

2014

Leveraging University Entrepreneurship Center Programs as a Means to Enrich Engineering Education

Tammy VanDeGrift
University of Portland, vandegri@up.edu

Jon Down
University of Portland, down@up.edu

Follow this and additional works at: http://pilotscholars.up.edu/egr_facpubs



Part of the [Education Commons](#), and the [Engineering Commons](#)

Citation: Pilot Scholars Version (Modified MLA Style)

VanDeGrift, Tammy and Down, Jon, "Leveraging University Entrepreneurship Center Programs as a Means to Enrich Engineering Education" (2014). *Engineering Faculty Publications and Presentations*. Paper 20.
http://pilotscholars.up.edu/egr_facpubs/20

This Conference Presentation is brought to you for free and open access by the Shiley School of Engineering at Pilot Scholars. It has been accepted for inclusion in Engineering Faculty Publications and Presentations by an authorized administrator of Pilot Scholars. For more information, please contact library@up.edu.



Leveraging University Entrepreneurship Center Programs as a Means to Enrich Engineering Education

Dr. Tammy VanDeGrift, University of Portland

Dr. Tammy VanDeGrift is an associate professor of computer science and the Associate Dean for the Shiley School of Engineering at the University of Portland. Her research interests in computer science education include perceptions of the field, student preconceptions, and student values. She is also interested in broadening participation in computer science and served as a co-editor for special issues on broadening participation in computing for K-12 and post-secondary education for the ACM Transactions on Computing Education.

Prof. Jon Down, University of Portland

Leveraging University Entrepreneurship Center Programs as a Means to Enrich Engineering Education

1. Introduction

As engineering curricula evolve to include greater emphasis on entrepreneurship and innovation, it is imperative to leverage well-developed resources that exist on many campuses. Today, more than 2,600 colleges and universities in the U.S. offer some form of entrepreneurship education and more than 300 have some type of center for entrepreneurship^[4]. In 1996 the Global Consortium of Entrepreneurship Centers (GCEC)^[9] was established and has become the leading organization for faculty and staff of university-based entrepreneurship centers to collaborate, share ideas and discuss ongoing challenges and opportunities. Of the 200 GCEC members, 152 of these universities have engineering programs (see Appendix 1). Drawing on the 15-year history of having a Center for Entrepreneurship (now expanded to the Center for Leadership, Entrepreneurship, and Innovation) at University of Portland, we describe how curricular and co-curricular programs developed by experts in entrepreneurship education can be successfully utilized by engineering students to enhance their engineering and computer science education.

2. Context: The University and the Center for Leadership, Entrepreneurship, and Innovation

Entrepreneurship is widely recognized as a fundamental building block of competitive advantage and business success^[3, 4, 7]. Creativity, passion, opportunity recognition, a willingness to take risks, strategy execution, a can-do mindset – these entrepreneurial traits and skills are the drivers behind the creation of new innovative business units, companies and organizations. These same characteristics are needed to solve complex global engineering challenges to enhance quality of life^[5]. The Center for Leadership, Entrepreneurship, and Innovation (CLEI) at the University of Portland is positioned to be a nexus of entrepreneurial programs, activities and thinking, a place for all students from across campus to learn and experience entrepreneurship.

An interdisciplinary and independent organization, the Center for Leadership, Entrepreneurship, and Innovation reports to the Provost and helps undergraduate and graduate students develop entrepreneurial skills by offering experiential learning opportunities and fostering relationships between the University and the global business community. Students have opportunities to engage in classroom activity; interact with business owners, corporate executives, professionals, university faculty, and entrepreneurs; and travel domestically and abroad to gain a global perspective and ignite ideas for creative ventures.

The value of experiential learning in the transfer of knowledge for university students has been demonstrated in numerous studies^[8, 12]. Experiential education can lead to more motivated and goal oriented learners^[17]. Furthermore, as on-line substitutes for traditional classroom instruction continue to improve, the importance of universities providing experiential learning opportunities is heightened. Entrepreneurship programs at many universities provide a means to contribute to the experiential learning of engineering and computer science students.

The University of Portland is a primarily undergraduate, Catholic institution, serving approximately 3500 students. The University has five academic units: Arts and Sciences, Business, Education, Nursing, and Engineering. All five units work closely with CLEI and students from all majors are invited to participate in entrepreneurship activities and programs.

Two long-standing programs of the Center are the Entrepreneur Scholars Program (started in 1999) and the \$100K Challenge Venture Competition (started as the \$16K Challenge in 2004). Engineering students have successfully participated in both programs in small numbers over the past decade. And while engineering faculty members have long recognized the curricular and co-curricular benefits of the programs, the historical engineering student participation rates have been low.

E-Scholars Program

Entrepreneur Scholars (E-Scholars) is a select group of undergraduate students who create new business ventures or develop and implement strategies to improve existing enterprises. Students in the E-Scholars program develop their entrepreneurial mindset. They learn how to come up with innovative ideas and develop realistic business plans around them. Through required domestic and international travel they also learn how to do business anywhere in the world.

E-Scholars commit to an academic curricular program, taking three three-credit entrepreneurship courses during their junior year. Students apply during the fall semester of their sophomore year through a process that requires references, interviews and an essay describing the mutual benefit of their participation in the program. Accepted students must also pay a \$4,000 program fee in addition to tuition for the program that offsets more than 50% of the additional direct expenses of \$7,000 per student in the program. The portion not covered by the student fees are paid for from annual donations and E-Scholar endowments.

This competitive program provides classroom activity and applied experience, including travel abroad, to expose students to new and different ways of doing business. They learn to create and discern feasible business opportunities, develop an in-depth understanding of the market, and build a plan with an eye to execution, including international aspects of what they intend to pursue. Throughout the three-course program, students develop skills to compete in the global business environment when they meet with international business leaders on their travels abroad. They interact with America's best entrepreneurs to learn business strategies. They design, implement, and lead a business project that aims to be the best of its kind in the world. They are treated to guest lectures in the classroom and a year-long series of business workshops held by some of the Northwest's most successful business leaders. See Appendix 2 for descriptions of the three courses in the E-Scholars program.

E-Scholars travel both domestically and abroad to meet business leaders across the globe. All students travel to New York, where they meet with companies, consultants, non-profits and government agencies, to delve deeper into actually understanding the business dynamics and to meet key opinion leaders in their chosen field. Similarly, students investigate the international aspects of their intended opportunity, by traveling to one of several international destinations chosen for the program each year.

Since CLEI is a university-wide resource, the E-Scholars program includes engineering and non-engineering students. This creates opportunities for students to engage in interdisciplinary projects and to leverage a variety of skillsets and areas of expertise. Any undergraduate major is eligible to apply to the E-Scholars program. Historically, each E-Scholar class of about 20 students is made up of approximately 55% Business majors with the balance being from College of Arts and Sciences, Engineering, Nursing, and Education. In recent years, a more intentional effort to recruit non-Business majors has resulted in less than 50% Business majors in the program. The diversity of majors in each E-Scholar class adds to the variety and richness of the ideas students in the program develop and in many cases implement.

Business Plan Competition

The CLEI offers a co-curricular opportunity for all students, and even community members, to compete in a \$100K Challenge Venture Competition. The competition is no mere ‘beauty contest’ awarding cash prizes to winners. Rather, it provides an opportunity for investment into investor-ready student-directed businesses, deploying up to \$50,000 annually in funds and another \$50,000 in in-kind services.

The Venture Competition is a multiple round team competition where student teams present their new ventures in a written business plan and a presentation to a panel of judges. Finalists (top six presenters) in the for-profit track will be eligible for an investment from the Launch Pad Fund, established by donors. These Launch Pad Fund Investments are made upon the decision of the investment committee. Finalist teams have six months to submit their application, and if selected for investment, to negotiate terms and complete the investment process, which must be made to a legally organized business entity.

E-Scholars are required to compete in the New Venture Competition as part of the E-Scholars curriculum. However, all students and community members are invited to submit plans for the competition. Both E-Scholar and non-E-Scholar teams have won past competitions.

3. Overcoming Barriers to Utilizing Resources

Future engineering and technological challenges will likely require multidisciplinary efforts to find solutions; therefore, engineering programs may want to consider providing opportunities for engineering students to work on teams with other non-engineering students, entrepreneurs, and business students. To leverage entrepreneurship opportunities, especially those that require coursework, it may be necessary to review and update existing engineering curricula. Many ABET-accredited engineering programs have curricula that include large footprints of engineering, math, and science courses, leaving, perhaps, little to no room for coursework opportunities in entrepreneurship and business.

At the University of Portland, the Shiley School of Engineering has undergone such a curriculum review to encourage engineering students to participate in the programs offered by the CLEI. Below, we summarize our efforts to build relationships and the modifications we have made to our engineering and computer science curricula.

Although the University's Center for Entrepreneurship has been established 15 years, before 2012-2013, we had just 20 engineering students take part in the E-Scholars program (out of 280 in total) and 32 engineering students participate in the Business Plan Competition (out of 330 total). We believe there were two main reasons for this lack of participation by engineering students: 1) the engineering and computer science students were not aware of the university-wide CLEI programs, and 2) engineering and computer science students had few to no elective courses to take entrepreneurship courses in an already full 123 – 131 semester hour degree program. We addressed both issues: we did more targeted advertising to engineering and computer science students and reduced the math/science/engineering footprint in the engineering curricula to allow space for coursework in areas outside engineering.

First, for engineering programs who want to leverage existing entrepreneurship opportunities on their campus, it is important to establish relationships with the leaders of the entrepreneurship programs. The Shiley School of Engineering has intentionally reached out to the CLEI faculty and staff to publicize opportunities to the engineering and computer science students. Publicity has been in the form of guest lectures by CLEI staff and faculty in engineering courses (first-year, second-year, and capstone courses); information about the CLEI provided to faculty advisors, academic advisors and students, email announcements; and targeted recruiting of engineering/CS students who have shown interest in entrepreneurship and innovation. These recruitment efforts have led to a recent increase of engineering and computer science students participating in the E-scholars program and the Business Plan Competition.

The second major effort was a curricular review during 2011-2012 of the four ABET-accredited undergraduate programs: mechanical engineering, electrical engineering, civil engineering, and computer science. The curricular review assumed that future leaders and innovators will need a broad technical foundation with opportunities to gain competency in design (disciplinary and multidisciplinary), real-world problem-solving, communication, ethics and professionalism, global and multicultural understanding, innovation and entrepreneurship, teamwork, computing, sustainability, and business^[1,2,3,11,13,14,15,16]. We identified this set of competencies from various national reports on the state of engineering education^[1,2,11], ABET requirements, as well as conversations with the School's advisory committee during 2010-2011. Table 1 shows the University of Portland's competency goals and how the entrepreneurship and engineering programs achieve these goals.

Table 1: Competency goals for engineering and computer science students at the University of Portland

Competency	Engineering/CS Curricula	E-scholars Program	Business Plan Competition
Technical foundation	X		
Design (interdisciplinary and multidisciplinary)	X	X	X
Real-world problem solving	X	X	X
Communications	X	X	X
Ethics and professionalism	X	X	
Global and multicultural understanding	X	X	
Innovation and entrepreneurship	X	X	X
Teamwork	X	X	X
Computing	X		
Sustainability	X		
Business	X	X	X

During the curricular review, we recognized that the engineering school is housed within a small university; therefore, it made sense to utilize the relevant existing university programs, such as the Center for Leadership, Entrepreneurship, and Innovation, study abroad programs, and academic programs outside the School of Engineering. To allow the engineering and computer science students to take advantage of these programs, we provided more curricular flexibility for the engineering and computer science students. Each of the engineering and computer science programs examined the math/science/engineering footprint and reduced the number of required engineering courses (while still maintaining ABET standards) to allow for 9 credits of professional electives. Given that the E-Scholars program is a 9-credit three course program, engineering and computer science students can now be E-Scholars without adding courses to their degree requirements.

Each engineering program decided how to reduce the total number of engineering course credits in exchange for nine credits of professional electives. Each program found solutions to this challenge in different ways. The computer science program merged two separate two-course sequences into single courses that covered material in less depth. Also, the pre-2013 computer science curriculum included one STEM elective that was converted to a required business course and one applied elective that was converted to a professional elective. The mechanical engineering program converted three mechanical engineering electives to professional electives. The civil engineering program streamlined the required CE courses, converting some previously required courses to electives. The electrical engineering program converted three previously required courses to electrical engineering electives, freeing up curriculum space for nine credits of professional electives.

Other engineering programs may want to do a similar curricular review to examine the balance of technical depth and opportunities for breadth in entrepreneurship and other co-curricular programs. If such a curricular re-organization is not feasible at an institution, the faculty might consider the following curricular alternatives: combining a one or more credit course in

entrepreneurship with senior design courses, welcoming guest lectures from entrepreneurship faculty in engineering courses related to design and innovation (i.e. software engineering, machine design, construction materials, digital systems design, capstone design), encouraging students to take business and entrepreneurship courses as electives if electives are already incorporated into degree requirements. Non-curricular activities related to entrepreneurship, such as student clubs, guest speakers, site visits, mentorship opportunities can be advertised to engineering students.

4. E-Scholar Engineering and Computer Science Alumni Perspectives

Engineering and computer science alumni who participated in the E-Scholars program were surveyed in Fall 2012 asking their thoughts about the impact of the E-Scholars program. The survey questions are shown in Appendix 3 and responses, shown in Appendix 4, were collected on-line. The survey and data collection procedures were approved by the institution's IRB.

Since the E-Scholars participation rate for engineering students was low in past years (a total of 20 alumni were engineering majors), there were few former participants to survey. However, four of the 20 E-Scholar alumni responded and their direct quotes appear in Appendix 4. Respondents described significant experiences while participating in the program, how the E-Scholars experience impacted their professional work, experiences that were not as helpful, and recommendations for improvement.

Experiences that positively impacted more than one E-Scholar engineering alumni included:

- Traveling to NYC and to international locations
- Discussing business ideas with professionals
- Letting students do the work and struggle with ambiguity

Experiences that were not as helpful were not as thematic, given that the areas for program improvement were more personal to each alumnus (see Appendix 4). The alumni provided the following recommendations to improve the program:

- Encourage more multi-disciplinary teams
- Encourage students to take risks
- Encourage students to follow through on ideas
- Provide mentors to assist with the practice of starting a business
- Visit more technology companies

Overall, the feedback is that the E-Scholars program was worth the time investment for the engineering alumni; even this fraction of feedback provides some evidence to encourage more engineering students to take advantage of this opportunity. Given such small numbers of prior participants, we did not study how E-Scholars compare to non-E-Scholars in terms of senior design project grades, success in securing jobs, starting salaries, or overall satisfaction with their University of Portland education. However, as more engineers take part in CLEI programs, it would be interesting to collect data to study the impact of participating in entrepreneurship programs on some of these metrics.

5. Survey of Entrepreneurship Programs

University of Portland is by no means unique in terms of offering campus-wide entrepreneurship programs. Several universities that offer engineering programs are part of the consortium for entrepreneurship centers (see Appendix 1). At the University of Portland, the challenges we faced related to awareness of entrepreneurship opportunities and creating curricular space to support engineering students in the E-Scholars program. Each university likely faces distinct challenges when trying to leverage entrepreneurship activities on their campus. However, results from the eight Kauffman Campuses Initiative grantee universities study provides an overview of entrepreneurship program components and recommendations when implementing entrepreneurship programs ^[10].

The eight universities offer slightly different experiences in entrepreneurship; however, most of the universities designed new courses in entrepreneurship, offered co-curricular activities such as clubs, lectures, workshops, business plan competitions, internships, and venture incubators, provided entrepreneurship research grants for faculty and students, and created opportunities for community involvement on boards, internships, mentorships, and consulting.

Most of the KCI universities emphasized expanding the availability of entrepreneurship curriculum to engage students outside the business school and identified three major challenges in doing so: (1) Attracting faculty to develop and teach courses, (2) Addressing the university's long approval process for new courses, and (3) Overcoming procedural barriers to student enrollment ^[10]. Other key issues to be considered by other universities as they plan and implement their own entrepreneurship programs include: (1) Establishing a clear identity for the initiative; (2) Successfully implementing the initiative's programs and activities; and (3) Planning to ensure sustainability of the initiative ^[10].

6. Discussion and Conclusion

Like many universities, there are entrepreneurial resources on campus at University of Portland that would be beneficial for a larger percentage of engineering students. Benefits reported by engineering E-Scholar alumni include exposure to interdisciplinary business functions, access to mentors and others helpful in student professional development, deeper insight into the complexity of real world problems, in the moment learning, dealing with ambiguity, and developing a more global perspective.

However, our experience has shown only a modest number of engineering students have participated in E-Scholars prior to 2012 (7.14% of E-Scholars were engineering or CS majors). Through structural changes in the engineering curriculum and an engaged campaign of awareness and promotion we found it possible to increase participation rates to 23.8% (5 of the 21 E-Scholars were engineering or CS majors in 2012-2013) and 38.8% (7 of the 18 E-Scholars are engineering or CS majors in 2013-2014). Five important levers for engineering students to successfully utilize campus entrepreneurship resources include:

- Awareness and incentives drive participation

- Structural barriers in the form of engineering curriculum requirements may need to be addressed
- In depth programs such as E-Scholars add an important dimension to engineering student education as reported by alumni
- Clear expectations about program outcomes are important and students should self-select to participate
- Greater participation rates can lead to a change in culture among engineering students and faculty

While the E-Scholars and Business Plan Competition programs have been the vehicles discussed in this paper, there are many other ways engineering students can gain experience in entrepreneurship. These include multi-disciplinary collaboration on senior design projects, involvement with entrepreneurship and innovation student clubs, and participation in campus business plan or elevator pitch competitions.

Acknowledgments

We thank the E-Scholar engineering alumni who responded to the survey questions. We acknowledge the Center for Leadership, Entrepreneurship, and Innovation for providing access to entrepreneurship experiences to all University of Portland students. Further information about the CLEI can be accessed at <http://www.up.edu/cfe/>.

References

1. ASCE. (2008). *Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future*. ASCE: 2nd edition.
2. ASME. (2010). *Creating the Future of Mechanical Engineering Education: Phase 1 Report*. ASME Center for Education Task Force: December 15.
3. Besterfield-Sacre M., Ozaltin N. O., Shartrand A., Shuman L. J. (2011). Understanding the technical entrepreneurship landscape in engineering education. *Annual Conference and Exposition of the American Society for Engineering Education (ASEE)*.
4. Brush, C. (2013). Does Entrepreneurship Education Matter? *Forbes*. June 24, 2013.
5. Byers, T., Seelig, T., Sheppard, S., and Weilerstein, P. (2013). Entrepreneurship: Its Role in Engineering Education. *The Bridge on Undergraduate Engineering Education*. Summer, 43:2.
6. Duderstadt, J. J. (2008). *Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education*. The Millennium Project, The University of Michigan.
7. Ewing Marion Kauffman Foundation. (2013). *Entrepreneurship Education Comes of Age on Campus*. <http://www.kauffman.org/newsroom/2013/08/entrepreneurship-education-comes-of-age-on-campus>
8. Furman, N., & Sibthorp, J. (2013). Leveraging experiential learning techniques for transfer. *New Directions for Adult and Continuing Education*, (137), 17-26.
9. Global Consortium of Entrepreneurship Centers. (last accessed 12/28/2013). <http://www.globalentrepreneurshipconsortium.org/index.cfm>
10. Hulsey, L., Rosenberg, L., Kim, B. (2006). Seeding entrepreneurship across campus: Early implementation experiences of the Kauffman campuses initiative. Final report. Mathematica Policy Research, Inc.
11. Joint Task Force on Computing Curricula. (2012). *Computer Science Curricula 2013: Strawman Draft*. Association for Computing Machinery and IEEE- Computer Society.

12. McClellan, R., & Hyle, A. E. (2012). Experiential learning: Dissolving classroom and research borders. *Journal of Experiential Education*, 35(1), 238-252.
13. National Academy of Engineering. (2005). *Educating the Engineer of 2020*. National Academies Press.
14. National Academy of Engineering. (2004). *The Engineer of 2020: Visions of Engineering in the New Century*. National Academies Press.
15. Plummer, J. D. (2010). "Educating Engineers for the 21st Century." *International Electron Devices Meeting*, San Francisco.
16. Sheppard S. D., Sullivan W. M., Macatangay K., Colby A. (2008). *Educating Engineers: Designing for the Future of the Field*. Jossey-Bass.
17. Sibthorp, J., Schumann, S., Gookin, J., Baynes, S., Paisley, K., & Rathunde, K. (2011). Experiential education and lifelong learning: Examining optimal engagement in college students. *Journal of Experiential Education*, 33(4), 388-392.
18. Tranquillo, J. (2013). The T-Shaped Engineer: Connecting the STEM to the TOP. *Annual Conference and Exposition of the American Society for Engineering Education (ASEE)*.

**Appendix 1: Global Consortium of Entrepreneurship Centers (GCEC)
Member Universities with Engineering Programs (as of 10/1/2012)**

University	Number of ABET-accredited engineering/CS BS degrees
Appalachian State University	1
Ball State University	1
Baylor University	4
Belmont University	1
Boston University	6
Bradley University	6
California State University-Fresno	5
Champlain College	1
Clemson University	10
College of Charleston	1
Colorado State University	7
Cornell University	7
Drexel University	14
Elizabethtown College	2
Fairleigh Dickinson University	6
Florida International University	7
Gonzaga University	4
Illinois State University	2
Indiana University	11
Louisiana State University	1
Louisiana Tech University	10
Loyola Marymount University	3
Michigan Technological University	12
Missouri Southern State University	2
MIT	13
Montana State University-Bozeman	9
Montclair State University	1
Northeastern University	10
Northern Kentucky University	2
Northwestern University	10
Ohio State University	14
Oklahoma State University	13
Oregon State University	13
Pace University	2
Pennsylvania State University	17
Rice University	5
Rowan University	7
Saint Louis University	4
Sam Houston State University	1

Santa Clara University	5
Southern Illinois University-Edwardsville	7
Southern Illinois University-Carbondale	7
Southern Methodist University	6
Stanford University	5
Syracuse University	9
Taylor University	2
Temple University	4
Texas A&M University	19
Texas Christian University	2
Texas State University-San Marcos	2
Texas Tech University	9
Tufts University	8
University of Arizona	13
University of California-Berkley	9
University of California-Los Angeles	8
University of California-San Diego	6
University of Central Florida	9
University of Cincinnati	16
University of Colorado-Boulder	10
University of Dayton	10
University of Evansville	5
University of Florida	14
University of Houston	7
University of Idaho	9
University of Illinois-Chicago	8
University of Illinois-Urbana-Champaign	13
University of Iowa	6
University of Maryland	9
University of Maryland-Baltimore County	4
University of Michigan	12
University of Minnesota	10
University of Missouri-Columbia	8
University of Missouri-Kansas City	6
University of Nebraska-Lincoln	11
University of Nevada-Las Vegas	5
University of Notre Dame	7
University of Pittsburgh	9
University of Portland	4
University of Rochester	5
University of San Francisco	1
University of South Florida	7
University of Southern California	10

University of Southern Maine	2
University of Tampa	1
University of Texas-Dallas	5
University of Texas-El Paso	6
University of Texas-Permian Basin	1
University of Tulsa	6
University of West Georgia	1
University of Wisconsin	12
Washington State University	8
Washington University-St. Louis	6
West Virginia University	10
Western Kentucky University	3
Western Washington University	4
Wichita State University	6
Wilkes University	3
Winston-Salem State University	1
Worcester Polytechnic Institute	11
York College of Pennsylvania	4

Appendix 2: E-Scholars Program Course Descriptions

There are three courses in the E-Scholars program.

Creating a World-Class Venture (BUS 480): Students work independently and in groups to develop ideas and create a venture. The structure of the E-Scholars program guides students from the inception of a business idea to its formation and implementation. Students meet with top experts in the field related to their new venture to gain further information and insight on how to successfully approach venture creation. A learning plan is developed, based on student strengths and weaknesses and will focus directly on the business idea. Examples include networking with business leaders who can assist in the promotion of the business idea, researching best practices and current trends in the industry, attending trade conferences, and further developing the business plan and market research. The central focus of the course is to enhance the entrepreneurial capacity of students with entrepreneurial desire and potential. This course is divided into four thematic areas: New Venture Creation, Best Practices Tour, Entrepreneurial Resources, and Classroom Experience. It includes coverage of conceptual entrepreneurial skills needed to create a business that is globally competitive. Emphasis is on creation of a plan for a potential world-class venture. A Program Fee to offset costs of travel and participation in various off campus events is required.

Global Entrepreneurship (BUS 482): This program course includes a trip outside of the United States to give participants the opportunity to experience how new businesses are created in other countries. Particularly in today's global business environment, entrepreneurs contribute significantly to the creation of wealth and welfare in every nation. Significant information is available about large business competition in the global economy. However, entrepreneurs must be especially attuned to the culturally specific business practices of the nations in which they operate. This course explores similarities and differences among entrepreneurs globally to help students understand pluralism of business more clearly, leading to better business practices. Students choose their destination and make their own business appointments, learning and practicing entrepreneurship across borders. Past international experiences have included business trips to Australia, Brazil, Chile, China, Korea, Israel, Malaysia, Poland, Russia, Singapore, South Africa, United Arab Emirates, Ukraine, and Vietnam. Past national trips have included visits to meet entrepreneurs in New York City, San Antonio, Washington D.C., Denver, and Chicago.

The Entrepreneur Apprenticeship (BUS 481): During this final phase of the E-Scholars program, students will transform their business ideas into a working entity with the help of business mentors, through a structured apprenticeship. All students also present at the \$100K Challenge Venture Competition at the end of the year. This annual competition is funded by the Launch Pad Fund and provides up to \$50,000 of cash investment and \$50,000 of support services for investor ready student businesses. As part of the Apprenticeship course students also attend numerous off campus entrepreneurship events and participate in our Annual Invention 2 Venture event which we put on in partnership with the National Collegiate Inventors and Innovators Alliance.

Appendix 3: Survey Questions for Engineering or Computer Science Alumni who Participated in the E-Scholars Program

1. What title or position do you currently hold?
2. What company or organization do you work for?
3. Describe the most significant experience you had as an E-scholar.
4. What aspects of the E-scholar program were most helpful for your professional work or personal activities?
5. What aspects of the E-scholar program were not as helpful?
6. Do you have any recommendations for improving the E-scholars program?
7. Do you want to be involved in Center for Entrepreneurship or School of Engineering activities? If so, what interests you?

Appendix 4: Survey Responses for Engineering or Computer Science Alumni who Participated in the E-Scholars Program

Most significant experience:

While I was on an E-Scholar trip in New York City, I met the person who would become my mentor and eventually the principal investor in my first startup (S1).

Learning to navigate remote cities/people on my own. To be put into a situation where you are completely unfamiliar with the surroundings and you are told you must gather contacts in this city, establish an effective agenda for the meeting, and navigate these cities with minimal, if any, hand holding, was invaluable to the learning experience in E-Scholars. It teaches you to be prepared and be confident that you can lead successful meetings whether they are in the United States or China (S2).

I enjoyed my time interning for former AD *<name omitted>* as well as winning a dinner atop Shanghai's Oriental Pearl Tower. I loved practicing and scrimmaging against the top basketball prospects in Shanghai. I found the opening book Dr. *<name omitted>* had the students read over the summer very memorable. But the most lasting experience is probably the struggle I had navigating my business idea to use fingerprint scanners for low security purposes (e.g. student dorms, employee punch cards, etc.) I struggled navigating around the intellectual property and how one develops a business even if they didn't "invent" the technology. At that time, I didn't understand IP and the legal makeup of the field. I also couldn't find a strong mentor that could help me understand what steps I should take. The experience pushed toward law school, but also left me with a nagging thought that maybe I gave up on the idea too soon (S3).

Dr. *<name omitted>*'s teaching philosophy. He always believed in the group and would say great words like "you're a self-selecting group." He believed that he just helped us do what we would do naturally. His personal investment in the group was a huge motivator. He's an outstanding leader (S4).

Aspects of the E-scholar program were most helpful for their professional work included:

I believe there were a number of benefits that I received through the program, but one of the most helpful was "showing up". A simple statement, but if you do not "show up" to the good and the bad events in your life you will never be able to learn in order to press onward and upward (S1).

The aspect of E-scholars that was the most helpful was learning how to prepare for and communicate ideas effectively in a business meeting. E-Scholars did a great job of teaching me how to gather useful contacts and make the most of those contacts whether they were in the United States or abroad. The communication and business skills E-Scholars taught me has been instrumental in my successes from job interviews to preparing resumes to communicating with nearly anyone in the work force. E-Scholars has also taught me, along with my other businesses classes (being an engineer) to look beyond the box of design and how my designs and work effect the company as a whole. The operations manager who hired me said that my business minor (which e-scholars was a part of) helped me get hired (S2).

The "real-world" applicability of what we were doing went a long way. The opportunity to schedule meetings, discuss business ideas, and be pushed to defend those ideas was valuable (S3).

Seeing the Wal-Mart "wiggle" and visiting their test store (fits nicely with an Engineering student). It was a great exposure to the inner workings of a huge company. Working in teams with students from various disciplines is a great representation of the working world (S4).

Characteristics of the E-scholar program that former students found to be not as helpful:

One of the hardest things to impart to young entrepreneurs is the need to make sure that your business fits who you are. Now this is a concept that requires a certain level of maturity and is a topic that may not be easily taught to college students, but I have found it to be one of most importance. Being an entrepreneur is an extension of self and is as much a commitment as marriage and should be considered as such while engaging in entrepreneurial activities (S1).

Most aspects of E-Scholars were pretty well structured and didn't seem to fall in the category of "Why am I doing this", it's been about 2 years now so it's difficult to remember specific tasks or events that were not useful. I found the meetings with the mentors to be helpful, constantly revising our business plans to be helpful...most of it was helpful (S2).

Some of the class room exercises were lacking. I also did not fully understand the connection between the business plan on paper and the practicalities of following through on it. This seems like a trivial connection for a student to make, but the real world applicability did not add up. Some of this is gathered with time and experience, but some of the dots may have been more fully connected in the E-Scholars environment (S3).

Meeting for dinner with a multimillionaire who talked down to us. I can still remember him saying (to table full of loan-riddled students) "when you have so much money, you just don't know what to do with it." He didn't really encourage the best motivator for success in business, but rather solidified some annoying stereotypes. Traveling to Malaysia was awesome, but we got exposed to some negative gender-related issues. The experience was a bit discouraging when the women weren't considered equal and it left a strong impression that it would be very difficult to do business in certain regions if you weren't a man (S4).

Recommendations for improving the program:

- Encourage the students to branch out, engage cross-functionally and to get comfortable with risk taking.
 - Most people in the world are risk averse and this directly conflicts with the act of entrepreneurship. Show the students that by being an entrepreneur, you create your own sense of comfort by controlling your own destiny; even in times of failure.
 - As of right now any software startup company requires few things other than computers and programmers. Principally, a well defined product (visually and functionally) and a sales & marketing strategy. I would recommend engaging with the Art, Business and Engineering schools to create trifecta E-Scholar company groups (S1).

I think the major downside I saw for my year was the lack of sticking with a project. I understand entrepreneurship is about passion but I also saw that some of the e-scholars wanted to start their own financing business or major engineering company which require years of experience. It seemed that some scholars were changing their ideas and goals quite often about 2 to 3 times which I believe can inhibit the effectiveness of the program. I am not doing what I went through e-scholars for but I stuck with it because I enjoyed it and changing the plan in the middle of the year would redirect my strategies, business plans, etc. so instead of learning more about the general aspects of starting a business such as acquiring capital, investments, people, etc. I would be spending more time redoing all the learning already accomplished. So I think what would be useful would be establishing that the scholar has a truly active idea, one that is in development and already has a plan and e-scholars in a vehicle to help get that plan moving or learn more about how to improve upon the plan to learn the strategies of starting a business. But to be honest I don't believe the idea of "I want to start my own engineering company/finance firm" is more useful after about 10 years experience in the work force because most of the time you need special licenses and years of experience to start these companies (S2).

I wouldn't suggest any improvements. It's a program where you can get out what you put into it. For some students, there is a disconnect between the skills being taught and learned in the classes and their applicability to everyday business.

Somehow bridging that gap of understanding so more students put in the effort to get quality experience out of it would be the biggest challenge and goal (S3).

A mentor to assist with the fine details of starting a business. More "nuts and bolts" how-to. Add tech companies to the list of visits (there weren't any that we visited during my time there). Having a sister-school type exchange was great, but it could use some refining. When we hosted the Malaysian students, there wasn't a lot of assistance from the program. I ended up taking the lead and along with some other E-scholars, we came up with an itinerary and showed them around. Some E-scholars weren't involved at all. I felt a bit embarrassed since what we could provide as students didn't measure up to what they had provided us when we were hosted by them (S4).