Teaching Engineers Cross-Cultural Skills – A Case Study

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Abstract
This paper describes the teaching of cross-cultural skills to U.S. mechanical engineering students studying in a semester abroad program in Nantes, France over the past seven years. Issues explored include differences between the American and French academic experience for our students, defining the term "cross-cultural skills," topics covered, how the content is taught and who teaches them, the evolution of our cultural program, ABET assessment, and success/failures. This ongoing effort includes faculty in France and the U.S., as well as French and U.S. engineering students, and has been well-received on both sides of the Atlantic.

Introduction and Background

Engineering employment is becoming an increasingly global endeavor. The might of U.S. industry has been challenged by competing economies in developing nations like China and India, and more developed regions like the European Union. At the same time, new opportunities are developing for U.S. engineers in the form of international jobs or domestic jobs with an international flavor. These may require engineers to work as part of an international team in the U.S. or even an overseas posting.

These new international opportunities require different skills compared to the old "domestic-only" jobs of the past. Cross-cultural skills are especially important, but not always easy to teach or incorporate into an engineering curriculum. How are the engineers of tomorrow prepared for the new multi-cultural realities of the workplace? These may include dislocations of both time and space (i.e., communicating with another time zone or moving your work place overseas), as well as managing in another language or culture.

Academic programs have tried a variety of approaches to teaching engineers cross-cultural skills - just a few examples are shown in Table 1 below. Most approaches fall into three broad categories:

(a) Teaching cross-cultural skills in a classroom or laboratory setting without actually leaving your home culture.
(b) Leaving your home culture and experiencing another culture.
(c) Combination of approaches (a) and (b), i.e., focusing on describing/teaching the skills (theory) and experiencing or "trying out" the newly acquired skills in a foreign culture (practice).

Most programs combine classes with short-term (less than a semester) travel, with relatively few programs featuring a full-semester of foreign study.

Table 1 - Example Approaches to Teaching Cross-Cultural Skills to Engineers

Program/School	Approach
ESL (English as a Second Langauge) class for foreign engineers, FH JOANNEUM Univ. of Applied Sciences, Austria[1]	Teach cross-cultural skills in the context of an English language class for engineering students. No travel involved.
Global Case Studies class, Iowa State[2]	Teach cross-cultural skills using the case study approach. No travel involved.
"Design for Society" course, Penn State[3]	Study influence of culture on the design process. Short-term trip to London, England.
Global Virtual Teams Course, Brigham Young University[4]	Capstone design linked electronically to projects and teams overseas. Short-term travel for some students.
"Ansanm" Program, Harding University[5]	Design project in Haiti managed from the U.S. by students. Some short-term travel to Haiti by selected students.
Foreign Campus Cross-Cultural Studies, Rochester Institute of Technology, Dubai campus[6]	American faculty teaching foreign students at an international campus in English. Use of cross-cultural issues to enhance communication.
Georgia Tech Undergraduate Program, Lorraine Campus, France[7]	Full semester study abroad for U.S. engineering students in English, but located in France. Cross-cultural exposure mainly experiential.
Global Citizenship Program, Lehigh University[8]	Multi-year cross-cultural study track for engineers with some foreign study options.
International Engineering Program, University of Rhode Island[9]	Combined foreign language/engineering program with required foreign internship. Cross-cultural exposure mostly experiential with diverse coursework.

Full immersion, semester-long study abroad programs (the focus of this paper) are used to teach cultural competency, but these programs may be difficult for engineers to take because of the required core engineering classes that may not be offered overseas in the same format. Other difficulties include: smooth transfer credit, high costs, and cultural and language barriers.

Our Program

Grove City College (GCC) launched an International Study Center (ISC) in Nantes, France in 2006 to address the challenges listed above. The ISC acts as an extension campus to GCC which allows American mechanical engineering students to spend the Fall semester of their junior year abroad and also complete their ABET curriculum on time. Students are dual-enrolled at GCC and at ONIRIS (the host university in France, specialty in agricultural engineering) giving them the visa status they need to study in Europe. Courses are taught in English using live on-site lectures/lab experiences for 60% of the classes and simulcast web-conferencing for the remaining 40%.

A total of 15-20 students live at the study center (approximately 2/3 of the students are mechanical engineering majors and 1/3 other majors). The fall semester was chosen to help balance study abroad numbers, as most of the students in other majors at GCC study abroad in the spring semester. Up to 40% of the graduating class in mechanical engineering spends the fall of their junior year abroad at the ISC in France.

What makes ***our program unique compared to other programs*** is (a) that cross-cultural skills are explicitly taught in a class that includes both visiting U.S. students and local French nationals, (b) the program lasts a full semester in a foreign country, (c) there is a high

participation rate among U.S. engineering students (expressed as a percentage of the graduating class).

Key Differences

Some of the key differences between the educational experience our students see in the U.S. and France are shown below in Table 2. These differences have shaped the cultural program in France as students complete their coursework overseas.

Table 2 - U.S./France Educational System Differences

U.S. System at GCC	French System as Perceived by U.S. Visitors
ABET regulates engineering education	No ABET, the French equivalent is quite different
strong system of outcomes, assessment, and ongoing improvement	assessment and ongoing improvement are ad hoc; e.g., student evaluations of teaching or course content rarely occur
fall semester runs from end of August to just before Christmas	fall semester runs from end of September thru end of January - breaks are different (e.g., no Thanksgiving)
mechanical engineering at our home campus; H.S. + 4 years, ABET undergraduate	agricultural engineering at partner campus ONIRIS in France (this was the campus closest and most willing to work with us); H.S. + 5 years, graduate level, master's degree
no special immigration status needed	special student visas needed, full-time student status in France, and a sponsoring French University ONIRIS
instructional language is unilingual English	instructional language is primarily French with some classes in English; students speak both French and English
American culture only	blended mixture of American and French culture with exposure to French nationals including students and faculty

Defining and Teaching Cross-Cultural Skills

What is meant by the broad term "cross-cultural skills"? For the purposes of this paper, it means the following:

- "***Cross***-" is communicating between two different cultures.
- ***"Culture"*** is a unique set of values or customs associated with a group of people like the "French" versus the "Americans."
- ***"Skills"*** are learned as opposed to a talent or gift which is innate. In the context of this program, these are the ***business or project management skills*** used to manage people and projects.

There are several approaches to teaching cross-cultural skills. All of these address the same basic questions:

- What content should be taught?
- How should the content be taught?
- Who should teach?
- How is it known that students have "caught" the skills that were taught?

What Topics? How Should They be Taught? Who Should Teach?

Perhaps the biggest debate after the theory versus practice question is the question about what cross-cultural topics should be covered. This tends to focus on "soft" skills that are largely qualitative (e.g., managing teams of engineers with different cultural backgrounds) versus "hard"

skills which are more analytic (e.g., a numerical scale that assigns numbers to qualitative cultural values).

Table 3 shows some example cross-cultural skills and the techniques used to teach them. The difference between soft and hard skills can be subjective, with many skills not falling entirely into one category or the other. Anthropologists/sociologists might argue that introducing business systems like Six Sigma and using them to teach cross-cultural communication is not "correct" or "pure." Our program ignores these finer distinctions and focuses rather on ***skills of immediate usefulness to engineers working internationally***.

Table 3 - Example of Hard versus Soft Cross-Cultural Skills

Soft Skill	Hard Skill
general stereotypes about human behavior and management habits in different cultures	***Geert Hofstede's theory***[10] of cultural dimensions, numbers assigned to cultural behavior (scale of 1-120)
broad management principles that apply to all situations independent of culture (e.g., clearly define project goals)	management systems that are applied cross-culturally because they create a special unifying vocabulary, normally with "hard metrics" used to measure project success (and thus cross-cultural skill); the ***Six Sigma (6S)***[11] management system popularized by Jack Welch at General Electric focuses on statistics and process control with metrics, but is used by cross-cultural engineering teams
sharing anecdotes about cross-cultural communication and management experiences	BaFa BaFa cultural ***simulation game***[12] that helps participants quantify their feelings of cultural isolation and adaptation to change (really a hybrid hard/soft skill tool); ***case studies***, e.g., Cola Wars case study[13] that examines the Pepsi-Coke-Cola drink business in a global setting and introduces basic statistical analysis and business tools

The "BaFa BaFa" Game is a good example of a popular ***participatory tool designed to teach cross-cultural skills and team building***. This business simulation game was developed in the 1970's to teach cultural sensitivity and adaptation to U.S. Navy sailors visiting Greece. For example, sailors unfamiliar with the Greek system of bartering felt that they had been cheated if two sailors paid different prices for the same item (something that would never happen in the U.S.). The game attempts to give participants cultural training BEFORE they experience the shock of a new culture.

BaFa BaFa introduces two fictitious cultures (the Alpha and the Beta culture) and lets participants experience cultural shock and adjustment as members of these cultures. BaFa BaFa (or simulations inspired by BaFa BaFa) has been used by virtually every major U.S. Corporation and university over the past 35 years, making it one of the most popular cross-cultural simulation games. An academic license was purchased to run the game in France and it worked extremely well.

Our program has evolved as various cross-cultural skills were taught with different approaches and with varied success. Table 4 shows this evolution over the past seven years; most years included a mixture of soft and hard cross-cultural skills and in-class theory and practice.

This program has moved from a stand-alone program with limited interaction with local language/culture to extensive interaction with the local academic partner. This has included; a

management class with both local French students and visiting U.S. students, French students traveling to the U.S., and language/cultural exchange events, including dinners and language tutoring[14,15,16].

How the class is taught and who teaches it has also evolved from classroom lectures for just U.S. students to participation exercises involving U.S. and French students taking the class together. We now have a healthy mix of live lectures, recorded lectures, web conferencing, field trips, and group exercises led by an international team of professors.

Have students caught the skills? (Assessment of Student Outcomes)

The ISC offered course that is most closely associated with teaching cross-cultural skills in France is "Engineering Management." This class has two course outcomes that are used to assess four different ABET student outcomes (indicated below).

Course Outcomes:

1. Understand cross-cultural management and working with an international team. (supports ABET student outcomes d, g)
2. Understand and apply selected management techniques. (supports ABET student outcomes e, k)

Associated ABET student outcomes:

d) An ability to function on multi-disciplinary teams.
e) An ability to identify, formulate, and solve engineering problems.
g) An ability to communicate effectively.
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The course outcomes are assessed through class participation**,** quizzes, homework, and tests. An example of student assessment of cross-cultural skills is shown below in Table 5. Students are required to memorize this simple chart using a mnemonic and to explain in detail each point of difference in a closed-book test.

A good example of the variation in perceived student satisfaction towards how cross-cultural skills are taught is shown below in Fig. 1. Note that 5.8 (out of a maximum score of 7) is the average score for student satisfaction for a typical GCC class. Clearly, student sentiment changes from year to year in response to changes in the course material. Students especially seem to enjoy field trips with French classmates (Figs. 2,3)

Table 4 - Cross-Cultural Skill Evolution

Year	Cross-Cultural Skills/Topics	Approach or Teaching Technique
1 (Fall'06)	FRENCH 101 to teach students the French language	standard language instruction and practice
	living and working in France, day to day language and cultural challenges	day to day experiential learning
	general project management skills applied to a project in France run by U.S. student engineers	class project to create the France ISC including academic structure, meal delivery, housing plan, ISC house cleaning, and other organizational tasks; limited interaction with French nationals
2 (Fall'07)	introduce field trip program to teach French language and culture: 6 weeks of cultural field trips, e.g., weekend trip to Paris	field trip quizzes test cultural material and supplement experiences, lectures
	basic management content/tools for communicating across cultures	traditional lectures
3 (Fall'08)	introduce academic and industrial visits in France, case studies	mainly cultural observation
	language/culture bus tours	U.S. and French students take a joint bus tour for cultural exchange
4 (Fall'09)	begin joint classes with French students	cultural interaction with local students
5 (Fall'10)	begin language partnering with French students; more intensive language and cultural interaction	mainly cultural interaction
	French student exchanges to the U.S. develop further	French students coming to U.S. partner school continue cultural interaction
6 (Fall'11)	Six Sigma project to improve student cafeteria experience in France	class project with combined U.S. and French student team; extensive cross-cultural interaction
	begin required weekly class dinners (after evening class) at local restaurant	cultural interaction
7 (Fall'12)	dual simultaneous enrollment at U.S. and French partner university	teaches cultural interaction and integration with French educational system
	introduce language interviews: U.S. students required to interview a French national (in French) about a cultural topic	one-on-one cultural interaction and communication
	BaFa BaFa cultural simulation game with French students	Cultural game simulation with U.S. and French students
	Cola Wars case study with in-class taste test; intercultural communication case study with Japanese business man; sexual harassment case study	interactive case study with U.S. and French students, some statistical tools
	some lectures transmitted from the U.S.	synchronous and asynchronous web-conferencing introduced to class associated with cross-cultural skills (real-time and pre-recorded lectures, U.S. to France)

Table 5 - Cultural Differences Between France and the U.S. that can Affect Project Management

France	**U.S.**
1. People-oriented	1. Project-oriented
2. Consider past, present, future	2. Consider only present, future
3. Time is flexible	3. Be on time
4. Employee orientation	4. Customer orientation
5. Reserved at first	5. Friendly at first
6. Quiet and more thoughtful	6. Loud and more direct
7. Leisure-orientation	7. Work-orientation

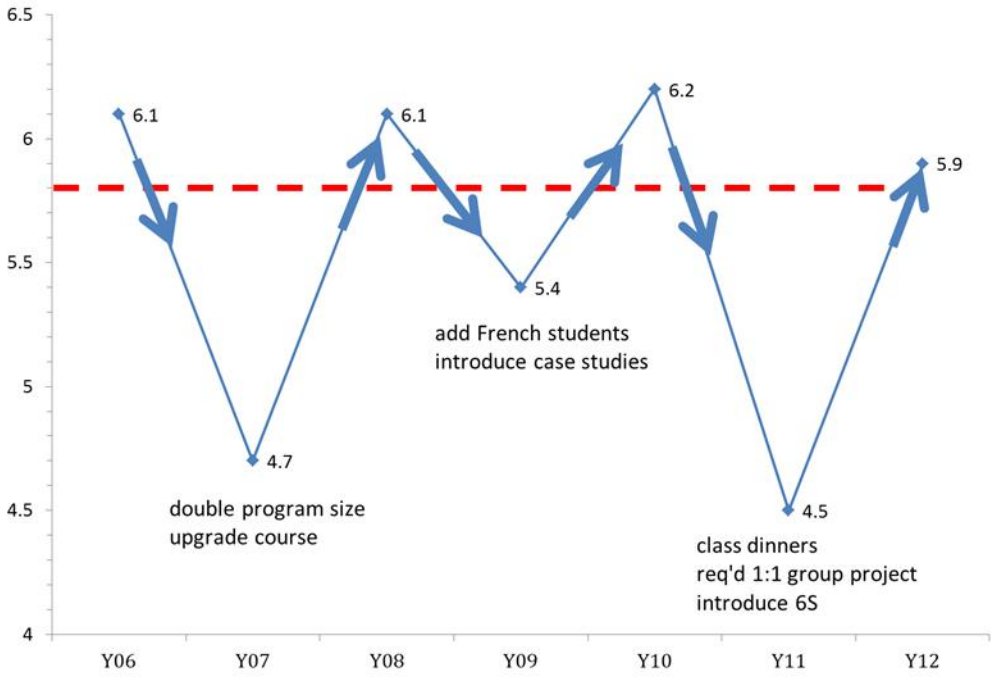

Fig. 1 - Student satisfaction with teaching of cross-cultural skills in associated management class.

Fig. 2 An American student (between two French students) endures a difficult language exchange on the tour bus.

Fig. 3 American/French group of engineering students on joint cultural tour designed to foster interaction and intercultural exchange.

Conclusions

Teaching U.S. engineering students cross-cultural skills in our full-semester program in France has been well received by both students and faculty. The program has evolved over the past seven years to include a careful definition of the term "cross-cultural skills," a diverse collection of course topics, and more refined ABET assessment. Topics now include quantifying aspects of cultural dimensions using numerical tools like Geert Hofstede's theory, simulation games like "BaFa BaFa," and management tools that can be applied across cultures like Six Sigma (6S).

Program activities have also evolved to include significant interaction with French classmates in the form of field trips, class dinners, language tutoring, and joint class projects. Students particularly enjoy class field trips and language events. Evidently, actually implementing cross-cultural skills is more fun than reading about the theory of intercultural interaction in a book.

Our program continues to change, even though we are entering year 8. Some of the challenges experienced include the following:

1. Difficulty in finding a good university partner and integrating into the French educational system, including obtaining student visas for U.S. students.
2. Year to year variation in student perception of course quality and the value of cross-cultural skills. Significant changes to the cultural program often produced significant drops in student satisfaction until the changes were absorbed and integrated into the program.
3. Difficulty in finding course material on cross-cultural skills for engineers.
4. Coordinating our international teaching team: U.S. faculty in France, French faculty in France, and the U.S. faculty in the U.S. participating thru web-conferencing.
5. Managing web conferencing tools and synchronous lectures. Some lectures are transmitted in English from the U.S., but these are often hard for French students to understand. U.S. and French students work in language pairs to help French students understand the English course material, as well as help U.S. students with their French communication skills.

Future plans include exploring the following ideas:

1. Focusing more on "soft" management skills and "hard" skills that attempt to quantify these soft skills. How can engineering managers work effectively across language and culture?
2. Evaluate the cross-cultural topics covered to make sure we have an ideal mix. For example, how should case studies be used?
3. Further refine the use of English and French in and outside of the classroom. There can be significant miscommunication between students and faculty because of the language barrier.
4. Include more participation from our French faculty team in teaching in France.
5. Better coordination between U.S. students who go to France and French students who come to the U.S. campus as part of our exchange program.
6. Investigate the use of more guest speakers.

Despite the significant challenges of offering a residential semester-long program in France, we feel the benefits outweigh the costs, and we are excited to move ahead with teaching cross-cultural skills to engineers.

Bibliography

[1] Tatzl, D., 2009, "Raising the intercultural Awareness of Engineering and Business Students in an Austrian Bachelor and Master of Science Program in Aviation," AC 2009-46, ASEE Annual Conference.
[2] Rectanus, M., 2013, "Transdisciplinary Case Studies as a Framework for Working in Global Project Teams," Vol. 6, Issue 1, Article 9, Online Journal for Global Engineering Education.
[3] Ciocci, R., 2005, "Delivering an International Experience to Students in an Intercultural Engineering Course," paper no. IMECE2005-82806, ASME Intl. Mech. Engr. Congress.
[4] Zaugg, H. et al., 2011, "Creation and Implementation of a Backpack Course to Teach Cross-cultural and Virtual Communications Skills to Students in an International Capstone Experience," AC2011-291, ASEE Annual Conference.
[5] Huff, J. et al., 2011, "Ansanm: A Cross-Cultural, Interdisciplinary Approach to Learning Human-Centered Design," Proceedings of the ASEE Midwest Section Conference.
[6] Friess, A. et al., 2012, "Enhancing Cross-Cultural Interaction in Courses with a Large Component of Visiting Study Abroad Students," AC 2012-3387, ASEE Annual Conference.
[7] www.georgiatech-metz.fr/undergraduateprogram (Georgia Tech Lorraine undergraduate website)
[8] Grudzinski-Hall, M. et al., 2007, "Engr. Students in a Global World: Lehigh University's Global Citizenship Program," Vol. 2, Issue 1, Article 1, Online Journal for Global Engineering Education.
[9] Erickson, L., 2012, "I Can Intern in France! Student Perceptions of Success during Their International Engineering Internship," Vol. 6, Issue 1, Article 6, Online Journal for Global Engineering Education.
[10] Hofstede, G. et al., 2010, "Cultures and Organizations: Software of the Mind," 3rd ed., New York, McGraw-Hill.
[11] George, M. et al., 2005, "The Lean Six Sigma Pocket Tool Book," Kindle Edition, New York, McGraw-Hill.
[12] Shirts, R., 2013, "BaFa BaFa Cultural Simulation Game," www.simulationtrainingsystems.com.
[13] Yoffie, D., 2011, "Cola Wars Continue: Coke and Pepsi in 2010," Harvard Business Case Study #9-711-462, Cambridge, MA, Harvard University.
[14] Bardy, E. et al., 2010, "A Blended Immersion Program in France", Poster Presentation, 13th Annual Colloquium on International Engineering Education, Newport, RI.
[15] Clauss, M. et al., 2008, "A Successful Model for Engineers Studying Abroad: A Foreign Study Center with Concurrent Instruction," Proceedings of the 115th ASEE Annual Conference & Exposition, Pittsburgh, PA.
[16] Bardy, E. et al., 2011, "International Based Engineering Management Course at Foreign Study Center with French University Partnership," ASEE North Central & Illinois Indiana Section Conference, Mount Pleasant, MI.