways that will survive changes in individual faculty leaders and deans.