AC 2007-1689: CULTIVATING AN ENTREPRENEURIAL MINDSET THROUGH INTERDISCIPLINARY COLLABORATION AND NETWORKING

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Cultivating an Entrepreneurial Mindset through Interdisciplinary Collaboration and Networking

Abstract

Lawrence Technological University, a private institution located in the Detroit metropolitan area, has an enrollment of approximately 3000 undergraduate students in day and evening degree programs. Unlike a majority of institutions were entrepreneurial programs tend to originate in the college of management or business, the entrepreneurial programs at the University originated in the College of Engineering. In the College of Engineering, the belief was that engineering graduates play many roles in industry, all of which require business and entrepreneurial skills. In response to this situation, the college developed the entrepreneurial certificate program. Separately, the College of Arts and Sciences, through the Undergraduate Management Program, also developed a certificate program and concentration in entrepreneurship. However, these two programs operated separately and only impacted a small percentage of the entire student population. In addition, a majority of the entrepreneurial focus, especially in the College of Engineering, has been on business skills and not on developing the "entrepreneurial mindset." Entrepreneurial mindset outcomes include innovation, vision, teamwork, communication, problem solving skills, opportunity recognition and risk management. In 2005, it was recognized that these two entrepreneurial programs, as well as the University as a whole, would benefit from collaborating.

The opportunity to collaborate and network presented itself in May 2006, when the University was awarded a Kern Entrepreneurship Education Network (KEEN) Fellowship Grant from the National Collegiate Inventors and Innovators Association (NCIIA). The grant provides funding to integrate the existing programs into a new innovative interdisciplinary program focused on developing the "entrepreneurial mindset" on campus. In addition, the grant bestows Kern Fellow status on two University faculty and provides access to the KEEN Network, which includes ten private institutions across the Midwest. This network has provided a support mechanism, assisted with program development, and broadened the impact of the funding. This paper will describe the KEEN Network, discuss the specific strategies employed to implement the new program at Lawrence Tech, provide program assessment and evaluation background, present assessment of the first year program outcomes and an evaluation of program impact, and finally, lessons learned by the program implementation team. It is anticipated that the narrative provided by this paper and the corresponding presentation will highlight how regional collaborations can support entrepreneurial efforts at individual campuses and how on an individual campus groups can coordinate to enhance impact. In fact, since being awarded a KEEN Fellowship Grant, developing an entrepreneurial mindset across campus is one of the revised Educational Goals of the University and an educational cornerstone of the new administration.

Historical Context of Entrepreneurship

Lawrence Technological University is a private institution located in the center of the Detroit metropolitan Area. Entrepreneurship at the University arose from two separate programs - one in the College of Engineering and the other in the College of Arts and Sciences. In the College of Engineering, it was recognized that graduates play many roles in industry, all of which require business and entrepreneurial skills. In response to this situation, the college developed the entrepreneurial certificate program and founded the Lear Entrepreneurial Center (LEC). The entrepreneurial certificate program courses provide a vehicle for sharpening the student skills in communications and business aspects of the engineering profession as well as industry specific technical skills. The entrepreneurial program also includes an extensive multi-disciplinary capstone design experience in which students form a "company" and are eligible for student venture grants administered by the institution. The development of the entrepreneurial program and LEC in the College of Engineering was bolstered by the receipt of two multi-year grants (one in 2001 and another in 2003) to create and then strengthen the entrepreneurial program in the college of engineering. These grants strengthened the entrepreneurial certificate program and promoted innovative teaching on campus by conducting workshops and keynote lectures, awarding faculty curriculum and student venture grants, and providing faculty incentives to work with industry sponsored student teams.

Simultaneously and separately, the College of Arts and Sciences, through the Undergraduate Management Program, developed certificate and concentration program in entrepreneurship designed to provide students with hands-on one-year preparation for business. The programs were created with new professionals in mind; many of whom will select new careers in the service and non-manufacturing sectors, requiring more innovation and creative thinking skills. The courses that make up these programs were created to provide a multidisciplinary experience for student's including interaction with students, faculty, and business leaders from across the region.

KEEN Network

The Kern Entrepreneurship Education Network (KEEN) was organized by the National Collegiate Inventors and Innovators Association (NCIIA) with support from the Kern Family Foundation. The goal of KEEN is to make entrepreneurship education opportunities widely available at institutions of higher learning, and to instill an action-oriented entrepreneurial mindset in engineering, science, and technical undergraduates. The current KEEN program involves ten private Midwestern institutions with ABET accredited engineering programs and provides access to vital resources for building quality entrepreneurship education programs that engage engineering and technical students. KEEN provides a synergistic combination of grants, faculty fellowships, capacity building workshops, networking opportunities, and resources. KEEN provided financial and development resources to grantee institutions for the development of entrepreneurship curricula, modules, and extracurricular activities like business plan competitions, speaker series, student entrepreneurship clubs, and seminars. Each of the participating institutions also chose two faculty to receive fellowship status. The Kern

Fellows collaborate to realize the entrepreneurship education vision of their home institutions as well as to support and enhance the overall network.

Lawrence Tech applied for and was awarded a Kern Entrepreneurship Education Network (KEEN) Fellowship Grant in spring. The grant provided the funding to integrate the existing entrepreneurial programs into a new innovative interdisciplinary program focused on developing the "entrepreneurial mindset" on our campus. The program described in the following section is the program funded by the KEEN grant.

Entrepreneurship Education Program

Entrepreneurial efforts at the University as described earlier, while successful, were conducted in silos and only impacted a small percentage of the entire student population. In addition, a majority of the entrepreneurial focus, especially in the College of Engineering, was on business skills and not on developing the "entrepreneurial mindset." It is the vision of the University that the curriculum and campus-wide culture will provide the entrepreneurial skills necessary for all graduates to be professionally and personally successful. Fulfilling the vision will be realized by focusing on the following five key goals - *Coordinate Entrepreneurial Efforts*, *Grow Entrepreneurial Culture*, *Entrepreneurial Program Growth and Increased Student Participation*, *Foster Enterprise Opportunities*, and *Program Sustainability*. Those goals (further described in the following paragraphs) are supported by the individual program components as indicated in Figure 1 in the Appendix.

Goal 1: To coordinate entrepreneurial efforts across all disciplines and class levels to ensure opportunities for entrepreneurial mindset development for all students.

The University seeks to establish a culture, which fosters an entrepreneurial mindset for all graduates. This will be accomplished by re-inventing our pedagogical approaches to include problem based learning, rich media, student team projects throughout the curriculum, and by introducing entrepreneurial skills in freshman and sophomore years and continuing to integrate entrepreneurship throughout the academic career. Cross campus collaboration will be accomplished by requiring multidisciplinary project teams and cross-listed courses open to other disciplines.

Goal 2: To provide an environment that encourages the growth of the entrepreneurial culture in the University community.

An entrepreneurship environment will provide stimulus and motivation to act with an entrepreneurial attitude in all facets of university life. This environment will be created through faculty incentives for fostering entrepreneurial projects, instituting pedagogical methods consistent with an entrepreneurial culture throughout the curriculum, requiring attendance at entrepreneur speaker series, and establishing a community of practice based on the successful best practices.

Goal 3: To facilitate entrepreneurial program growth and increased student participation.

Meaningful and sustainable progress toward the vision will require that the program content expands to include a comprehensive curriculum, and participation from all disciplines and all levels of the University student body. The overall strategy to accomplish this goal will be allowing enrollment in the entrepreneurial certificate courses to students from all disciplines, embedding entrepreneurial activities in core engineering, science, and technology courses, conducting boot camps for University and high school students, and producing a testimonial e-Clips for effective marketing and improved course content.

Goal 4: To foster internal and external entrepreneurial enterprise opportunities for program constituents.

Educating by example and increased partnerships provide an effective means for incubating the entrepreneurial mindset. This will be facilitated by providing professional development opportunities for faculty and local entrepreneurs and fostering their collaboration with students on enterprises, maintaining industry advisory boards comprised of successful entrepreneurs from diverse technical and non-technical fields, publicizing successful alumni entrepreneurs, and conducting panel discussions on entrepreneurship on campus.

Goal 5: To partner with academic, professional, and governmental organizations to secure long term viability of the program.

The key strategies for sustaining the program are curricular integration of entrepreneurship, institutional budgeted support, endowed faculty, a broad and expanded student base through cross listed courses, multidiscipline capstone experiences, funded student and faculty activities, and an established passionate community of entrepreneurs and university constituents.

Program Student Learning Outcomes

The student learning outcomes are the measurable skills for students involved in the program. Those skills are *communication, teamwork, leadership, ethics and ethical decision-making, opportunity recognition, persistence, creativity, innovation, tolerance for ambiguity, creative problem solving, critical thinking, and business skills (marketing, financial analysis, and strategic planning).* This skill set embraces the entrepreneurial mindset as defined by the KEEN network, but is uniquely defined as the program outcomes for University students. In addition, each of those skills is further refined into measurable student learning objectives which also support ABET Program Outcomes for the engineering programs. The student learning outcomes are listed in Table 1.

Table 1: Student Learning Outcomes

Skill	Upon completion of the program, a student will be able to…
Communication	- effectively communicate through oral presentations in diverse settings. - write reports, plans, and grants for different organizations and purposes.
Teamwork	- function on multidisciplinary teams for successful completion of a project. - to assess team interactions and the functional relationships within a group. - work with people unlike themselves in the workplace and in society.
Leadership	- describe characteristics of successful business and civic leaders. - discriminate between effective and detrimental leadership traits. - demonstrate techniques for building consensus, making decisions, and formulating plans of action.
Ethics and ethical decision-making	- describe the ethical responsibilities of professionals. - resolve various ethical and/or moral dilemmas. - describe the impact of engineering solutions in a global, sustainable, and societal context.
Opportunity recognition	- recognize and demonstrate confidence in approaching professional opportunities and exhibit a willingness to take measured risks.
Persistence	- demonstrate an ability to identify, formulate, analyze, and solve problems, and implement solutions.
Creativity & /innovation	- demonstrate creativity and critical thinking when solving problems consistent with the technological focus of the university.
Tolerance for ambiguity	- analyze and solve open ended problems consistent with problem based learning. - accept and work with ambiguous problems statements and conditions.
Creative problem solving	- demonstrate an ability to identify, formulate, analyze, and solve problems , and implement solutions.
Critical thinking	- demonstrate creativity and critical thinking when solving problems consistent with the technological focus of the university.
Business skills	- develop and write business plans which demonstrate marketing, financial analysis, and strategic planning skills.

Program Components

As indicated in Figure 1, the proposed program consists of numerous individually defined program components to support the realization of our five goals. For discussion and effective implementation, the program components are aligned into the eight actionable strategies and described below.

Strategy 1: Entrepreneurship throughout the engineering curriculum

Beginning with the 2006-2007 academic year, freshmen students will be introduced to entrepreneurship in the Introduction to Engineering course by including creativity, team based and project based learning, and use of rich media. In addition, a new sophomore level course will be developed and implemented that will enhance creativity, innovation, critical thinking, leadership, ethical decision-making, and teamwork skills. Finally, the team based project learning pedagogy successfully employed in physics and calculus courses during the 2005-2006 Academic Year was introduced into sophomore level courses.

Strategy 2: Expanded entrepreneurship course offerings for all students and majors

The present Engineering Entrepreneurial Certificate Program that was implemented in the Mechanical and Civil Engineering Departments in the fall 2002 provides the basis for expanding the teaching of entrepreneurship to other disciplines and other majors. In the 2006-2007 academic year, the entrepreneurial courses will be made available to non-engineering majors and cross-listed as appropriate. Additionally, non-engineering courses involving entrepreneurial skills will be identified and offered within the engineering curriculum as electives.

Strategy 3: Multidiscipline capstone enterprises

The entrepreneur minded engineer or scientist of the 21st century will be required to understand many disciplines to succeed, and a multidisciplinary capstone enterprise at the University will provide a first experience to develop that understanding. Beginning in the 2006-2007 academic year capstone projects will emphasize the collaboration of engineering, management, and science students.

Strategy 4: Promoting and funding student ventures

Student venture capital grants have existed at the University since the 2003-2004 academic year on a voluntary basis as a means of supporting projects, which have potential commercial viability. All students in the Mechanical Engineering Entrepreneurial path will be required to submit applications beginning in the 2006-2007 Academic Year and the program will be expanded to all engineering students in the future.

Strategy 5: Embedding entrepreneurship beyond the classroom

Limited space for additional stand alone courses in the curriculum requires continuous learning of entrepreneurial skills outside of the classroom. To guarantee all students benefit from the presentations, courses will be identified in each engineering discipline that will require attendance during the 2006-2007 academic year. While the major thrust of the program will be curricular, student activities are an effective method for expanding the learning experience without additional credit hours. Support of the existing student Collegiate Entrepreneur's Organization, conferences, and student/entrepreneur networking activities was funded through this grant and other University partners.

Strategy 6: Faculty Development

The Center for Teaching and Learning at the University will host workshop and provide keynote speakers on effective pedagogical techniques as well as integrating entrepreneurship into the curriculum. It is anticipated that faculty and students will be a source of best practices for instilling the entrepreneurial mindset.

Strategy 7: Marketing the program and encouraging growth

Intense immersion in the theory and skills required to be entrepreneurially minded will help to influence students to realize the benefits of engineering entrepreneurship. Week long "boot camp" programs will be initiated in the summer of 2007 for selected incoming freshmen and promising high schools seniors selected through existing University Partnerships with local high schools. The present website will be updated and new brochures generated for the fall semester 2007.

Strategy 8: Maintaining the program

In the next 18 months, relationships will be cultivated with existing and emerging that will benefit from the robust entrepreneurial environment created at Lawrence Technological University. It is anticipated that the partners will help to sustain the program through financial support and future endowments. Strategies for ensuring that the program continues will include curricular integration, institutional support, a strong advisory board, dedicated facilities, financial support and faculty endowments. Integrating entrepreneurship in required courses in the curriculum will ensure that students will not forego entrepreneurship education. In addition, the University has recognized institutional support of entrepreneurship as critical and future budgets will reflect University support. A commitment exists from the University Office of Advancement to secure future program funding. Finally, a capital expenditure was approved to create the Lear Product Innovation Laboratory where students involved in industry sponsored projects and entrepreneurial projects will develop and prototype their inventions.

Program Evaluation Plan

To assess the success of the proposed project, the team has devised a comprehensive assessment and program evaluation plan that includes periodic collection of quantitative and qualitative data. The evaluation plan consists of two primary components; 1) overall evaluation of the program and individual program components by various constituents (students, faculty, alumni, and industry), and 2) assessment of student learning and graduate capability to perform published program learning outcomes.

Program Evaluation

The proposed program has five goals for enacting our vision for entrepreneurial education. Each of those goals is supported by multiple program components. Each of those components will be evaluated using two or more measures. The obtainment of those measures will provide the faculty leadership team with an indication of program success. In addition, the program as a whole will be evaluated on an annual basis utilizing several assessment tools including survey of student satisfaction, survey of alumni satisfaction, feedback from industrial advisory board, oral and written feedback from KEEN network, and performance appraisals of student projects. These tools will be

developed in house and/or modified from existing NCIIA/KEEN resources to meet team needs.

Assessment of Student Learning

To determine the efficacy of the program to provide an entrepreneurial mindset will require a formal assessment of the entrepreneurial skills fastened by the graduates. The proposed entrepreneurial program will have 19 student learning outcomes (Table 1) which graduates should be able to perform upon completing the program. Each of these outcomes will be evaluated using one or more assessment tools (including direct and indirect measures). Details of the assessment program are being finalized in Spring of 2007 and data will be collected for the 2006-2007 Academic Year.

Lessons for Other Institutions

A major benefit from the KEEN initiative was the sharing of experiences and networking opportunities with other KEEN institutions as well as development of new tools. Therefore, we encourage other institutions to take advantage of regional partnerships to strengthen and broaden the impact of entrepreneurial programs and to assist with identifying and securing funding for those partnerships. While there may not be "KEEN" program in your region, it does not mean a similar regional initiative could not be developed. In addition, utilize existing tools such as the NCIIA Curriculum Link; ASSESS database, and e-clips, instead of reinventing tools and techniques. Another important consideration is for individual entrepreneurial programs to determine what components of entrepreneurship are already occurring at their institutions (including engineering, business, non-profit management, professional development/continuing education). Internal partnerships will benefit the entire institution and solidify entrepreneurial programs and outcomes. It's also important to foster off campus relationships and partner with technology partnership offices for issues such as tech transfer, funding, etc.

Another important piece is to establish well-defined program goals, outcomes, and components and to have a well-defined program evaluation plan to determine if program outcomes are achieved and assess whether entrepreneurial activities are successful. This will assist in securing internal and external support, especially if you can identify how entrepreneurial activities support additional institutional and/or discipline specific program outcomes. A benefit of the KEEN grant for our institution was it encouraged us to develop a specific evaluation plan and to map our program components onto our goals, which support the program vision. While each institution is going to have a unique entrepreneurial program, the process utilized by our institution can provide guidance to others.

Finally, ensuring that all students achieve an entrepreneurial mindset (should that be considered important to your institution) begins with curricular modifications that should include modifying courses, supplementing coursework with activities outside of the classroom, adding required entrepreneurship courses throughout the entire academic

career, allowing enrollment in the entrepreneurial courses in all majors, changing core engineering, science, and technology courses to include problem based learning and open ended projects, and developing multi-discipline capstone design experiences with entrepreneurial components. In addition, program implementation and acceptance by the student population is largely dependant upon student involvement and enthusiasm. As such, a key component of a successful program will provide incentives for funded projects and activities that include requiring student enterprise project submissions for student e-team competitions in the senior design sequence, allocation of funds to support student involvement in organizations and national conferences and competitions, hosting entrepreneurship boot camps, and planning for a future business plan competition.

Biographical Information

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Figure1: Vision, goals, and program components of entrepreneurial program.