AC 2007-2805: CULTURE, CREATIVITY, AND CONFIDENCE: SYNTHESIZING THE INTERNATIONAL EXPERIENCE

Carolyn Percifield, Purdue University

Carolyn Percifield is Director of Strategic Planning for the College of Engineering at Purdue University; helped found and continues to co-advise two engineering student organizations; and created two study abroad courses for engineering students.

David Bowker, Purdue University

David Bowker is the Director of Undergraduate Engineering Recruitment at Purdue University. He has a bachelor's degree in organizational leadership and supervision, a master's degree in higher education administration (both from Purdue University), and has worked in college recruiting and admissions for ten years. David regularly presents on engineering topics on campus, at high schools and conferences. He is a Co-instructor for ENE 595G Global Leadership and Innovation.

Demetra Evangelou, Purdue University

Demetra Evangelou is an Assistant Professor in Engineering Education at Purdue University, College of Engineering. Her research interests include early engineering and the effects of multiple influences on engineering thinking.

Mi'schita' Henson, Purdue University

Mi'schita' Henson is currently a graduate student in the Engineering Professional Education Department at Purdue University. Her interests are Human Factors Engineering and Software Engineering. She received a Post-baccalaureate Certificate in Computer Information Systems from Indiana University – Kokomo and a B.S. in Electrical Engineering from Kettering University. She has been employed with Delphi Electronics and Safety for 10 years, both as an Engineering Co-op and Full-time Engineer. Her current Professional Affiliations are with the Human Factors and Ergonomics Society (HFES) Member – Purdue Chapter and the National Society of Black Engineers (NSBE).

Culture, Creativity, and Confidence: Synthesizing the International Experience

Abstract

Success for today's engineering students will depend on their ability to work with people of many cultures and experiences, to innovate creative engineering solutions to increasingly complex problems, and to develop innovative business and technology strategies using creativity and sensitivity as they navigate increasingly complex environments and markets.

A four week (Maymester), six credit course was developed to provide engineering students at Purdue an opportunity to immerse and stretch professionally and personally in a global environment. The four instructor team that included an alumna, accompanied 21 freshman through PhD students from 9 of the 12 engineering disciplines and included 7 women and 5 African Americans.

The destination was Chania, Crete. Home base was on the campus of the graduate research campus, Mediterranean Institute of Chania (MAICh) where students met and lived with graduate students primarily from the Mediterranean region.

The course titled ***Global Leadership and Innovation*** was designed to provide an intercultural experience that would

1. immerse students in a culture vastly different from their own so they could learn to appreciate and value human differences, and develop strategies for venturing outside their comfort zone;
2. reinforce and help synthesize the notion of cultural identity and how our culture flavors our experiences, our interpretations, and our interactions with other people by using a uniquely American academic "product," Engineering Projects in Community Service (EPICS), for a feasibility study;
3. develop intellectual and practical tools so students can "make themselves ready" for creativity, openness to new ideas, and working effectively without enough information; and
4. develop teamwork and build a community of students who will share their experiences with others when they return.

The results from the student feedback were overwhelmingly positive.

Introduction

"Solutions of societal problems require that these [safe, reliable, and innovative] technologies be applied in innovative ways with consideration of cultural differences, historical perspectives, and legal and economic constraints, among other issues. … We aspire to an engineering profession that will rapidly embrace the potentialities offered by creativity, invention, and cross-disciplinary fertilization to create and accommodate new fields of endeavor, including those that require openness to interdisciplinary efforts with non-engineering disciplines such as science, social science, and business. … We aspire to a future where engineers are prepared to adapt to changes in global forces and trends to ethically assist the world in creating a balance in the

standard of living for developing and developed countries alike. … Our aspiration is to shape the engineering curriculum for 2020 so as to be responsive to the disparate learning styles of different student populations and attractive for all those seeking a full and well-rounded education that prepares a person for a creative and productive life and positions of leadership.[1]"

"Today, America finds itself at a unique and delicate historical juncture, shaped by two unprecedented shifts—one in the nature of global competition, the other in the nature of innovation itself: The world is becoming dramatically more interconnected and competitive. ... Where, how and why innovation occurs are in flux—across geography and industries, in speed and scope of impact, and even in terms of who is innovating.[2]"

"…In a globally integrated economy, our workers will get paid a premium only if they or their firms offer a uniquely innovative product or service, which demands a skilled and creative labor force to conceive, design, market, and manufacture—and a labor force that is constantly able to keep learning.[3]"

"The four drivers of Interdisciplinary Research are: 1) the inherent complexity of nature and society, 2) the drive to explore basic research problems at the interfaces of disciplines, 3) the need to solve societal problems, and 4) the stimulus of generative technologies. [But] at the heart of interdisciplinarity is communication—the conversations, connections, and combinations that bring new insights to virtually every kind of scientist and engineer.[4]"

"…the world is going through a period of fast-paced innovation that will become increasingly intense in coming decades thanks to global competition and scientific breakthroughs. …companies want to increase the proportion of their innovation that is "break-through" or "disruptive" as opposed to incremental. [5]"

***Observation 1:** faculty are most comfortable teaching the technical –*

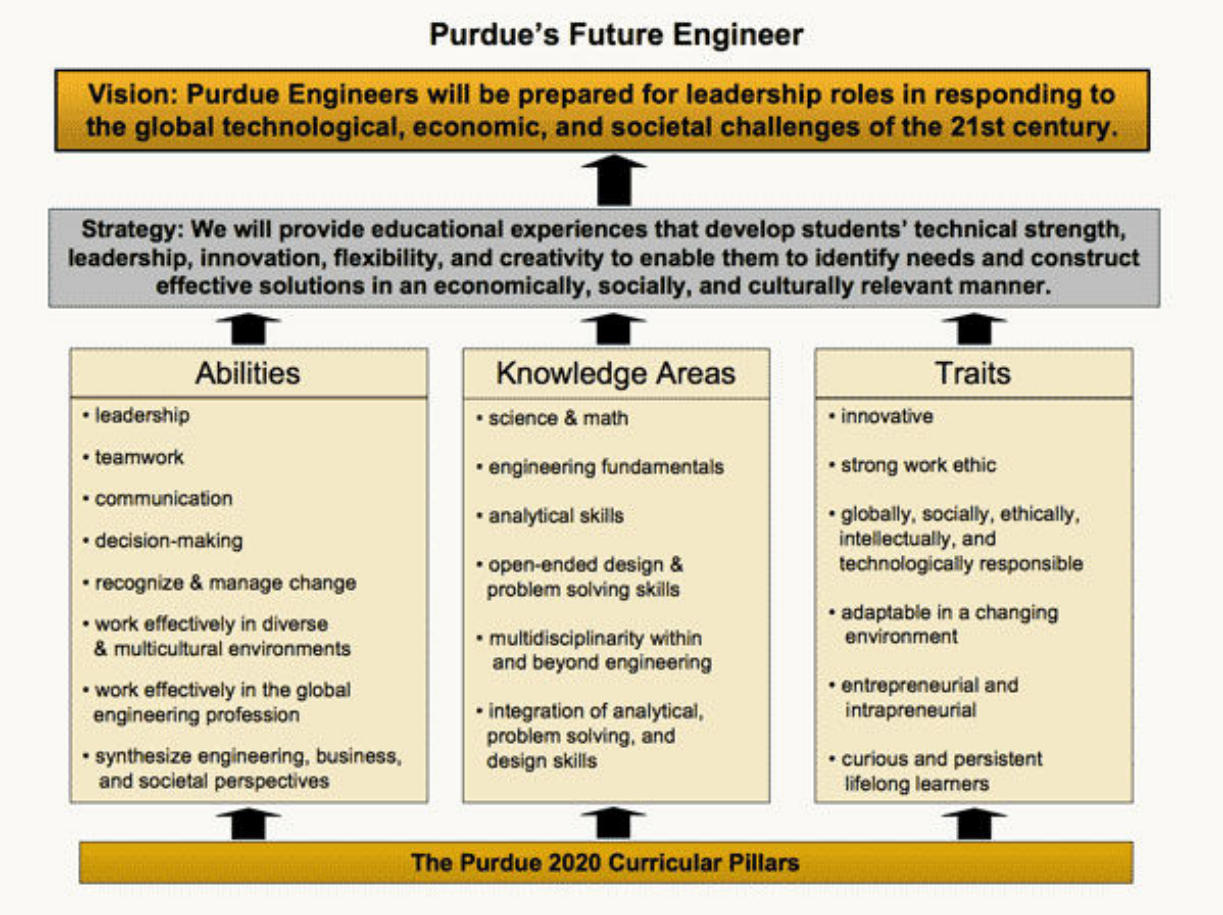
a. faculty are recruited, rewarded and promoted primarily based on their potential and ability to create new knowledge and expand their technical expertise and esteem;

b. teaching priorities have traditionally focused on delivering the "hard" skills rooted in math, science and engineering fundamentals including design, problem-solving and analytical components.

We know from our own faculty that they do value teaching and student learning. They agree that the non-technical, leadership abilities or "soft" skills demanded by employers and the councils advising our engineering deans, and identified as career critical by engineering education interest groups such as ABET Criterion 3: A-K, the National Academies, and the Council on Competitiveness are important. In fact, they have identified a strategy path for the engineering curriculum that embraces the NAE aspirations (see Table 1 below).

Ironically, while successful faculty are indeed very accomplished at these non-technical skills, they are a bit confounded when asked how to achieve a curriculum that provides the requisite technical foundation, allows students to graduate in a reasonable time, and incorporates these non-technical imperatives.

TABLE 1: Purdue's FUTURE ENGINEER Curriculum Strategy



Observation 2: *students are a living dichotomy –*

a. idealistic and fresh they have tremendous capacity to start new things energized by the passion of their desire and blinded to daunting barriers and hurdles by the naiveté of their under-experience;

b. full of bluster and confidence born from a short life, well lived in a narrow frame of reference, they also tend toward conservatism and complacency that translates to risk aversion, intolerance or at least impatience for experiential differences, fear of failure and mistrust of the unknown.

This split personality of brilliance and bluster often leads to a kind of compartmentalization of all things into rather black and white categories; good/bad, smart/dumb, valuable/junk, worthwhile/meaningless, etc. and unintentional devaluing of people, places, approaches, and ideas that fall outside this comfort zone built from naiveté and under-experience.

Threat: students graduate strong on fundamentals, but short on vision, creativity, expressiveness, openness, and flexibility; thin on global perspective and multicultural appreciation; reticent to press the boundaries of what already is; short-sighted about the value of other experiences and viewpoints; inflexible and unimaginative in pursuing unanticipated opportunities; in short, lacking the abilities that will differentiate them as great thinkers who approach issues with ingenuity and add tremendous value to an organization's competitive agenda.

Opportunity: enhance technical teaching with global experiential learning by challenging students to leave their comfort zone, test their assumptions, expand the boundaries of their frame of reference, internalize cultural identity, experiment with the creative process, explore new lands and people, learn through inquiry and analysis, and synthesize all of this through a multidisciplinary, team-based, systems oriented engineering feasibility study of the EPICS service learning model.

Course Objectives

The six credit course, ***ENE 595G Global Leadership and Innovation,*** provided an intercultural experience that

1. immersed students in the Greek Cretan culture and reinforced their own cultural identities;
2. explored the creative process and exercised a variety of communications techniques;
3. synthesized their experience through a feasibility study of the Engineering Projects in Community Service (EPICS) design through service learning curriculum; and
4. developed teamwork and a sense of community across ages and disciplines.

Course Leadership

Instruction was a team effort that included included Carolyn Percifield, Director of Strategic Planning and Assessment; David Bowker, Director of Undergraduate Recruitment; Demetra Evangelou, Professor of Engineering Education and Amanda Newton, a Purdue alumna and Industrial Engineer at Ingersoll Rand.

Our team was diverse in skill sets and experiences including: leadership, EPICS, engineering, Greek language, market analysis, global experiences, team building, report writing, presentations, and humor. The creativity exploration was lead by Shelley Berc, professional stage writer and Alejandro Fogel, multimedia artist both former faculty of the University of Iowa.

Student Participation

The course was open to all engineering majors at all grade levels, who were in good academic standing at the University. It was strategically calendared to allow students the time to complete ten weeks of summer internship or coop employment or Purdue's eight –week summer session upon returning from Greece.

This breadth of student pool allowed us to attract twenty-one students from the one hundred plus who attended the call-out or contacted instructors. The class included students from nine of Purdue's twelve engineering disciplines and a practicing engineering enrolled in the distance learning program (EPE). Seven women and five African-American distributed across all grade levels from freshman through Ph.D. Please see details in Table 2 below.

TABLE 2: ENE 595G Student participants

	Gender		Ethnicity		Total
	Male	Female	Caucasian	African-American	
Freshman	1	1	2	0	2
Sophomore	5	1	6	0	6
Junior	7	2	6	3	9
Senior	1	1	1	1	2
Grad	0	2	1	1	2
Total:	**14**	**7**	**16**	**5**	**21**

* Majors included: AAE, BME, ChE, CE, CEM, EE & CompE (from ECE), IE, MSE, ME, and MDE (from EPE).

Course Credit

ENE 595G was created as a six-credit hour graded course. Each engineering discipline evaluated the graduation credit based on its specific requirements. Undergraduate students received between three and six credits of general, technical and/or free elective credit, while neither graduate student was granted credit toward graduation. All students received graded transcript credit, however. In addition to the timing and graded credits, structuring it as a six-credit course allowed students to apply for federal financial aid, which we believe had a very positive impact on the number of students who participated.

Location

The students were housed at the Mediterranean Agronomic Institute of Chania (MAICh). This is a global institution that attracts graduate students from all over the world. It proved to be a very rich environment for our students to learn about multiple cultures, develop professional and social networks, and explore a variety of viewpoints that were helpful in their project research.

Course Structure and Execution

The course was executed in three distinct yet integrated phases to meet and reinforce student learning objectives. This consisted of one week on campus, a cross-cultural synthesis project, and a six day creativity workshop. Table 3 below highlights the class schedule.

TABLE 3: Class Itinerary

May 15-19	Pre-travel intensive incl. readings, guest speakers, Greek dinner; group exercises & Phase I team project research, presentations, & submission of preliminary reports.
May 21-22	Travel to Chania; welcome reception; journaling begins and continues throughout
May 23-26	Phase II team project research & interviews; excursions to Knossos & Samaria Gorge; lunch with Technical University of Crete students
May 27-28	Free weekend for independent exploration of Crete & environs
May 29-30	Phase II team project research & interviews; tour of EADS (a defense manufacturer); tour of MAICh research labs & gardens
May 31	Phase II team project culmination with presentations & submission of final papers; Cretan night celebration with invited guests & MAICh students
June 1-6	Creative process exploration; visit to local family home and their cheese, wine, & olive oil making businesses; develop and submit group multimedia PPT & personal dissemination plans
June 7	Return to United States

Pre-travel Intensive

One key aspect of the pre-travel course work was to acknowledge the "American and Purdue cultures" and gain perspective on the culture of Greece and specifically the Island of Crete. Native Greek faculty gave presentations on current social, political, educational, and business systems; the impact of history on culture and technological development; and provide some insights as to local cuisine, language, and geography. Students were challenged to compare/contrast Purdue and United States cultures to Greek culture.

Each student was required to maintain a hard copy journal, as well as an on-line journal (Wiki-based) to articulate, reflect on, and synthesize their experiences throughout the four weeks. This was introduced in the first week of class.

One very interesting exercise had students complete an on-line character assessment, Globe Smart by Aperian, which presented students with a personal profile. Each profile consisted of six attributes that they could then compare to those of other class members, people from the U.S. and other countries, and even the course instructors. The six dimensions were arranged in continuums as follows:

Independent – Interdependent

Egalitarianism – Status

Risk – Restraint

Direct – Indirect

Task – Relationship

Short-term – Long-term

By comparing profiles, we were able to discuss style differences, group dynamics and characteristics, and the value and dangers of generalizing group attributes to individuals.

The team synthesis project was introduced on campus and was based on doing an engineering-type feasibility study using an academic model (Engineering Projects in Community Service) as the subject being evaluated for fit and adaptability in the Greek social and educational system. By comparing and contrasting the cultural systems of the U.S. and Greece, students were forced to synthesize their global experience, the underlying systems and values that define being American, and their understanding of the systems and values that shape Greek culture.

Engineering Projects in Community Service (EPICS) is a service learning program started at Purdue that pairs engineering students with community agency partners. Teams were required to evaluate and hypothesize if and how this model might be effective in Chania and develop creative alternatives. The first step was to help them develop a common understanding of the values and goals of the EPICS program. Guest speakers included faculty director, Bill Oakes, and two representatives from local partner agencies. The key characteristics of EPICS include:

- Multidisciplinary engineering design course that provides engineering and non-engineering students the opportunity to work together with not-for-profit community partners on technically based problems
- Long-term (multi-year) team projects that give students real-world experience and application of skills simultaneous with education in service learning environment

Teams of students mixed by majors and grade levels were organized on the first day of class and began researching the cultural institutions of Greece and the U.S. Each team was expected to deliver a preliminary paper (Phase I draft) before leaving the country that outlined its interpretation of the EPICS model, compared the two countries cultural systems, articulated assumptions and offered a recommendation based on their understandings, and identified the questions that needed to be asked and sources who might provide perspective to validate or debunk the team's assumptions and recommendations.

Synthesis Project in Chania, Crete, Greece

Upon arriving in Chania, students immediately began the on-site project research. Interviews were scheduled with local authorities and class excursions to Knossos, the Samaria Gorge, EADS (a defense contractor) were included to give students perspective on the culture, history, and geography of the region, as well as provide contacts for possible project topics.

The majority of the interviews were with local agency representatives to identify interest and opportunities for service learning type projects and evaluate how this program might be structured to be successful within the Greek culture. Each of the five teams had identified topic areas that merited exploration including: education, the environment, and preservation of historical artifacts and sites.

Interviews were conducted with the Minister of Education, with municipality officials, with local elementary school teachers, and with representatives from the tourism bureau, environmental agencies, museums, and other agencies. The art of setting up meetings, traveling to location, overcoming language barriers, describing the EPICS concept (service learning), and extracting

pertinent information was an invaluable experience for the students. New topic areas were discovered and assumptions and recommendations confirmed or denied.

For example, one team had planned to package their model in the form of an academic competition similar to the popular Science Olympiad in the U.S. They were very surprised to learn that the concept of academic competition was completely foreign to Greek school administrators. They not only had difficulty understanding the concept described by the students, but when they did understand they expressed a strong aversion to pitting students against each other in a learning situation. They explained that in the Greek culture equality of education was highly valued and while grades were given as a measure of progress it was not done in the spirit of educational winners and losers. The team had to completely redirect their efforts to revise their assumptions and identify alternative solutions.

One of our objectives was to enable dialogue with local engineering students and faculty from the Technical University of Crete (TUC) to understand higher education, service learning as a concept, and potential fit for EPICS within their curriculum structure. An unforeseen obstacle occurred when we learned that the students, who have a powerful voice in the politics of education in Greece, were on strike. In that situation, we were not allowed on campus (nor were their own faculty!).

We did manage a luncheon held at a harbor-side restaurant with a handful of students, one administrator, but no faculty. Some of the lessons learned included:

1. Greek students do very little collaboration with organizations to gain work experience,

2. All courses end in a final exam, whereas EPICS concludes with a design review,

3. Motivation may be low for students if it does not benefit in faster access to employment, and
4. The general idea of real engineering experience was of interest,

5. One TUC faculty member was involved in a service learning style project with an educational center using wind tunnels, and

6. Much deeper collaboration with the university would be needed to accurately evaluate TUC's possible involvement/adaptation of EPICS in its curriculum.

Observations of Student Learning

Looking for Trouble – As students engaged with the experts that they identified, they urged them to share their needs. The students and interviewees would restate the needs until all perspectives were assimilated into a common vision. This transformation of the problem definition helped students be more flexible in their thinking and enhanced their awareness of differences.

Judging from the Look of Things – Students expanded and tested their assumptions by "seeing" their new environment. But sometimes all was not as it appeared. For example, in a crowded elementary school computer lab there was very advanced technology in use allowing classrooms to communicate and collaborate across geographies. The implication was not only advanced instrumentation, but a high level of technical support. However, a fairly simple IT glitch had

rendered one group of stations useless due to lack of on-site IT support to resolve the issue (which was done on the spot by a computer engineering undergrad).

Individual Expertise – Student interests in particular areas allowed them to probe or steer potential project discussions in directions aligning with their particular area of expertise making the problem negotiation very efficient. Two examples include development of a topic on sea turtle preservation and one on flexible use lighting and electronics configurations in a municipal theater.

The deliverables from the team synthesis project were group presentations and a final (Phase II) paper that revised all previous understandings and assumptions and delivered final recommendations.

Exploring the Creative Process

The final six days students focused on creativity and how individuals can develop personal and group tools to open us to new ideas, allow a variety of non-traditional stimuli to fuel creativity and innovation, and value and welcome diverse points of view in developing new approaches. Students participated four hours a day in individual and group exercises including; map making, visualization, automatic and collaborative writing, automatic drawing, and group constructions.

Homework was assigned that required observing the local people and environment, seeing people, objects, buildings, etc. through a camera lens (sometimes intentionally blurred), imagining the stories of the people of our observations, describing through sketching and storytelling, and many other interesting techniques to draw on the many senses that fuel imagination and inspire curiosity.

For some, this was discomforting, especially those who tend to be linear, analytical, and have a prescribed system for solving problems. It did challenge them to stretch out of their comfort zone and open their minds to new approaches. Others were grateful for the opportunity to use creative gifts that are often viewed as irrelevant. All struggled a bit with the enforced slower pace and self-reflection demanded by the instructor.

The Value of a Free Weekend

While a group flight to and from Crete was offered for convenience and parental comfort, a weekend off gave students the opportunity to make their own adventures and misadventures. While this may seem trivial, our intent was to allow a controlled amount of time for students to leave the city and/or Crete under their own guidance, and in the process develop a sense of accomplishment and confidence in their ability to navigate a foreign environment. We made no restrictions other than to ask that they do it in groups of at least two and to "file" a travel plan in case they did not show up at out Monday morning meeting. Happily all returned with marvelous stories of car, bus and boat trips, hide-aways in olive groves, island hopping, and views of the Acropolis.

Class Assignments and Grades

Table 4 below highlights the graded assignments required throughout the course. Part of the student's responsibility was to package their experience to encourage more engineering students to participate in study abroad. Individuals were required to develop a dissemination plan that creatively marketed to students and contribute to a class presentation that could be used in many venues.

TABLE 4: Grading Structure

Phase I Team Project Report	30 points
Final Team Project Report	60 points
Final Team Project Presentation	40 points
Individual Participation	80 points
Individual Written & Wiki Journals	40 points
Individual Dissemination Plan	30 points
Class Multimedia Presentation	40 points
Creativity Homework & Participation	50 points
Creativity Culminating Project	30 points
Total	400 points

Course Evaluation

Students were overwhelming favorable in their value of the experience, giving the course as a whole a score of 4.1 out of a possible 5 (Excellent) and evaluating the value to their broadened multi-cultural understanding a perfect 5 of 5. The students responded well to the challenge of a fairly open-ended project assignment and interviewing primary source experts whose English language skills were nominal.

Team teaching in a foreign environment also presented challenges that required agility on the ground and constant vigilance to strive for consistency of message. Predictably, the two metrics that fell below acceptable reflected student perception of incongruence when teams met with us individually and the scurrying to fix unanticipated obstacles such as building alarms sounding when we accessed our 24/7 accessible computer facility!

Table 5 below highlights some of the metrics we had students evaluate.

TABLE 5: Selected Course Metrics

Metrics for Course Structure & Content	**Mean Score**
Overall I would rate this course as	4.1
The course was creatively planned	3.9
Class mix of grade levels added value	4.9
Size of class was appropriate	4.8
Climate of class was conducive to learning	4.1
Course activities & projects involved me in learning	4.4

Course flexibility helped all kinds of students learn	4.1
Collaborative work was a valuable part of this course	4.8
The course provided opportunity to learn from other students	4.6
Each student was encouraged to contribute to class learning	4.5
The course supplied me with an effective range of challenges	4.1

Metrics for Student Outcomes	**Mean Score**
Overall the course contributed significantly to my professional growth	4.5
This course broadened my understanding of people from different cultural & ethnic backgrounds	5.0
The course was intellectually fulfilling for me	4.1
This course fostered respect for new points of view	4.6
This course helped me synthesize information from several sources	4.4
This course helped me develop confidence in myself	4.0
Oral presentations helped me develop my communications skills	3.9
This course developed the creative ability of students	3.5
This course helped me understand the nature of group work	4.1

1=Poor, 2=Fair, 3=Average, 4=Good, 5=Excellent

Conclusion

We all grew and learned from the experience. Results from a national cultural attitudes survey (IRI) done pre- and post- experience will be available soon and we hope to learn more about the impact of the experience. The course has been modified for round two in Volos, Greece this summer and one important feature is the explicit inclusion of a Greek university partner, University of Thessaly.

Anecdotally, our students have uniformly expressed appreciation for the quality and power of the experience. In one student's words:
"I have traveled in Europe many times, but I never had an experience like I did this past May. I learned so much not only about Greece & other cultures, but about myself …I believe that because of the whole experience I will be not only a better engineer, but a better me."

Bibliography

1. National Academy of Engineering, The *Engineer of 2020: Visions of Engineering in the New Century, 2004*, pgs 49-52
2. Council on Competitiveness, *National Innovation Initiative Summit Report, 2005*, pg 8
3. New York Times (December 13, 2006) editorial "Learning to Keep Learning," Tom Friedman
4. National Academies, *Facilitating Interdisciplinary Research, 2004*, pg 21?
5. Mark Vickers, Human Resource Institute, *Innovation & Creativity*