



## **Development of a Novel Interdisciplinary Engineering Student Exchange Program**

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# **Development of a Novel Interdisciplinary Engineering Student Exchange Program**

## **Abstract**

As an initiative to prepare engineering graduates for the ever-changing global landscape and a job market that is increasingly becoming more international and competitive, the Whitacre College of Engineering (WCOE) at Texas Tech University (TTU) requires that all undergraduates, starting with the Fall class of 2013, complete an international academic experience before graduation. The WCOE has implemented an international platform model to offer a broad range of flexible programs that accommodate student's interest, goals, and personal situation.

In order to diversify the student's options, a number of different programs have been developed in countries located in Central and South America, Europe and Asia. One of these programs is developed with Universidad del Norte (Uninorte) located in Colombia, South America, and sets a combined model of Study Abroad - Research Experience while providing a cultural engagement. The project model is a novel student exchange program that seeks to reach the WCOE goals of expanding its international programs and diversifying student's offerings. The program brings engineering students from both universities into an innovative model of exchange agreement that combines the development of an academic, research, and societal study abroad experience related to a sustainable or renewable energy topic. Undergraduate students from both institutions are engaged in a summer course, a research experience for undergraduates, and interaction in local professional contexts related to the selected topics, in order to connect academic and research contents with societal needs from an abroad perspective.

During this student exchange, students will take part in classes directly related to the selected research topic, language classes, culturally adaptive events, and a workshop designed to teach students how to approach societal needs and problems from the engineering research perspective. The program will also include development of important skills to conduct research activities and professional presentation of the results. Students in either country have different opportunities to explore and engage the local cultures. A full project design for the eight weeks has been established including the student evaluation and the program assessment. All students participating in this program will receive academic credit related to their discipline and devoted time towards the research experience. Each institution selects students from multiple disciplines in engineering and a group of faculty to coordinate the interdisciplinary activities and assess the entire program.

The project will allow a number of results to be achieved: (1) the development of a combined Research-Academic undergraduate student exchange program, and (2) the interaction between both institutions' faculty in academic and research domains. Project results will pave future avenues of collaboration at the graduate level, and increase cultural awareness of students studying abroad to the U.S. and Colombia.

## Background

Higher education institutions are moving toward the internationalization of their campuses. In the U.S., universities are recognizing the need to prepare graduates for the ever-changing global landscape and a job market that is increasingly becoming more international and competitive. Mazon<sup>5</sup>, (2009) stated “creating an international culture presents many challenges for universities since there is a parochial culture among American citizens that devalues international experiences.” Many undergraduates do not see the need to participate in an international experience and are fearful to go abroad (Mazon<sup>5</sup>, 2009). Some students and parents show concern regarding student safety, housing arrangements, and the financial burden that this experience may impose on them. These are some of the causes why the annual growth of US students going overseas is slower than the growth in other countries (Bidwell<sup>2</sup>, 2014).

Trends on study abroad participation show an increase in student enrollment. Data from the *Institute of International Education*<sup>3</sup> 2014 shows that from the academic years 2002-03 to 2012-13, the number of foreign students enrolled in study abroad in the U.S. increased by 72%, while the number of U.S. students going abroad only increased by 40%. In Texas, only 0.86% of college students went abroad in the year 2012-13, while the national average was 1.4% (NAFSA<sup>7</sup>, 2014).

Texas Tech University (TTU) is a public university located in West Texas. In order to increase TTU international presence, many academic departments and colleges within the university are working on developing new programs to provide an international experience that is safe, attractive, cost neutral and relevant to the student’s academic/professional needs. The Office of International Affairs at TTU provides a platform that supports all international academic programs and opportunities offered at TTU colleges.

The Whitacre College of Engineering (WCOE) has an undergraduate enrollment in 2014 of approximately 4700 students. These engineering undergraduates can be more competitive in the global marketplace if they possess an understanding, appreciation, and respect for cultural diversity. According to Berdan and Goodman<sup>1</sup>, (2014) “international experiences shouldn’t be a separate or tangential part of education, but rather an integrated part of the curriculum.” With the support of TTU administration and WCOE alumni, the WCOE implemented an undergraduate student requirement to have an international experience before graduation. This requirement began with the fall class of 2013.

In order to provide students with many international options integrated to the curriculum in modalities such as study abroad, internships, research experiences, and community service abroad, WCOE leadership has visited many universities around the world. A number of agreements have been established with universities in Europe, Asia, Latin America, and the Caribbean, among others. Participation from department chairs, faculty and student advisors have been crucial in the development of the international program in the college. The implementation of this graduation requirement contributes to increasing the workforce of U.S. professionals prepared to face global challenges and work in diverse environments while increasing Texas underrepresentation for students that go abroad. However, the implementation of this novel requirement has created new challenges for the college. Developing enough abroad

programs to serve a population of about 1000 students to go abroad every year continues to be the main WCOE challenge, along with changing the perception of many students that do not see a need to go abroad, but view the requirement as an imposition from the college with no benefit. This resistance to go abroad is common among students and it is attributed to barriers such as security concerns, high costs, academic demands, and lack of encouragement by faculty and advisers (Williamson<sup>8</sup>, 2010).

In March 2014, members of WCOE leadership were invited to the Universidad del Norte (Uninorte) in Colombia. Uninorte, located in Barranquilla, Colombia, has developed international collaborations in countries located in Europe, South America, and the U.S. Uninorte engineering school courses, accredited by ABET, are offered in English for international students. Services from the International Studies Abroad (ISA) are available to visiting students providing the students housing arrangements with home stays, field trips, and a buddy support system. Uninorte, recognizing the value of global competencies that study abroad brings, is also developing programs to send their students abroad.

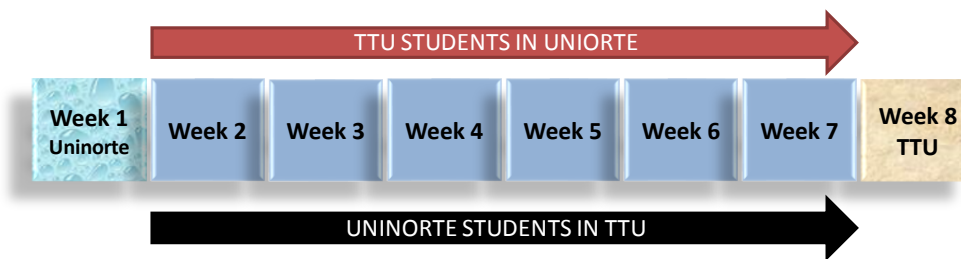
As an additional advantage, the *Uninorte-TTU Study Abroad-Research Experience* program would contribute to place Colombia on one of the top 25 *Leading Destinations of U.S. Study Abroad Students* data included in the *Open Doors* report, while also increasing the number of Colombian students in the U.S. In 2014, twelve Colombian students were studying at TTU but no TTU students were studying abroad in Colombia.

The development of the *Uninorte-TTU Study Abroad-Research Experience* program was the catalyst agent to develop collaboration agreements and a strengthen relationship between the institutions. In October 2014, the *Uninorte-TTU Study Abroad-Research Experience* team from Colombia visited TTU. The visit allowed further development of the student exchange model abroad program and signing of the letter of intent agreement. On March 2015, a TTU team visit Uninorte to sign the student exchange agreement and to offer a presentation at Uninorte's *Catedra Europa* international week event as the keynote speaker.

### **Program Description**

The Uninorte-TTU Study Abroad-Research Experience is an eight (8) week summer program that engages engineering students and faculty in a bilateral exchange that creates an academic-research-societal interaction linked to current society needs. Led by a group of faculty from both institutions that share mutual research interests in Renewable/Sustainable Energy, the program develops academic, research, and local experiences for the group of participating students. As a result, both institutions' collaborations at the research level are expected, promoting future similar programs at the graduate level as well. The program is interdisciplinary, allowing for collaboration between different engineering disciplines while addressing the same technical issue. The collaboration assumes culture and knowledge combined can create the type of integrated environment best suited for research. The topic of renewable energy will be explored and studied, and also examined through lenses designed for sustainable innovations.

All students participating in this program will receive academic credit related to their discipline and devoted time towards research experience equivalent of 9-credits. Each institution will select five students from multiple disciplines in engineering and one faculty advisor. The program will begin with the attendance of all program participants at a workshop taking place in Barranquilla, Colombia at Universidad del Norte, designed to create a standard for successful undergraduate research experience, both experimentally as well as applicably. After the first week of the program, TTU faculty will travel to the Texas Tech campus while the students from TTU stay in Colombia with the Colombia faculty. From weeks two to seven, students will attend their respective courses, work on research projects and attend cultural events. At the end of the seventh week, TTU students and Uninorte faculty will travel to the TTU campus where all program participants will work together during last week. Please see Diagram 1 for the program timeline. During the last week at TTU, everyone will participate in a Symposium on Renewable Energy. The symposium will consist of a professional seminar and a poster presentation of all the student’s research projects. Diagram 1 describes the model of student and faculty mobility during the eight-week period of the program duration.



**Diagram 1: Program timeline.** TTU-Uninorte students and faculty will be together during week 1 and week 8 of the program. From week 2 to week 7, TTU students will attend the program in Uninorte, and Uninorte students will attend the program in TTU.

### Program Participants

The program participants at each university include one faculty program advisor, the faculty teaching the courses offered by the program and faculty research advisors for the student’s projects. Each university has a staff team that worked on the program design and implementation at their respective institutions. See Diagram 2 for participant’s distribution.

Faculty	Students	Staff
1 Faculty Program Advisor from TTT	5 students from TTU 5 students from Uninorte	<b>TTU team:</b> Assistant Academic Dean WCOE for Central and South American Programs
1 Faculty Program Advisor from Uninorte		WCOE Director of International Programs
Faculty teaching course offered for the program at each university		<b>Uninorte team:</b> Director of International Programs
Research advisors for the student’s projects At each university		International Studies Abroad (ISA) representative

**Diagram 2: Program Participants**

The students participating in the program will be selected by an appointed committee at their respective universities based on their academic merits. Student participants need to meet selection criteria such as GPA requirements, course prerequisites (physics and differential equations) and letters of recommendation from faculty. The faculty program advisors are in charge of all academic aspects of the program at their institutions. Part of their responsibilities include the program academic design, courses selection, overseeing and advising the students in their research projects, selecting the research advisors and designing the assessment plan for the academic aspects of the program.

Staff teams from both universities will be responsible for all program logistics. Team members will be involved in the student selection, the coordination of all activities related to the program’s components, student travel, etc. The TTU team will coordinate the housing and meals for the Uninorte students and faculty and will coordinate cultural activities or events together with the Office of International Affairs staff at TTU. Airport pick-up and drop off will also be provided. Students from TTU will use ISA as a provider of services for their visit to Uninorte. ISA services include academic support, housing, meals, field trips and excursions and on-site transportation.

### Academic Components

The program academic format is based on three components: courses, research projects and cultural activities. Students will receive 9 hours/credit for their course work and the time devoted to the research project. See diagram 3 for courses description.

Course Name	Course Codification	Credits/hours
Solar Energy	ECE 4378	3
Independent Study	XE 4331	6
	X=M (Mechanical) X=EC (Electrical and Computer)	

Course Name	Course Codification	Credits/hours
Renewable Energies	IME 7285	3
Research Experience	PIN 2017	6

**Diagram 3: Program Courses**

Students from Uninorte will register in the TTU Solar energy course ECE 4378 that will be offered during the first summer session and is open to TTU students as well. TTU students will register in the Uninorte Renewable Energies IME 7285 offered in English and open to Uninorte students as well. The research project will be equivalent to 6 credit/hours independent study course awarded by either the mechanical engineering or the electrical engineering department depending on the participant program of study. The potential research topics are building energy efficiency, sustainable development and construction, smart grids, energy markets, and biomass

gasification, and solar energy. The research aspect of this program will last through to the seventh week of the program.

The cultural activities are an important component of the program. Both TTU and Uninorte have designed cultural activities to provide visiting students the opportunity to learn about the culture of Colombia and the U.S. For TTU students, a Spanish course will be offered to improve their language communication through the main language skills: speaking, writing, reading and listening. This is a course offered by Uninorte at no cost to the TTU students. The course is based on innovative methodologies that facilitate learning the Spanish language and provides the communication tools necessary to understand and appreciate the socio-cultural manifestations of Spanish-speaking cultures, especially the Hispanic Caribbean. Uninorte will arrange, through its International Cooperation and Development Office, a series of activities to promote knowledge on Barranquilla, Colombia and the Caribbean region.

The Uninorte students visiting TTU will participate in a range of cultural events from camping trips to movie nights. These events will provide the opportunity to learn and interact with the American and Texan Culture. Engineering field trips to the National Wind Center and visits to the Ranching Heritage Museum and the Buddy Holly Museum will be included. Uninorte students at TTU will stay in the TTU dorms and will receive access to the facilities on TTU campus including the Student Recreational Center, library, writing lab, and the other benefits of studying at TTU.

### **Assessment and Evaluation**

The *Uninorte-TTU Study Abroad-Research Experience* program has a number of concrete indicators of success. The first is the signing of our student Uninorte-TTU student exchange agreement, which allows students to enroll for the course and the research credits at their home institution, therefore the costs for the credit hours remains neutral. Services provided by ISA for TTU students are included in the exchange agreement and include an on-site orientation upon student arrival to Colombia. Similarly, TTU will provide on-site orientation for incoming exchange students including preparation for their time in Lubbock. The TTU Office of International Affairs support staff will organize different events to help inundate students into Texas and the American culture.

As students work through their classes and their research projects they will receive feedback from the faculty for class/project assignments. Student success in the courses/research projects will be quantified by their final grades through specific course evaluations. Students will have to present their research experience results in an open public poster session in Uninorte and TTU by using evaluation rubrics for the engineering aspects of the projects and the ability to communicate effectively their results.

All cultural activities, services and overall program satisfaction will be assessed at both institutions using evaluation questionnaires that student will complete after each activity and at the end of the program. The program staff and faculty advisors will analyze the assessment results to incorporate all recommendations and sustain program success for subsequent years.

Students at TTU will register at *Global Scholars* to receive multicultural credit for their participation in the program. Students will sign up for the three online courses: pre-departure, during and post-departure. After the courses are completed, the students will receive a *Global Scholar Certificate* and the courses work requirements will be used to assess the changes in attitudes towards cultural diversity of the participants.

### **Financial Support**

The WCOE requires all the undergraduate students to participate in an experience abroad. For that reason, the college develops international agreements that provide cost neutral academic experiences and that do not represent a financial burden for the students. The Uninorte-TTU Study Abroad-Research Experience was designed to be as cost neutral to the students as possible. With the student exchange agreement in place, students enroll for the courses and the research credits at their home institution, therefore the costs for the credit hours remains neutral. Students are responsible to pay for all program costs and may be eligible for scholarships based on financial need.

### **Program Sustainability**

As previously presented, the *Uninorte-TTU Study Abroad-Research Experience* program will exchange 5 students from Colombia and 5 students from TTU in the hopes of expanding student interest in Latin American countries while also creating an atmosphere allowing innovative research in a topic as important as Sustainable Energy. The program design considered the support of institutional offices in both universities including the colleges of engineering and the offices of international affairs plus the services provided by ISA, in aim to create an entirely self-sustaining program.

The Uninorte-TTU exchange agreement is a key factor in the sustainability of the program since participant students pay their program tuition at their home institution. The financial support provided by the hosting institutions guarantees student participation in the program, since it provides an excellent international academic opportunity at a fair cost. Program assessment will ensure the competitiveness of the program, students will be able to fulfill a degree requirement, participate in a research project while living and learning in another country. The cultural component of the program will allow students to immerse in the culture of a foreign country, developing second language skills and in general gain a sense of identity (Miller-Perrin and Thompson<sup>6</sup>, 2014).

According to Miller-Perrin and Thompson<sup>6</sup>, 2014, most universities recently focusing on globalization efforts, are not focused on the traditional way of pursuing the arts and literature as only topics to learn abroad but are providing programs that prepare students to present solutions of global impact while immersing in cultural experiences. The topic of renewable energies selected by the Uninorte-TTU teams, will prepare the participant students with knowledge and hands on research to compete in the global market and implement solutions to problems of global significance.



Participant students will become our ambassadors for the *Uninorte-TTU Study Abroad-Research Experience* program for years to come. Both Uninorte and TTU participants will be encouraged by their home institutions to promote the program and encourage others to participate.

Kowarski<sup>4</sup>, 2010, addressed the problematic that some students that participate abroad are not able articulate what they have learned from the experience when talking to other students, faculty or during job interviews. By becoming ambassadors, participating students will have to analyze the study abroad experience and reflect on the lived and learned experiences in a holistic way. It is the goal of all members of the team, both faculty and staff, that this academic-research-societal interaction linked to current global solutions on renewable energy will provoke personal and professional growth, the development of a global perspective when seeking solutions and acquisition of respect and tolerance for different cultures; and that “all those benefits added” by the abroad experience will be palpable to the participant students and others.

#### Bibliography

1. Berdan, S., Goodman, A. (May 12, 2014). Every Student Should Study Abroad. *The New York Times*. Retrieved from <http://www.nytimes.com/roomfordebate/2013/10/17/should-more-americans-study-abroad/every-student-should-study-abroad>
2. Bidwell, A. (2014). *U.S. falls short in studying abroad*. Retrieved from <http://www.usnews.com/news/blogs/data-mine/2014/11/17/how-studying-abroad-has-changed-in-the-last-decade>
3. Institute of International Education (2014). *Open Doors Report on International Educational Exchange*. Retrieved from <http://www.iie.org/opendoors>
4. Kowarski, I. (July, 2010). Colleges help students translate the benefits of study abroad. *The Chronicles of Higher Education*. Retrieved from <http://chronicle.com/article/Colleges-Help-Students-to/123653/>
5. Mazon, B. (2009). Creating the cosmopolitan US undergraduate: Study abroad and an emergent global student profile. *Research in Cooperative and International Education*, 4(2).
6. Miller-Perrin, C., Thompson, D. (2014). Outcomes for global education: External and internal change associated with study abroad. *New Directions for Students Services*, (2014), 77–89. doi: 10.1002/ss.20093
7. NAFSA (2014). *Study abroad participation by state: Academic year 2013-2014*. Retrieved from [http://www.nafsa.org/\\_/File/\\_/studyabroad\\_statebystate\\_2012-2013.pdf](http://www.nafsa.org/_/File/_/studyabroad_statebystate_2012-2013.pdf)
8. Williamson, W. (July 25, 2010). 7 signs of successful study abroad. *The Chronicles of Higher Education*. Retrieved from <http://chronicle.com/article/7-Signs-of-Successful/123657/>