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# Compact International Experiences: Expanding Student International Awareness Through Short-Term Study-Abroad Courses With Substantial Engineering Technical Content

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## ABSTRACT

Compact International Experience (CIE) courses are investigated as a suitable tool to raise student international awareness while retaining substantial engineering technical content. These courses were developed due to a strong student desire for engineering international studies as well as a drive by the home institution for internationalization of the curriculum. The efficacy of such courses is described through experiences gained from delivering two distinct three-semester-unit engineering elective courses in a three-week time frame in France and Australia. While each of these courses, Topics in Fluid Mechanics and Advanced Electronic Circuit Design, focused on its technical content, the desire for student understanding of the cultural environment and the impact of engineering solutions from a global and societal viewpoint were strong driving factors for each. Assessment validates the hypothesis that CIE courses can successfully deliver substantial engineering technical content while providing an enriching international experience to students.

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## I. Introduction

Over the past decade, the number of university students involved in an international experience has increased by 88% (Institute of International Education, 2011). There are a variety of reasons for this increase including a desire of students to incorporate global competencies in their studies and a drive by the institutions for internationalization of the curriculum. Positive aspects of study abroad have been noted. For example, Montgomery (2009) attributed improved student views in cross-cultural group work to internationalization efforts over the past decade. Dolby (2004) discusses the impact of study abroad on national identity. An international experience can be obtained in many different ways, including year-long or term-based study-abroad programs, summer or intersession study-abroad classes, or courses with an international focus taught at the home institution.

Engineering students are typically underrepresented in study abroad programs (Stroud, 2010). Klahr and Ratti (2000) point out the necessity of study abroad experiences for students of professional program and engineering students in particular. They discuss impediments to engineering students and how they can be overcome. Approaches to an internationalization of engineering curricula with the goal of “what proactive steps need to be taken by engineering educators to ensure that their graduates are prepared to be productive citizens and professionals in today’s and tomorrow’s complex world” were explored at the National Summit Meeting on the Globalization of Engineering Education (Grandin and Hirleman, 2009). Renganathan et.al. (2008) present best practices for engineering departments to build global competence among students. Those students who study engineering abroad typically participate in year-long or term-based study-abroad programs either by directly enrolling into the host institution or through exchange programs. The long duration arguably provides the best basis for an international experience,

but cost and differences in the curricula limit this option for many engineering students. Courses with an international focus taught at the home institution (international experience without a passport) are easily accessible to students, incur no additional cost, and can provide a global cultural and engineering context. However, such courses have been rarely offered in engineering programs. Summer or intersession study-abroad courses provide a balance in terms of duration and cost and are the focus of this study.

Parkinson (2012) suggested that engineering study-abroad programs fall into eight broad categories: dual degree, exchange, extended field trip, extension, internship or co-op, mentored travel, partner sub-contract, project-based learning/service learning, and research abroad. While such classifications are helpful, most established engineering-abroad programs include features of multiple categories. In the following, an overview of the variety of international experiences provided in some established engineering-abroad programs is given.

An established engineering study-abroad program with high student enrollment is the Global Engineering Education Exchange Program run by the Institute of International Education (Gerhardt et.al., 2002) (Global E3, 2012). In that program, students enroll in courses at a foreign university for one or two semesters and may also participate in a paid internship. Tuition exchange arrangements are made, classes may be taught in English or the language of the host country. Many universities have similar agreements with foreign universities over a broad spectrum of fields of study including engineering.

An extensive international experience is provided by the International Engineering Program at the University of Rhode Island (URI, 2012). In this five-year program, students obtain both a B.S. in an engineering field and a B.A. in German, French, Spanish, or Chinese language. Students spend their fourth year abroad: the first half studying at a partner university and the second half interning at a company. The goal of the program is to develop students who have acquired technical skills in a field of engineering as well as intercultural and language skills (Neidert, 2011).

Another approach is that taken by Boston University College of Engineering in cooperation with the Technical University of Dresden (Eisenberg et.al., 2003). In a program specifically designed to increase study abroad experiences for engineering students,

sophomore engineering students travel to Dresden for a five-and-one-half month period over which they complete 20 semester units of credit. There is very close cooperation between the Boston and Dresden faculties: the Dresden engineering courses are taught in English using the same textbooks and course syllabi as used in Boston and provide equivalent laboratory experiences. Since the courses are considered Boston University courses, the problem of transfer of credit is avoided. Programs in the study of German and cultural experiences accompany the technical courses.

Worcester Polytechnic Institute's Global Perspective Program (DiBiasi and Mello, 2004) is a faculty-led project-based study-abroad program where students, typically during a two-month period, complete an engineering project at one of WPI's project centers to find solutions to issues that impact local communities. Typically the project is nine semester-units with an additional 4.5 units of site-specific preparation.

Rensselaer is developing the REACH (Rensselaer Engineering Education Across Cultural Horizons) program where all undergraduate engineering students will be required to spend a full semester studying abroad (Gerhardt and Smith, 2008). The program began in 2009 with approximately 25% participation and is expected to be fully in place by 2015. Initial exchanges were with the Technical University of Denmark and the Nanyang Technological University of Singapore.

Shorter format educational programs (as opposed to internships or research experiences) follow an intensive study format popularized by National University (2012) and others. National University claims their one month per course format gives the student, among other benefits, "unprecedented focus" in their studies. Other, more traditional, universities offer similar short-format courses on a limited basis: typically between semesters (often called intersession) or during the summer months. Such short sessions provide students with an opportunity for a greater role in planning their curriculum. Students have the chance to enrich their course of study, reduce the overall time spent in school, and decrease their regular course load by careful selection of such short-term courses. The authors' home institution, the University of San Diego (USD), is one university committed to short-term opportunities with a three-week intersession term in January and a variety of terms in the summer months (USD, 2012a).

USD is also strongly committed to global competence through the internationalization of its on-site

curriculum and through study-abroad opportunities. This commitment is so strong that USD is currently ranked first in the nation for undergraduate study-abroad participation with 71.4 percent of USD's undergraduates involved (USD, 2012b). USD requires all undergraduate students, including engineering majors, to have third-semester competency in a foreign language as part of the core requirements for a degree. However, the majority of engineering students at USD fulfill the foreign language requirement during the first two years and the language choice is typically unrelated to an upper division engineering study-abroad opportunity. Unfortunately, in the past, the USD Department of Engineering has been only a very minor participant in intersession and study-abroad courses.

The broad range of international experiences in place suggests to the authors that a single best practice has not yet been determined and that there is room for additional exploration of course formats. It is with that exploratory mission in mind, that the study-abroad courses described here were developed at USD. These courses have taken many aspects of other formats into account and blended them together.

The Compact International Experience (CIE) courses considered in this study are short-term, faculty-led, study-abroad courses with the goal to combine substantial technical engineering content with an international experience. The two CIE courses described here are upper-division undergraduate engineering elective courses offered to USD students in mechanical and electrical engineering majors, covering technical material in fluid mechanics and electronics at locations in France and Australia, respectively. The course technical content is delivered through daily lectures within a three-week time period. Additional lectures or presentations cover cultural or global engineering topics. The international experience is rounded off by tours and excursions in the host country to further the cultural or international engineering experience. These courses were designed with the hypothesis that CIE courses can successfully deliver technical content comparable to courses delivered at the home institution while providing an enriching international experience.

Hence, CIE courses have two primary goals. The first goal is to provide students with an international experience. This goal, for engineering students, is not different from that for any other body of students. The CIE classes are designed to be a tool to boost engineering international experiences as engineering

students have been historically underrepresented. The international experience is partially accomplished through the engineering content of the course, e.g., guest lectures or technical tours, but also through additional activities not directly related to the technical content, e.g., interactions with local faculty, researchers, and students or daily life experience in a foreign country.

The second goal of the CIE courses is to preserve, if not enhance, the technical content in comparison to traditional on-campus courses. The technical content is transferred through regular class meetings and direct contact with the primary instructor. In addition, the goals for the international experience also help to fulfill the goals for technical content by providing additional discussion topics and diverse viewpoints on engineering topics.

Both the technical content and the international experience are assessed in this study using a four-pronged approach. First, student evaluations as required by the home institution provide an overview of student attitudes about the course. Second, instructor observations and course grades are used to assess the efficacy of the delivery of technical material. These observations are compared to similar courses taught in a semester-long format at the home institution. Third, weekly reflection papers written by students concerning their experiences are considered. Fourth, a survey instrument is used to assess the international experience of the students.

In the following, each of the two engineering courses is described. Next, the assessment methods are introduced and assessment results are presented and discussed. Finally, conclusions are drawn from the assessment results.

## II. Description of the two Compact International Experience Courses

Two engineering courses at the University of San Diego were recently offered as Compact International Experience (CIE) courses: Topics in Fluid Mechanics (MENG 494) was offered to mechanical engineering majors as a senior elective in January 2010 in France, and Advanced Electronic Circuit Design (ELEC 494) was offered to electrical engineering majors, also as a senior elective, during January 2011 in Australia. Each of these courses were developed at the request of engineering students seeking international experiences that would enhance their upper division engineering study without interfering with the tight course sequencing constraints characteristic of the

small engineering programs at the USD. After initial discussions, the course topic and an appropriate site for the international experience was chosen: prerequisite courses were used to inform students about the opportunity. While USD has several “cluster” sites for international study, neither of these two USD engineering CIE courses was centered at one of those sites. The University supports faculty participation through a stipend as well as by covering course-related expenses. A minimum enrollment of eight students has proved to be a financially sustainable level for USD faculty-led international study courses.

USD has priced CIE courses so that the cost to students is comparable, but slightly higher, to an on-campus course taken during the same session. The fee includes housing and local excursions: airfare is the main additional expense. Some students were able to take advantage of support funding in the form of: tuition remission for families of University employees, ROTC scholarships, and student loans. Beginning in 2012, USD made need-based scholarships available for CIE courses.

In each case, students were required to attend a pre-departure orientation on the USD campus approximately six weeks prior to departure given by the international office in conjunction with the primary course instructor. An overview of the course was presented as well as information on how to get to the destination, paths to discounted airfare, etc. Approximately three weeks prior to departure, required software was installed on student laptop computers as allowed for by special licensing arrangements.

The two courses are described in the following.

### **A. Topics in Fluid Mechanics (MENG 494)**

The mechanical engineering senior-elective course Topics in Fluid Mechanics (MENG 494) was offered in Marseille, France during January 4 to 22, 2010. The course further developed selected topics in fluid mechanics, including boundary layers, pipe flow, and an introduction to flow stability and turbulence. It also included an introduction to numerical analysis and the students simulated flow problems using Comsol Multiphysics (COMSOL, Inc., Los Angeles, CA) on laptop computers.

The course was held in Marseille in the south of France. The students stayed in a university residence with individual bedrooms and bathrooms, as well as

shared kitchens and living rooms. The instructor stayed with the students in the same residence. The lectures were typically held at the University of Provence campus outside of the city, but within easy reach by public transportation. The campus location enabled many interactions with engineering faculty, students, and postdoctoral researchers on a daily basis. The students attended presentations on research projects in progress at the host institution. The presentations included a discussion of vorticity dynamics, a topic directly related to the course material, as well as an introduction to magneto-hydrodynamic flows, a topic of strong research interest at the host institution.

The course met for three weeks with an average of three lecture or presentation hours per day. The majority of course topics, including boundary layer flow, pipe flow, an introduction to turbulence, and an introduction to computational fluid dynamics, was given by the primary instructor. An introduction to numerical analysis was taught by the host faculty in Marseille. Research topics, discussed in one hour lectures, included turbulence research, nuclear fusion reactors, and helicopter noise. The lectures were conducted in a seminar room at the university. There was one three-hour midterm focused on theoretical material at the end of the second week and a final computational project presented by the students on the last day of classes. The grading was based equally on homework, the midterm, and the final project. The final project was assigned in the form of a research project, results were presented to a group of French graduate students and their professor on the last day of the course, and a poster of their findings was submitted to Creative Collaborations: an annual presentation at the University of San Diego of undergraduate research work (USD, 2012c).

Cultural activities included visiting a variety of local attractions (Chateaux d’If, Vieux Port, Vieille Charite, Calanques), a weekend trip to Aix-en-Provence, and an overnight weekend trip to Paris. The students also used afternoons and evenings for a further exploration of the city and its surroundings. French language and history lessons to facilitate greater cultural immersion for the USD students were conducted by faculty, researchers, and students of the University of Provence on an almost daily basis.

### **B. Advanced Electronic Circuit Design (ELEC 494)**

The electrical engineering senior elective course, Advanced Electronic Circuit Design (ELEC 494), was



offered during January 1 to 18, 2011 in three Australian cities: Sydney, Newcastle, and Canberra; with an optional three-day sightseeing excursion to the Great Barrier Reef at the end of the course. Since southeast Australia is a hub of electronics-related activity, basing the course in multiple cities in that area opened up opportunities to draw upon that activity as well as explore the possibilities of graduate study or employment in a foreign country. The course explored contemporary electronic design beyond that usually taught in the two electrical engineering core electronics courses and focused on the analysis and design of analog and digital electronic circuits and systems including: oscillators, non-linear waveform generation and waveshaping, power electronics, communication circuits, and digital gates. There was a strong emphasis on computer-aided analysis and design.

The textbook used was an out-of-print electronics textbook coauthored by the course instructor. Since the authors now own the copyright to the textbook and it is undergoing revision for a new edition, electronic copies were made available at no cost to the students for their private use. While a few students own hard copies of the textbook, everyone, including the instructor, used the electronic copy exclusively. Each student was provided with a licensed copy of National Instruments Multisim™ 11.0 (National Instruments, Austin, TX) for use as a circuit simulator – arrangements were made so that the department's license could be extended to the student laptops for this course. The student laptops were evenly divided between PCs and Macs.

In order to facilitate general computational needs and tradeoff studies, each student was expected to have a math computational program installed on their laptop. The instructor prefers Mathcad (Parametric Technology Corporation, Needham, MA) for this purpose and the majority of students used it as well. Three students chose MatLAB (The Mathworks, Inc., Natick, MA) as their math primary computational program.

The course met for eighteen days with thirty-five scheduled classroom hours and an additional two-hour final exam period. The lectures were typically conducted in a classroom, or conference room at one of the varied locations. The students stayed in a college residence across the bay from Sydney for the first week and youth hostels thereafter, typically in rooms of two to four students. The instructor stayed with the students in the same residences in a private room and held office hours in that room or in a public

room at the hostel. Public transportation and private coaches provided easy access to the varied locations.

Since the course instructor had not previously traveled to Australia, an educational support provider, AustraLearn, was engaged to make arrangements for housing, transportation, tours and excursions, as well as a vast variety of details that make such an adventure work. Both technical and cultural activities were planned by AustraLearn and provided a full plate. Tours and excursions included locations that were intended to be purely cultural (Sydney Tower, Blue Mountains Eco Tour, etc.), to be purely technical (Canberra Deep Space Communication Complex, Sydney Observatory, etc.), and some that were to be a mix (Sydney Opera House technical tour, Canberra Sustainability House, etc.). This assortment intentionally showed solutions to real-world engineering problems and, as such, emphasized that this international experience was more than just a USD engineering course taught in another country. In addition, the students toured three Australian universities (University of Technology, Sydney; University of Newcastle; and the Australian National University) where they were introduced to the research activities at the universities and explored opportunities for further international study. On the arrival day, AustraLearn provided a one-hour introduction to Australian culture and language differences.

### III. Assessment and Results

In the following, both the technical content and international experience are assessed. First, results from teaching evaluations as required by the university are presented and compared to those from a comparable course. Then, student performance is discussed in terms of grades and faculty impressions and again compared to a previous course. The students' international experience is assessed using a survey instrument. Finally, student impressions of the international experience from reflection papers are described.

#### A. Assessment of course delivery by teaching evaluations

The course Topics in Fluid Mechanics (MENG 494) was previously offered by the same instructor as a senior technical elective in a semester-long format in spring 2007. The course met for three lectures a week throughout the semester (41 lectures). There were 8 mechanical engineering senior students enrolled in

the class. The topics covered in the course were identical to the CIE course, but the Ansys Fluent (Ansys Inc., Canonsburg, PA) CFD software package was used instead of Comsol. There were weekly homework assignments based on technical material from fluid mechanics or numerical analysis as well as computational modules using Fluent. Due to the semester-long format, the homework volume and the number of computational projects were higher compared to the CIE course.

The courses were evaluated differently by the students. For the semester-long course, Instructional Assessment System teaching evaluations with a 6-point scale (0-5, 5 being highest) were used. Overall, most students selected the highest (excellent) or second-highest (very good) selection to evaluate the varied aspects of the course and the combined median was 4.2. For the CIE course, teaching evaluations were provided by USD's International Center which used a 3 or 5-point scale. For the 3-point assessment statements, all students selected the highest selection. For the 5-point assessment statements, students selected the highest (outstanding) or second-highest (above average) selections. The combined average of the 5-point questions was 4.4.

While Advanced Electronic Circuit Design was a first-time offering, the instructor has previously presented a senior elective course in Analog IC Design and was the course instructor for these students when they were enrolled in the prerequisite electronics courses. Those courses were all in the traditional semester-long format, with the lecture portion meeting for three lectures every week. The quantity of coverage in all courses was essentially the same: the two prerequisite courses cover 11 chapters in two semesters while the CIE course covered 5 chapters of the same text in three weeks. Homework in the CIE course was, by necessity, somewhat less. The instructor feels that this reduction in homework was completely compensated for by a vast expansion of student-instructor interaction facilitated by close-proximity living accommodations.

As was the case in the other CIE course, the home-institution and study-abroad courses were evaluated differently by the students. Overall for the home-institution prerequisite courses, most students selected the highest two categories on the 6-point scale (0-5) with a combined average ranging between 4.1 and 4.9. For this CIE course, teaching evaluations were provided by USD's International Center which used the 3 or 5-point scales. For the 3-point assessment statements, all students selected the

highest selection. For the 5-point assessment statements, students selected the highest (outstanding) or second-highest (above average) selections. The combined average of the 5-point questions was 4.79.

## **B. Assessment of student performance (grade distributions, etc.)**

It appears that the technical evaluation of the two Topics in Fluid Mechanics (MENG 494) courses was quite similar. For the semester-long course taught at the home institution, the grade distribution consisted of 4 As, 3 Bs, and 1 C with an average GPA of 3.4. For the CIE course, 3 As and 1 B were given with an average GPA of 3.7. The GPAs are relatively high in both courses. There are two main reasons for this: first, both courses were senior electives and only students with a strong interest in the topic enrolled in the course. Second, due to the small student numbers in both courses, a high level of student-faculty interaction was present. This argument is particularly applicable to the CIE course with just four students.

In ELEC 494, there were two midterms and a final exam on the last day of classes. As for a typical course at USD, grading was based primarily on homework, the midterms, and the final exam. However an additional component relating to the international experience was factored into the final grade for this CIE course.

Homework submission was done in a paperless environment. Students showed the instructor their work and computer simulations and the instructor often made suggestions as to how to improve the submission: students made changes before homework grades were recorded. As a result, all the students achieved homework scores greater than 92%: typical homework grade averages for this course instructor during a normal semester lie in the 75-90% range.

Given that Advanced Electronic Circuit Design was a first time offering, technical comparisons are a bit more difficult. However, since the course instructor also taught these students in the prerequisite courses, direct comparisons can be made. The students enrolled in the course were a select group whose grade average in the prerequisite courses was slightly above a B+ (~3.4) while the total student population averaged a B- (~2.7) in those courses. For the CIE course, the average grade was somewhat higher: A- (~3.6) with no student receiving a grade below B. As was the case for the other CIE course in this study, it appears that strong student interest, close student-

faculty interactions, and the concentrated, single-focus format are the primary factors for improved student performance.

### C. Assessment of the international experience

After each CIE course was completed, students were asked to complete a survey concerning their international experience. This survey was comprised of 19 queries taken from the USD School of Leadership and Education Sciences international experiences survey, 3 queries comparing the CIE courses to USD courses given in the traditional semester-long format and during the three-week intersession on campus, and 2 queries concerning the international experience as related to engineering. The survey used a 6 point scale ranging from “strongly agree” to “strongly disagree” and asked for short statements relating examples from the student’s own experience related to the queries. Students were also asked to indicate whether their experience was related to the CIE class.

Due to the small total enrollment in the two CIE courses of this study, the following assessment of student international experience is presented collectively. A total of fourteen students completed the voluntary survey. Students perceived that their international awareness after the CIE experience was high with average scoring over the 19 queries in the “agree” category. Of those students who indicated their response was related to the CIE course, the average score was 1.69 (where 1 is “strongly agree”), while the overall average score was 2.12. In Figure 1, the distribution of responses related to the CIE courses is shown as the shaded area while the unshaded area is the distribution of student responses where no relation to the CIE course was indicated.

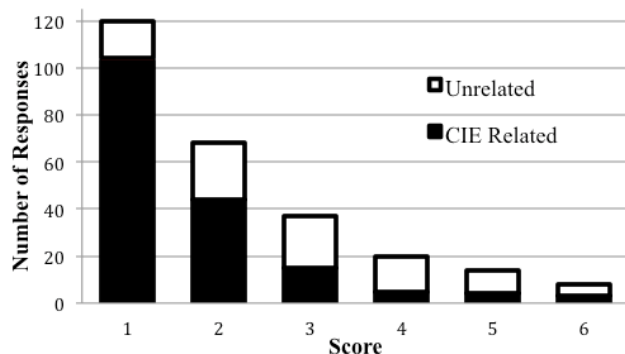


Figure 1. Overall Student Perception of International Awareness

Highest scoring awareness queries were:

- I have looked up the meaning of a non-English word (1.21/1.00)<sup>1</sup>
- I have thought about the differences between myself and people from other countries (1.21/1.08)
- I have looked up something (location, fact, etc.) about another country (1.21/1.18)
- I know the currency conversion rate for the U.S. dollar to a least one foreign country (1.29/1.31)
- I have thought about the similarities between myself and people from other countries (1.33/1.19)
- I have watched or listened to a non-American TV station, news broadcast, or other media show (1.36/1.00)

The CIE courses compared well to more traditional course formats on those three queries:

- The format (content, workload, material learned, etc.) of the study-abroad course compares well to a three-week intersession class at USD (1.30)
- The format (content, workload, material learned, etc.) of the study-abroad course compares well to a semester-long class at USD (1.93)
- There was more faculty-student interaction during the study-abroad course than during a class at USD (1.57)

Comments included:

- “Material learned was relatively comparable, but workload was more because we fit about the same # of assignments and tests in about 1/5 the time.”
- “This [faculty-student interaction] was the best part of the course.”
- “Lots more interaction.”
- “In my experience the workload [ ] was more than any 3-wk class.”
- [ ] compares “favorably to other courses I have taken in both workload and intellectual growth”
- “I learned a lot more than I would have in a semester.”

<sup>1</sup> The construct (X/Y) is used to indicate average student reported responses. X is the overall average response and Y is the average of responses where the student indicated the response was related to the CIE course.



The relationship of the international experience to engineering also was favorably perceived by the students on the 2 queries relating the aspect of the courses:

- This international experience enhanced aspects of my engineering knowledge (1.64)
- This international experience has helped me understand the impact of engineering solutions in a global and societal context (2.14)

Comments included:

- “the class itself was great and seeing how another country does some things broadened my perspective.”
- “very interesting to see the opportunities and work being done abroad.”

The survey data suggests that there is a high level of student perception of international awareness due to the CIE courses. Students also strongly felt that the CIE courses enhanced their understanding of the impact of engineering in a global and societal context as well as increasing their knowledge in the topical content of the courses.

#### **D. Student observations from weekly reflection papers**

For Topics in Fluid Mechanics (MENG 494), reflection papers were assigned weekly to capture students' observations and attitudes on their international experiences on a regular basis. The reflection papers were mandatory, but their content was not graded in order to encourage students to write openly about their impressions. The reflection papers were handed in by e-mail and some students decided to copy friends and family on their writing.

The reflection papers at the end of the first week contained thoughts on the travel preparations, travel to Marseille, and initial impressions. Travel preparations included movies: “My mom made me watch Taken (it's about 2 girls who get kidnapped in Paris) which made both of us even more paranoid.” Initial impressions often centered on the language barrier: “I really thought that a lot more people here would speak English.” “Trying to function in a society without speaking any language makes me feel like I'm 3 years old again.”

Impressions of the second week showed efforts to talk with locals and the enjoyment of the surroundings: “We ended up eating dinner at a new restaurant and made friends with the table sitting next to us, which

was a couple and their friend.” “I absolutely loved going to Notre Dame and the Louvre and seeing the Eiffel Tower at night (even though it was miserable in the rain). I really liked walking around Paris on the second day when it wasn't raining.”

The final reflection papers from the end of the course often contained insightful comparisons: “The French know a lot about our popular culture, history, and politics while we hardly know anything about France.” A strength of the course was its setting at the University in Marseille and a student commented on the interactions with our hosts: “One of the many things I will take away from this trip were the people that we met.” Another student also commented on the benefits of the course location and setting: “Having come back from this trip, I must admit that I have enjoyed it, learned a lot and found it to be an incredibly rewarding experience. Going there I saw no reason why a course in fluids should be studied abroad as the setting would not add at all to the course, but after all the complaining we did, I must admit that I definitely felt that this course benefited a lot from being located in Marseilles.”

Overall, the comments in the reflection papers suggest that the students did obtain an international experience during the course: “Overall, I had a fantastic time in France and I miss it already. Even though it was expensive, we couldn't communicate with anyone, and we ate bread for 3 weeks straight, it was so much fun. I hope to go back one day, hopefully with a little more money, and explore more of France especially Normandy and maybe Paris. I'm very grateful to have this abroad experience that I originally did not think I was going to be able to have.” “It was an experience that will definitely impact what I do in the future. It opened my eyes to traveling and experiencing different cultures.”

In that Advanced Electronic Circuit Design was presented in three different cities, it was decided to assign the reflection papers on a city-by-city basis. In contrast to the fluid mechanics course reflection assignment, students were asked to write “a short (~ one page) reflection paper concerning your stay in that city, the cultural differences that you noted, the engineering-related tours and lectures, and anything else that was of particular interest ...” at the end of each city stay. While the content of the papers was not graded, a sincere student effort was required to achieve full credit (tours, guest lectures, and global impacts accounted for a portion of the course grade). Papers were handed in as soft copies, typically by

direct downloading to the instructor's laptop through the use of flash drives.

The time in Sydney was quite busy with class and at least one tour every day. The reflection papers contained some of the obvious cultural and technical differences: "One of the first things that I realized was the use of 240V electric lines which directly affected me as I needed to buy an adapter. The next noticeable difference was the fact that the car's steering wheels were on the opposite side of the car." "One of the biggest, and probably my favorite, cultural differences I've noticed so far is that in Australia, the 'price you see is the price you pay.' When you sit down at a restaurant, you *aren't supposed to* tip the waiter/waitress. Even at bars you aren't supposed to tip the bartender..." "First of these is the public transportation system: INFINITELY better and more reliable than anything I have ever experienced on the West Coast of the States. Taking the ferry every morning from Manly Beach to the city was a great way to start the day. The people are all very friendly and want you to feel welcomed." The visit to the University of Technology, Sydney, while primarily technical, provided insight into some cultural differences: "Another surprising thing about their education was the fact that college is not about moving super far away from where you are from, but instead staying close to where you are from." Similarly, students noted the differences in university-industry interaction: "His discussion of how the University was so closely related to the industry in Sydney was very interesting, and seems different than the system in America."

The educational provider arranged tours in the Sydney area got mixed reviews: "I was a bit disappointed at some of the tours' lack of technicality. Of the three technical tours, none of them got into many technical details, which would have been fascinating." "My favorite activity, by far, was hiking in the Blue Mountains... After a week of different 'go green' tours, the Blue Mountain tour guides reminded us exactly what we were trying to save." "The nature walk at Blue Mountain was probably the second most technical tour, next to the Powerhouse. One of the guides had previously been an electrical engineer and worked in telecommunications. He told us about lightning [sic] strikes and how they destroy so many electronics due to the power of the strikes."

Time in Newcastle was somewhat less structured, but still busy. Once again traffic conventions were noted: "When a pedestrian started to cross, the cars (and ALL of them did this) would drive up to the cross walk that

the pedestrians were in and wait for them to cross, despite the tail end of their cars being in the intersection. Quite different!" Students responded well to the tour of the University of Newcastle and found some engineering highlights in town: "It is a very interesting city to see because there has been a lot of influence from engineers in the city since it is one of the more industrial of towns found in New South Wales."

Unfortunately the local population in Newcastle did not necessarily make a good impression on the students: "We got some weird looks from the locals and some of the people were very strange." "The worst part of my stay in Newcastle was being attacked by a drunk man." "The whole city had a weird twilight zone feeling to it." Still there were some brighter opinions: "The people of Newcastle are much more down to earth than in Sydney."

By the time of the last reflection paper, student commentary diminished somewhat to more of a report of daily activities than true reflections on global perspectives. Nonetheless, a few comments touched on the subject: "It was nice to see such a level of cooperation between the Australian and United States governments [Canberra Deep Space Communication Complex]." "It [Canberra] was urban enough that I got an urban feel, but was also designed in such a way that I felt the culture and kind of at home."

Overall the students gained a good perspective on our greater world: "I feel that I am more culturally expanded and have a wider view of what the world is about from my travels in Sydney." "As a class we have learned a lot about Australian culture as well as electronics." "The overall intersession class in Australia was a great experience. I'm very glad I decided to take this opportunity."

#### IV. Summary and Conclusions

Compact International Experiences, as described in this paper, proved to be an effective format for the delivery of two senior elective engineering courses in France and in Australia. Despite the short timeframe of delivery, all evidence collected (student course evaluations, instructor observations and course grades, student weekly reflection papers, and an assessment of the international experience) point to an educational experience equivalent in course content and depth of coverage to that of typical semester long courses delivered at the home institution coupled with an enriching international experience. Extremely strong student-faculty

interaction was achieved by close-proximity housing accommodations and was a strong factor in successful course delivery. The students' immersion in the host university environment in Marseille proved particularly successful.

Even though the CIE experience is quite short in duration, students appeared excited about the possibilities of future international experiences. The visit to the University of Technology, Sydney coincided with a prospective new student "open house." Students were able to easily obtain materials concerning study in Australia. Graduate study opportunities were also part of the visit to the University of Newcastle and Australian National University: "I had heard from one of the members of USD's Advisory Board that they have a really good Control System program at this school. Sure enough this was brought up on the tour. The work they did there was cool, but I don't know how I feel about the location. I guess it should not matter if I were to try and study abroad for my Masters and PhD since I would be busy with that work. I don't really know"; "Of all the universities that we visited this was my favorite "uni", and somewhere that I would consider doing graduate work." "It seemed like a great place to be a graduate student because they offer great financial opportunity and a strong research environment." At a recent panel discussion for the freshman engineering class at USD, graduates from our program highlighted the need for foreign language proficiency and international experiences as a factor for success in the engineering profession.

That is not to say that everything always goes exactly as planned when delivering a course in a short time abroad. In Australia, there were three student computer failures. Similarly, one must be extremely explicit about needs and careful when working with an educational support provider as was the case in Australia. Problems encountered included: classrooms without a board to write on, scheduled tours that were advertised to have electrical engineering technical content but turned out to be the same tour as any tourist might take, and some living environments more suited for youthful tourists than students deeply engaged in a technical course. More careful planning and attention to detail could have avoided many of these difficulties. In France, the course was based at a university and, consequently, these difficulties were not observed.

Course instructors are on call all day (and almost all night) throughout the duration of the course and entirely responsible for the students' educational and

cultural experiences as well as their general wellbeing. Those responsibilities create a workload that is significant by any measure. Without a doubt, both of the instructors feel that the outcomes are worth the investment of time and effort to successfully deliver a CIE course. Both instructors feel enriched by the experience.

While a semester- or year-long study abroad may provide a richer international experience, only a minority of engineering students at our university pursues such a course of study. Reasons include: graduation schedules, tight integration of engineering courses by prerequisites, and financial considerations. The CIE course format, in the authors' view, is a valuable model, among many, for internationalization that works particularly well for engineering to boost international exposure. Based on the evidence collected, both goals of the CIE courses have been fulfilled: students obtained substantial engineering technical content with an enriching international experience.

In summary, the authors see CIE courses as an engineering solution to the underrepresentation of engineering students in study-abroad programs. The CIE approach helps to provide international experiences to more engineering students by finding a compromise: the courses use acceptable levels of time and cost while providing both technical content and an international experience.

Each course was repeated in January 2013 with changes based on observations reported here. The changes included an increased number of company and technical tours as well as joint lectures with US and French students.

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