

International Experiences in Sustainable Education for Engineering and Technology Students

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ABSTRACT: *This paper describes a unique, cross-cultural, international, multidisciplinary, experiential course in sustainable practices originally created for engineering and technology students designed by several faculty members in the Purdue School of Engineering and Technology at Indiana University-Purdue University Indianapolis (IUPUI). The GO GREEN course which stands for "Green Organizations: Global Responsibility for Environmental and Economic Necessity" was conceived out of a desire to actively engage students in learning about sustainable practices in industry. However, as the course developed a second focus naturally became apparent. This short study abroad experience could also teach students to appreciate, understand and recognize diverse cultures. Our partnership with the Berufsakademie Mannheim (BA-M), a cooperative education university located in Mannheim, Germany, enabled the faculty to link with corporations (ABB, BASF, MVV Energie, and DaimlerChrysler) demonstrating best practices in sustainable development located in and around Mannheim, Germany. The faculty were able to develop the GO GREEN course which was conducted for the first time during the summer of 2003. Along with a discussion of the course and its outcomes, this paper will focus on the benefits of the cross-cultural studies integrated into the course. This paper will also focus on the challenges and opportunities in continuing to offer the overseas course.*

1 INTRODUCTION

IUPUI is a 21st century model for urban higher education. It has more than 240 academic programs. Two universities come together in one location to offer certificate programs, associate, bachelor, master, doctoral, and professional degrees. IUPUI has the most comprehensive range of programs in the state with more than 30,000 students. Teaching and learning are central to campus life. The faculty at IUPUI have developed award-winning programs that assist students to become successful in achieving their academic goals. The Purdue School of Engineering and Technology is one of two Purdue schools on the IUPUI campus with 2,500 plus students. The School of Engineering and Technology is the largest degree granting school on campus and many of the school's faculty are active in the American Society of Engineering Education. The school has eight departments, Mechanical Engineering, Electrical and Computer Engineering, Biomedical Engineering, Computer Information Technology, Mechanical Engineering Technology, Electrical and Computer Engineering Technology, Construction Technology, and Organizational Leadership and Supervision.

Faculty from four departments on campus, three of which are within the School of Engineering and Technology collaborated to develop the GO GREEN course. The first course was held during the summer of 2003 with seven students attending enrolled in the following majors:

- Interior Design (1)
- Construction Technology (2)
- German Language (1)
- Informatics/Multimedia (1)
- Organizational Leadership (2)

The age range of students also was diverse from 20 to 46. Of the group, three were female and four were male. In class standing, four were seniors, one was a junior, and one was a sophomore.

2 DEVELOPING THE GO GREEN COURSE

The GO GREEN course was originally designed specifically for engineering and technology students to teach them about sustainable development using best practices in industry as real world examples. (The generally accepted definition of “sustainable development” is meeting the needs of the present without compromising the ability of future generations to meet their own needs.) However, while the course was being designed it was decided that all students could benefit from learning about sustainable development, global issues, and cultural differences and the course was opened to all IUPUI students.

Germany’s industries were chosen as the “best industry practices” for sustainable development for several reasons. First, Germany is recognized as a leader in the area of sustainable practices even within the European Union (EU), which has been actively engaged in instituting environmental policies for over thirty years. This effort began with the 1972 Paris Summit where European Heads of State and Governments started working on environmental issues. The Amsterdam Treaty (ratified May 1, 1999) gave environmental issues the legal basis it needed to take hold in Europe; thus the promotion of sustainable development in the European Union became an important issue in the European Commission Treaty. There are nearly 200 legal acts covering all areas of the environment (European, 2004). As part of the EU, Germany is a leader in economic sustainable development and practices in business and industry. In fact, Germany and The Netherlands both have been credited with using new methods and tools to strengthen their government’s policies and regulations aimed at improving environmental performance in industry and products (Lewis, Gertsakis, 2001).

A second reason to focus on German industries was that the school had a long standing partnership with the Berufsakademie Mannheim. Faculty at the Berufsakademie facilitated the meetings with the Sustainable Controllers at BASF, ABB, and Daimler/Chrysler with the IUPUI faculty during the summer of 2002. Other German industries, MVV Energie and Freudenberg Corporation have been added from connections acquired from networking at conferences in the United States.

During the fall of 2002, as the course was being developed, the faculty realized that students would also be learning about sustainable development in a global context while being exposed to a totally different culture. This trip could possibly be the first time a student has traveled abroad. To make sure that cross-cultural elements were elaborated in the course a colleague from the German Language Department was included in our team.

To have students understand different cultures was important for various reasons. First, one of IUPUI’s six Principles of Undergraduate Learning is about understanding Society and Culture. Six years ago, the faculty on the campus came together and decided that all undergraduate students needed to have the following common set of skills:

- Core Communication and Quantitative Skills
- Critical Thinking
- Integration and Application of Knowledge
- Intellectual Development, Breadth, and Adaptiveness
- Understanding Society and Culture
- Values and Ethics

The GO GREEN course would address the Principle for Understanding Society and Culture as well as several of the other Principles. When the course is completed, students should have the ability to recognize the differences between their own culture and the German culture, and have an appreciation for the diversity of the human experience both in the United States and abroad. Students should also understand the interconnectiveness of global and local concerns, especially given our topic of sustainability. The last area under the Principle of Understanding Society and Culture is to operate in a civil manner in a complex social world. This is one area that is not hard to ignore, especially in a time influenced by international conflicts and terrorism. Civility in the workplace is an important ethical issue which students need to be prepared for during their academic career.

Another reason to understand different cultures was for the fact that industry leaders have been preaching that engineering schools are increasingly out of touch with the practice of engineering. The changing nature of international trade coupled with the restructuring of industry and business, the use of new materials and biological processes, and the growth of information technology has changed the practice of engineering dramatically over the last twenty years (Wulf, 2002). The engineer today needs to

understand complex interactions, across many disciplines, and of real-world engineering systems. Today's engineers need not only to have a grasp of global issues and cultural diversity but also to communicate effectively (Wulf, 2002). William Wulf speaking on behalf of the National Academy of Engineering (NAE) believes little or no change has occurred in our institutions of higher learning. This was another argument to stress the importance of the cultural diversity and global awareness in the GO GREEN course.

3 THE GO GREEN COURSE

The GO GREEN course is an interdisciplinary course exploring the areas of sustainable design, engineering, manufacturing, technology, and leadership processes implemented and maintained in business and industry for the purpose of being environmentally responsible, energy efficient, and cost effective to save natural resources. The course looks at the complex interactions of costs versus environmental safety and responsibility in decision making models of eco-efficiency models used in industries. The course also focuses on the sustainable practices of the industries in Germany and the impact of those practices locally, nationally, and globally. Students see real world applications of sustainable practices in industry. Students also learn about German culture through active learning, which causes them to examine their own culture and understand why there are differences. While this course won't totally solve the dilemma of a new engineering education called for by William Wulf, President of the National Academy of Engineering, and George Fisher, Chairman of the National Academy of Engineering, it will begin to address some of the important issues in better preparing engineering students for the 21st century.

There are just a few prerequisites to the GO GREEN course. Students need an understanding of sustainability. A prerequisite of a one to three credit hour course in "sustainability" is required unless a student has taken some environmental science equivalent course. In addition, a sophomore standing is required and at least a 2.75 GPA is also required. The GO GREEN course objectives are to:

- Acquire base knowledge of issues in sustainability as they relate to engineering and technology efforts in businesses both internationally and nationally
- Examine and evaluate case studies of sustainable practices in business and industry
- Visit international and national industries and organizations that practice sustainability to gain first hand knowledge of operations
- Identify trends and business practices in various sustainable organizations
- Utilize information from course to apply sustainable knowledge in the workplace upon return
- Acquire knowledge of the German culture and some language skills (enough to be polite)

The GO GREEN course includes discussions and short lectures with sustainable leaders from BASF, ABB, DaimlerChrysler, and MVV Energie. The class also includes a tour of the town of Ladenburg, Germany, known for its 2,000 year-old Roman history and relics. The course includes approximately a six hour lecture/discussion on German culture, language, and travel prior to arriving in Germany. Students are required to write a ten page paper comparing the German entities visited with comparable entities in the United States. The paper is due approximately one month after the visit to Germany. Course readings included sustainable models in industries such as Interface, Nike, Coca-Cola, Apple, Shell, and Coors. Students are required to keep a journal while in Germany to record their daily experiences of their cultural interactions and notes on their industrial visits.

4 THE IMPORTANCE OF CROSS CULTURAL EXPERIENCE

Although engineering schools in the U.S. provide a solid technical education, they fail in providing students with a real-world experience (Bursky, 2002). As stated earlier, the engineer today needs to understand complex interactions across many disciplines and of real-world engineering systems, in addition to understanding global issues and cultural diversity. Last but not least, the engineer must be able to communicate effectively (Wulf, 2002). Substitute the word engineer or engineering for business, medical, and law and the same skills would be required in today's world. In order to be more competitive in business one must enter into international cross cultural alliances. More and more companies in the future will be engaging in this type of business in order to stay competitive. The creation of the European

Union and the common European currency has removed the barriers of trade and deregulations of certain industries and has made Western Europe a more attractive place to invest. In addition, the third world countries such as Korea, Singapore, and Taiwan have had successful industrialization which has affected the U.S. dollar in recent years and brought about increases in foreign investment. Unfortunately, all of this though has not brought about a reciprocal revolution in cross cultural understanding among the people of the world (Ferraro, 1998). Today, words like international, multinational, transnational, and global are not just heard in large corporations. While international business has existed for centuries, we are seeing an ever increasing activity of unprecedented global economic activity which includes worldwide productions, distributions, international joint ventures, multinational mergers and acquisitions and global strategic alliances. Global corporations, whose main business was once located in the U.S., are now doing business all over the world (Adler, 2002).

The Encarta Dictionary defines culture as 1.) Shared beliefs and values of a group: the beliefs, customs, practices, and social behaviors of a particular nation or people; 2.) People with shared beliefs and practices: a group of people whose shared beliefs and practices identify the particular place, class, or time to which they belong; and/or 3.) Shared attitudes: a particular set of attitudes that characterizes a group of people. Jawaharlal Nehru, an Indian nationalist leader who was the first prime minister of independent India once said, "If we seek to understand a people, we have to try to put ourselves as we can, in that particular historical and cultural background," (Adler, 2002). Student in the GO GREEN class used all the opportunities they had to connect and communicate with as many people while they were in Germany, so they could better understand or learn about the customs, beliefs, practices, behaviors, etc. of the German people and their culture.

Engineers with cross cultural skills and a background in another language are in growing demand, due to the ever-increasing globalization. The skills which allow individuals to perform comfortably and effectively outside their own culture appear to be best acquired through experiential learning, which often takes place outside of the traditional setting. Therefore, teaching and learning across the curriculum as well as outside the classroom is essential in preparing young engineering graduates for the challenges of a global marketplace.

Parallel to an increased emphasis on 'soft skills' within the engineering education, foreign language education has also undergone a considerable change. Many college German programs nowadays stress oral proficiency and communication skills over grammar and literature studies. The American Council on the Teaching of Foreign Languages strongly supports the following five standards for second language learning:

- Communication: oral and aural proficiency
- Cultures: knowledge and understanding of other cultures
- Connections: interdisciplinary approaches to learning and teaching across the curriculum
- Comparisons: developing insight into the nature of language and culture
- Communities: utilizing language skills beyond the classroom and applying them in a variety of fields, thus becoming lifelong learners.

These standards were adopted by several national language organizations in 1993 in order to prepare students to "communicate successfully in a pluralistic American society and abroad" (ACTFL, 1993).

Even students with no or limited skills in the target language have had considerable learning experiences overseas when they are involved in a study abroad program that is tailored towards their expertise and prior knowledge, involves them actively in every aspect of the program, and addresses personal interests. According to several studies in applied linguistics learners who can perform a specific task in their own language are able to transfer this knowledge to a second language. Whereas a short-term study abroad program can not achieve a high level of oral proficiency, the standards of 'cultures', 'connections', and 'communities' are all addressed in this intensive short-term course.

5 EVIDENCE OF STUDENT LEARNING

The very best part of this class from the instructors' point of view was the satisfaction knowing that the students truly learned from and enjoyed their experiences while taking this course. This course was designed specifically so that students would learn about and experience German culture in addition to

learning about sustainable practices in an international setting. Below are some quotes from student papers that show their satisfaction and some evidence of learning in the course:

“When I first was introduced to sustainability, I thought that meant recycling and planting trees. Through this class I realized it is that and much more. By being interdisciplinary, this course allowed students from all backgrounds to learn the importance of sustainability. Everyone was able to take something different away from this class. By restricting this class to students in one department, it would inhibit students from applying sustainability to all aspects of their career.

From this trip to Germany, I was personally able to gain a better knowledge of German culture. From learning about their sustainable practices, I was able to understand many of their other cultural differences. Also, in any career that I may use my knowledge of German in, I will also be able to use my knowledge of sustainability, and who know what that might involve.” Alison Land –GO GREEN Summer 2003.

“The learning and usefulness from this interdisciplinary study can be measured in a number of ways. First, did I learn anything? Absolutely. This experience was not only in a topic of study I already had some interest in but it gave me the opportunity to round out the remainder of my undergraduate education in a study abroad experience through a different department. Second, did I have fun? Some people might think that fun isn’t a prerequisite for learning. But think of how much more this topic has been ingrained into my memory and knowledge base because I enjoyed the experience. Third, I was able to meet new people and network in different fields of study and interest.

The readings were successful in adding perspective to the subject. I feel they increased the understanding level of why the things we were learning were important. Without some of the required readings there would not have been the same perspective or experience in the field.

The visits to the sites in Germany were critical to making the whole experience an applicable and memorable one. I am much more of a hands-on person and being able to see what these companies are doing in green design and sustainability allowed me to better understand the topic.

The US-German comparisons also helped broaden my general knowledge base about sustainability. It added perspective on what companies are doing here.

My role as a customer, citizen, manager or decision maker will be different in light of this new awareness. I hope to retain this spirit of importance and need for change as I make decisions and choose products.” M. Craig Bowen –GO GREEN Summer 2003.

“Obviously we toured and learned how some pretty major companies operate and apply sustainable practices to their operations. These companies have placed a value on sustainability that could be qualified in dollars. This sends a message that is hopefully echoed around the world that sustainability is important. Its importance on an industrial level is huge because industry has a higher impact on the earth and all of us. However, this experience has also shown there is a need on an individual level to apply the same basic sustainability principles of reducing, reusing, and recycling to our everyday life. The every-person culture of recycling in Germany needs to be ingrained into American culture. I have seen on this trip that Germany leads the U.S. in the adoption of sustainable practices. I now also see the need for us to step up and be responsible for ourselves and our impact on those around us.” M. Craig Bowen –GO GREEN Summer 2003.

“Overall, I feel the Go Green course assists in preparing students to deal with real technology, real-life challenges, and inspire creativity by providing a catalyst of new ideas. The format of the class and teaching methods achieve this goal and enable the student to grow both personally and professionally. I found, upon later reflection, I was

struck by an expanded and renewed understanding of a principal I thought I already recognized. As Dr. Jeffery Borenstein said, people are “just friends waiting to be made.” Regardless of cultural differences, the same basic needs drive humanity as a whole, and individually; how we perceive the world often comes down to how we deal with one another. Although I realized this concept as it fit into my world, my interaction with the German community provides me with a more complete understanding of the way humans seek to interact with one another. I have felt inspired to close the gap between Americans and interact with one another. I have felt inspired to close the gap between Americans and our European neighbors, to accommodate the technological and social interest of my country, as I develop my own career. The world seems a little smaller today.” Paula Baty –GO GREEN Summer 2003.

“I arrived in Europe on the first of July, and as I would expect of any American who had never traveled outside the United State of America, I had lots of apprehensions on how other people from Europe would perceive and treat me. These thought come about because of the recent wars, September eleventh, and the roles the Americans play in these times. All of the problems I believed I would have when I got over there were quickly dispelled. I found out that my fears were unsubstantial and just not true.” Philip Hurley – GO GREEN Summer 2003.

“I am thankful to everyone I came in contact with in Germany. One reason is that they all spoke English and were very helpful whenever I needed information which was often. The German people were all very cordial and gracefully humble. I felt safer and more secure there than in many places I have been here in the States. The experience of visiting another country with nearly all the same attributes and fewer resources to work with makes me appreciate the fact that I am an American. It also reconfirms to me how important it is to be tolerant, understanding, and open-minded to the ideas of others.” James Young – Construction Technology Student –GO GREEN Summer 2003.

“The language difference originally was concerning, but after arriving I found that most people could speak English without much difficulty making it easy to communicate. Another pleasant surprise was the friendliness of the German people, who on more than one occasion, went beyond the norm to be helpful and accommodating.....Just as things became more familiar and similar they also remained different, adding to the enjoyment of the trip. The lessons learned in Germany went beyond the expected.” Christina Osborn –Interior Design –GO GREEN Summer 2003.

In addition to the student quotes, taped interviews with several of the participants and a short video clip on the summer 2003 experience can be viewed at the following web site, <http://www.engr.iupui.edu/gogreen>.

This course was a learning experience for everyone involved, including the instructors. While the professors presumably know more about their subject matter than their students, learning doesn't just occur on the student side (Rainey, 2002). In this course, everyone involved learned from their experiences in Mannheim.

6 CONCLUSIONS

Through the use of the student feedback and evaluations, the faculty have made a few changes to the course. One of the required course readings was changed and a “green product” facility was added to our industry tour list. During the summer of 2004, the class will visit the Freudenberg plant which manufactures nora® rubber flooring. The factory is located less than 10 minutes away from Mannheim. The students from the 2003 summer course were very pleased and satisfied with the course. Various GO GREEN faculty have had occasions throughout the year to get together with several of the students who took the course during the summer of 2003, several have expressed their desire to return.

The cost of the program is the biggest dilemma for students. While the costs are not outrageous, students are always looking for ways to fund the travel expenses of the trip. At the high end, the trip may cost up to \$2,500 (in addition to the cost of the three credit hour course); however, students have been known to live on a shoe string and there are ways to trim expenses. Some students from the summer of 2003 spent as little as \$1,500 for their trip. The faculty are working on ways to find scholarships and grants to help students support the overseas travel.

This was the first study abroad course for the IUPUI School of Engineering and Technology. The school is very grateful to the German industry sponsors who welcomed our students and faculty and provided all of them with a unique opportunity to view their sustainable practices and developments. Our students were able to see sustainability as a global issue and to learn and experience a new and different culture. The course instructors are looking forward to adding new industries to the course in the future. Currently, plans are underway for subsequent yearly offerings of the course.

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