Spreading the Fire: Broadening Faculty Support for the Entrepreneurial Mindset

John-David Yoder and Robert Kleine,
Ohio Northern University
Don Carpenter, Lawrence Technological University
Cynthia Fry, Baylor University

ABSTRACT

Lawrence Technological University, Baylor University, and Ohio Northern University are members of the Kern Entrepreneurship Education Network (KEEN). KEEN schools are focused on instilling the entrepreneurial mindset in their undergraduate engineering students. While colleges and universities across the country take a variety of approaches, these three schools have focused on faculty development efforts. These schools presented at NCIIA previously on their initial efforts at faculty development. In this paper, each school will present progress on moving beyond the impact of faculty “champions.” While all three schools have taken different approaches, techniques will be discussed that have been used to encourage faculty to incorporate aspects of the entrepreneurial mindset into existing engineering courses. Assessment and tracking of progress will be presented as an integral piece of the faculty development. Faculty development efforts have influenced other network schools through translational opportunities and outreach. This collaborative effort has broadened the impact of the approach.

Introduction

One of the programs funded by the Kern Family Foundation (http://www.kffdn.org/) is the Kern Entrepreneurship Education Network (KEEN). The focus of this program is to instill the entrepreneurial mindset in engineering students at private, ABET-accredited universities. As of 2012, there are 19 universities in KEEN across the United States. While schools in the network are using a variety of strategies to instill this mindset in their students, the focus of this paper will be faculty development efforts at three of the network schools.

Broadly, the strategy of using faculty development relies on three main tenets. First, that faculty development activities get faculty excited and knowledgeable about instilling the entrepreneurial mindset in their students. Second, that faculty who have experienced those activities will carry that excitement back to the classroom and make changes in a variety of courses throughout the curriculum. Thirdly, that we are able to measure the impact that this has had in terms of instilling the entrepreneurial mindset in our students.

This paper will define the entrepreneurial mindset from the perspective of KEEN and discuss how the three schools have used faculty development as the catalyst to create change on their campuses and others.
The Entrepreneurial Mindset

There is wide agreement that the US engineer of the future will have different attributes than the stereotypical 20th century engineer. The attributes of the 21st century engineer have been described in many documents, including The Engineer of 2020 (National Academy of Engineering 2004), ASCE’s Body of Knowledge for the 21st Century (2008), and ASME’s “Vision 2030” (Wepfer and Warrington 2010), among others. These attributes include the technical knowledge that all engineers should have and are included in traditional engineering curricula, and other characteristics related to what have often been called “soft skills” or professional attributes, including communication, leadership, and entrepreneurial skills. KEEN views the entrepreneurial mindset as the most critical, and currently unmet, need in undergraduate engineering education.

The entrepreneurial mindset as defined by KEEN consists of seven student outcomes. It is expected that engineering students graduating from KEEN universities will have demonstrated the ability to:

1. Effectively collaborate in a team setting.
2. Apply critical and creative thinking to ambiguous problems.
3. Construct and effectively communicate a customer-appropriate value proposition.
4. Persist through failure to learn what is needed to succeed.
5. Effectively manage projects and apply the commercialization process.
6. Demonstrate voluntary social responsibility.
7. Relate personal liberties and free enterprise to entrepreneurship.

These seven outcomes are meant to supplement, not supplant, ABET’s a-k student outcomes, as well as any other outcomes required at each respective university. It is also worth noting that there is some overlap with ABET outcomes, notably in the first outcome.

The authors firmly believe that students with the entrepreneurial mindset will be far better equipped for their careers over the next 40 years than their peers, regardless of the field they choose to pursue. It is critical to note that none of the outcomes above are valuable only to entrepreneurs. KEEN is about the entrepreneurial mindset, not creating entrepreneurs. While a “side effect” of instilling the entrepreneurial mindset in all our engineering students may be that more of them become entrepreneurs, this is not the goal of the program, nor the way in which success will be judged. It is also important to realize that the addition of a minor, or some additional electives, will not satisfy the goal of KEEN, which is to impact 100% of engineering undergraduates at our universities.

For these reasons, the authors and their institution administrators feel that to make a sustainable impact on our universities, the faculty must be convinced that the entrepreneurial mindset is beneficial to our students. All three schools have focused on faculty development as a major component of our KEEN programs. The ultimate goal is to build toward the point where the entrepreneurial mindset is embedded in a large number of required and
elective courses in the engineering curriculum, so that students are exposed multiple times. This is important for three reasons:

1. There is evidence that multiple touchpoints for a topic produce better learning than something covered only in one course (DiBiasio, Clark, and Dixon 1999).

2. By seeing that the entrepreneurial mindset is related to a variety of engineering courses, students realize that the entrepreneurial mindset is simply part of being a good engineer—not a skill set that only applies to, for example, engineering economics.

3. Having this content be pervasive in the curriculum makes the program more sustainable. If the content is only in the course of one or two “champion” faculty, then the content is at risk of being replaced if those faculty leave, or are assigned different teaching duties.

Therefore, the goal must be to have a large number of faculty teaching the entrepreneurial mindset. KEEN is convinced that this needs to be a “bottom-up” effort, rather than be dictated from administration (although administrative support for the effort is also important). This bottom-up approach requires faculty development to ensure that they understand the entrepreneurial mindset, why it is a benefit to their students, and how they can bring that content into their existing courses. This paper focuses on the effort to accomplish this at three of the KEEN schools: Lawrence Technological University (LTU), Baylor University (BU), and Ohio Northern University (ONU). These three schools have taken slightly different approaches to faculty development, which will be described in the following pages.

### Lawrence Technological University

Lawrence Technological University is a private non-affiliated institution located in Southfield, Michigan with a motto of “Theory and Practice.” The school has approximately 3,000 undergraduate and 1,200 graduate students and prides itself on professional programs such as engineering and architecture. Lawrence Technological University is in the fourth year of a five year process to modify 75% of the courses in the engineering curriculum to include Active and Collaborative Learning (ACL), Problem/Project Based Learning (PBL), and entrepreneurial mindset elements. Aside from traditional engineering courses, such as statics and mechanics, the modified courses include those in our general education core curriculum, such as calculus, history, literature, communication, and the sciences. As such, this robust and widespread course modification process involves more than 50 faculty members from multiple departments and colleges. Multiple faculty development techniques have facilitated this transformation, including intensive week-long workshops, one-day entrepreneurial mindset workshops, report-out accountability sessions (internal peer-review), closing-the-loop sessions, support teams of faculty from related content areas, and mini-workshops for lateral spread of course content.

Faculty members were selected for program inclusion by a committee of faculty and administrators. Faculty were selected based on probability of success (early adopters) and by identifying key courses within the engineering curriculum. In some cases, faculty declined the invitation and were not included in the process. A small stipend and course release time was offered over a
two-year period as an incentive for faculty to join the program and provided the resources necessary to make the proper course adjustments. Each academic year, a new faculty cohort (approximately 12 to 15 faculty) is formed, with additional courses being included in the program. Faculty cohorts serve as a mechanism for intellectual and emotional support and are considered critical to the success of the program.

Participating faculty members learn strategies for course improvement through multiple types of faculty development workshops. The primary driver is a one-week theme workshop. The theme workshop alternates each year between problem-based learning (PBL) and active and collaborative learning (ACL) techniques, which represent the two primary pedagogical techniques utilized during the course modification process. PBL reinforces the critical thinking/problem solving component of the entrepreneurial mindset, and ACL reinforces teamwork, communication, and critical thinking skills. Both of these techniques are frequently coupled with other elements of the entrepreneurial mindset, including customer awareness, social responsibility, project management, and business topics. These additional topics are introduced during the week-long workshop and also during the one day, entrepreneurial mindset workshop which is geared toward the entrepreneur side of the entrepreneurial mindset.

Faculty are grouped into related content cohorts (for example, three faculty who all teach statics or mechanics) for support and co-development of curricular materials. This measure was implemented after early faculty development programs were less successful because individuals lacked supportive disciplinary peers during the process. Faculty who have completed the program can become trainers/facilitators for future workshops or entrepreneurial faculty mentors (as described below).

Throughout the two year process, there are report-out accountability sessions (internal peer-review) that serve as either intermediate feedback steps or year-end closing-the-loop sessions. The mandatory year-end peer reporting presentations are based on the “plus/delta” format (Ledlow 2010), which allows for formal program evaluation as well as monitoring faculty participation. The plus/delta presentation format involves course instructors producing PowerPoint™ slides where they discuss the “plus” or positive things they experienced as part of the course modification process and the “deltas,” or items they would recommend improving. Improvements could be suggestions for the course modification program or specific to their course. The intermediate feedback sessions are focused more on what pedagogical techniques faculty have developed for implementation and what they should consider before offering their courses.

Mentorships and mini-workshops for lateral spread of course content have also been implemented. These sessions are less formal (brown bag luncheons, evening faculty development workshop for adjuncts, one-on-one peer instruction) and are meant to increase lateral spread of the content into other sections of a course or into similar courses. For example, a full-time faculty member in physics will hold a two-hour session with new adjuncts to demonstrate how entrepreneurial mindset modules should be implemented in their courses.
The program was evaluated using several techniques, including an annual best-practices symposium (scholarship), plus/delta presentations on course improvements (described above), and faculty surveys regarding their impression of the process upon completion of their two-year commitment.

**Baylor University**

Baylor University is a private, Baptist university in Waco, Texas, chartered in 1845. Baylor has nearly 13,000 undergraduate students and over 2,000 graduate students. Undergraduates can pursue 144 baccalaureate degrees spread among 12 academic units.

If faculty members do not adequately understand the fundamental changes occurring in the global economic landscape, as well as their importance (Hirleman, Groll, and Atkinson 2007), these topics will not be incorporated into the curriculum and may even be actively denied their place in the curriculum development process. In addition to providing the means to learn and discuss pedagogical techniques, several programs in Baylor University’s School of Engineering & Computer Sciences (ECS) have been put in place to accelerate the process of integrating the entrepreneurial mindset, including:

- The KEEN Innovators Program
- Engineering & Computer Science (ECS) Technology Entrepreneurship (TE) Fellows

**KEEN Innovators**

Through the KEEN Innovators program at Baylor University, selected faculty who have shown an interest are exposed to ideas that can help them develop an understanding of the needs facing the US today as it relates to the changing requirements for engineering success. Past publications have explored the beginning of the KEEN Innovators program, emphasizing integration of some of these skills in the various design courses (Fry et al. 2010). This paper will continue the discussion of the various faculty development programs and activities offered to those selected to be KEEN Innovators.

In the first two years of the KEEN Innovators program at Baylor (2009 and 2010), two new innovators were selected each year. They were exposed to many different methods of integrating the entrepreneurial mindset into their courses. These opportunities included a one-day workshop conducted by Dr. Jonathan Weaver from the University of Detroit Mercy on teaching creativity techniques. The Innovators also attended the annual KEEN Winter Conferences, and had opportunities to participate in the exchange of ideas on how to integrate some of these “soft skills” into their courses through a series of regional KEEN conferences. They were awarded a summer stipend to help compensate for the time required to synthesize what they had learned and their implementation approach to their classes.

During our charter year of 2009, instructors teaching the far-reaching design courses were selected with the objective of exposing as many engineering and computer science (ECS) students as possible to the entrepreneurial mindset. In the first year, of a total of 526 engineering students in the school, 361 of them, or 69% of them, were exposed to the entrepreneurial mindset.
The addition of the 2010 KEEN Innovators brought technical depth to our continuing innovations in the design sequence. This second cohort had access to the same one-day workshop as the previous year’s Innovators, and were also able to attend the 2010 KEEN Winter Conference. The two KEEN Innovators included new course objectives in their classes pertaining to innovation and creativity. These objectives can then be measured at the end of the semester to determine the extent to which the students developed an understanding of the concepts.

In the 2010-2011 academic year, the selection and stipend process were changed to increase our growth rate among the ECS faculty. Instead of awarding a stipend to two new Innovators, the program was expanded in the following way:

- Summer stipends available for ten new Innovators for the following required components:
  - One-day summer workshop.
  - Implementation plan developed and submitted, including assessment plan.
- From the ten implementation plans provided, four would be selected for additional funding:
  - Analysis of end-of-course assessment (raw data and analysis).
  - Travel to annual KEEN Winter Conference.

Current efforts include researching and collaborating on how best to present these key topics in a new way, without repeating what has been done in the past. The KEEN Innovators Program is now aligned with an internal teaching grant application process, allowing faculty to submit a proposal on how/where/why they will incorporate the entrepreneurial mindset into their undergraduate courses. In the past four years of implementation, the KEEN Innovators program has touched 100% of engineering and computer science undergraduate students.

For the longer-term impact, as Baylor maintains the momentum of a critical mass of engaged Innovators, the plan is to use this convergence of Innovators to allow assessment of the best ways to incorporate entrepreneurial concepts into the entire curriculum.

**Technology Entrepreneurship Fellows at Baylor**

One of Baylor’s current KEEN objectives was to buy out one course per semester for one additional faculty member in ECS to complete the efforts of the Technology Entrepreneurship Fellow. The spring 2012 TE Fellow coached several project teams and corporate partners through Baylor’s ENT 4340: Technology Entrepreneurship course. The TE course at Baylor is designed to bring together innovators who have a relatively unrefined technology business concept with teams of technical, business, and IP law students to do the research, planning, and validation needed to prepare an effective presentation and written business plan that will enable the innovator to attract the needed support to advance the concept (Leman 2011). The deliverables are tailored to the specific audience and context of the project owner—a corporate lab scientist will often present to an internal Stage-Gate® review team,
whereas an entrepreneur may be preparing for an SBIR grant application or an angel investor event. The project is not an assignment within the TE course—it is the course. The TE Fellow is the faculty coach who works with the student teams to make sure that the process is producing meaningful results for the client.

Our fall 2012 TE Fellow is currently teaching ECS’s feeder course to ENT 4340, EGR 4301: Global Business: Economics and Communication. This course is an innovative approach to synergistically teaching the requisite engineering economics content and professional communication content to students, who must apply what they are learning to a group project that is assessed not only by their team of instructors, but also by their corporate partners and a discipline-appropriate panel of judges.

These two courses work hand in hand to provide an alternative educational experience for students who desire a more intentionally connected learning environment. Both of these courses fulfill ABET requirements for the traditional courses in Technical and Professional Writing and Technical Speaking, as well as Engineering Economic Analysis. After several years of research, development, testing, and analysis, this two-course sequence was shown to provide the same or superior coverage of the material than the traditional courses (Fry and Leman 2010).

Ohio Northern University

Ohio Northern University is a private, Methodist-affiliated, comprehensive university located in Ada, Ohio. Over 3,500 students pursue studies in the colleges of Arts and Sciences, Law, Pharmacy, Engineering, and Business.

Ohio Northern University focused initial faculty development efforts on workshops to help faculty to understand the entrepreneurial mindset. As such, two workshops took place. Both brought in experts from across the country to discuss how they implement the entrepreneurial mindset. These included speakers from a variety of disciplines, such as Michael Morris (Oklahoma State) and MacRae Banks (North Carolina at Greensborough) from business colleges, Elizabeth Kisenwether (Penn State) and Anthony Marchese (Colorado) from engineering colleges, Mary Godwin (Babson) from the social sciences, Barbara Miner (Toledo) and Gary Beckman (South Carolina) from the arts, and Andrew Matheson, a theoretical physicist and entrepreneur.

On the first day of the workshop, the entrepreneurial mindset was introduced, and speakers discussed their successes in bringing the entrepreneurial mindset to their classrooms and their campuses. There was a shared meal in the evening, with the speakers spread out at separate tables. The second day consisted of individual faculty bringing syllabi from a course that they wanted to change. The faculty broke out by discipline, with the speakers working to help find ways in which the entrepreneurial mindset could be implemented in the courses.

Finally, the faculty reported back to the group about planned changes in the courses. This time led to a very productive discussion about interaction among disciplines and how best to disseminate the entrepreneurial mindset on our campus. All told, more than 50 faculty took part in these workshops, or nearly 25% of the faculty on campus. Surveys after the workshops indicated
that 80% of the faculty were very satisfied with the workshop experience, and 85% were very likely to recommend such a workshop to a colleague.

One clear finding is that follow-up with faculty who have made changes is critical to maintaining momentum. Early efforts at ONU were not as successful as they might have been because there was a lack of resources to follow up with, monitor, document, and reward faculty who successfully integrated the entrepreneurial mindset into their courses. This has been addressed in a variety of ways. First, each year there is a competitive process for grants related to the entrepreneurial mindset in classes. There are three levels of grants. The highest level requires a faculty member to modify the course outcomes so that one of the course outcomes is a KEEN student outcome. The second level requires the development of a module in a course. The modules are typically 1-2 weeks of a course related to one of the KEEN outcomes, and includes the creation of an artifact (homework, project, or laboratory) related to the outcome. Finally, the third level is for continued assessment existing courses in which entrepreneurial mindset content has already been added. More details on assessment will be provided later in this paper.

A KEEN committee made up of one member from each of the three departments in the College of Engineering reviews these proposals. This past year, there were approximately twice as many proposals as ONU was able to fund. Faculty who are awarded funding for their proposals will receive a stipend after the changes have been documented and the student work related to the entrepreneurial mindset has been assessed. The KEEN committee is responsible for tracking progress toward the proposal goals. Although this is only the first year of this model, it is clear that it is providing results far superior to prior years, both in the number of courses impacted, and in the volume of assessment data generated.

Development Across the Network

There are two additional workshops that exist across the network: Integrating the Curriculum with Entrepreneurial-Mindset (ICE) Workshops and Shaping Entrepreneurial Engineers (SEE) Workshops. The ICE workshops are theme-focused one- to two-day workshops on topics such as statics, biomedical, mechanics, and thermofluids. The ICE workshops bring 10 to 20 faculty from around the network together to explore how entrepreneurial content can be included in a technical course. In that regard, the ICE workshops are a mixture of a best practices symposium and a facilitated workshop, organized and hosted by individual institutions in the network.

The SEE workshops are one-day workshops on broader entrepreneurial mindset topics and/or pedagogies such as painstorming, creativity and innovation, societal values, ethical development, active learning, and commercialization. These workshops for 40 to 50 faculty of diverse backgrounds are facilitated by experts, since the topics tend to be more pedagogical and entrepreneurial and not focused on a specific discipline. The SEE workshops are organized by the Kern Family Foundation and a faculty development committee and are hosted twice a year in conjunction with other conferences/events.

In addition to the workshops described above, KEEN holds an annual Winter Conference to which each university is encouraged to bring at least five people, often including several faculty. These meetings have been a good way
to expose new faculty to the entrepreneurial mindset, to the network as a whole, and to faculty at other institutions who share similar interests and disciplines. While this is very “high level” exposure, it is often the first step for faculty to begin the process of further development related to the entrepreneurial mindset.

**Assessment**

As with any project, one clear question is “how will we know if we have been successful.” This is complicated for this project, because there are really three levels of success. In some ways the easiest thing to assess is the ability of students to demonstrate success in the acquisition of their associated outcomes. While this may be the easiest, it is certainly not easy. KEEN has used a variety of assessment tools. While the details have been presented elsewhere, current efforts include using a rubric-based assessment specific to a given outcome (Kleine and Yoder 2011). This is certainly a work in progress, but allows the network to gain experience in the level of student achievement for various outcomes. A second level of assessment is required to see if the faculty development described in this paper has been effective. While initial results have been very successful in terms of numbers of faculty, courses, and students affected, these are short-term measurements. The true test will be whether these faculty continue to “spread the fire” when they are no longer receiving additional funds to do so. Will the entrepreneurial mindset remain an important part of the curriculum? Will faculty involved in teaching the entrepreneurial mindset mentor new faculty as much in teaching the entrepreneurial mindset as they would in helping them teach, for example, statics? This is clearly a long-term measurement, and has not been accomplished to date.

Finally, the fundamental question is whether KEEN has been successful in changing undergraduate engineering education. As Mr. Robert Kern, former entrepreneur and co-founder of the Kern Family Foundation, has said, “we won’t know for decades whether or not we have been successful.” However, the overlap between The Engineer of 2020, ASME’s “Vision 2030,” and other documents with the entrepreneurial mindset indicates that a consensus is beginning to form among professional societies and educators about what must be done. Epicenter (n.d.) has recently been formed to pursue goals similar to KEEN’s, and it is hopeful that a synergy will exist to accelerate the change both organizations can bring to undergraduate engineering education. Clearly the hope is that in the future, no one will need to talk about the entrepreneurial mindset as such, because it will simply be an integral part of engineering education.

**Conclusions**

KEEN is working to instill the entrepreneurial mindset in engineering undergraduates. Faculty are key to making any sustainable change in higher education. This paper describes the efforts at three of the KEEN universities to lead change through faculty development. It also describes more recent efforts by the network as a whole to provide faculty development opportunities. All three schools have seen success as the KEEN efforts on campus have moved from one or two “champions” to a wider base of the faculty. These efforts make a small contribution to the vast literature on organizational change in higher education (see Kezar (2001) for an accessible review). These efforts also
leverage insights from the Kauffman Campus assessment into what succeeds and fails with regard to implementing the entrepreneurial mindset (Husley, Rosenberg, and Kim 2006). Hopefully, the models described here can be applied at other KEEN schools, and at schools outside the network interested in instilling the entrepreneurial mindset in their undergraduates. Recent efforts such as the ASME “Vision 2030” project and Epicenter make it clear that employers and the government feel that all schools should be including at least some aspects of the entrepreneurial mindset in their programs. It should also be noted that while this paper focuses on faculty development, the schools described here also have a variety of other efforts on their campuses, ranging from competitions to curricular and programmatic efforts to living-learning communities.

References


