

A Design Seminar Course on Developing Technologies for Rural Nicaraguans

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Abstract

A collaboration between the Universidad Nacional de Ingenieria (UNI) in Managua, Nicaragua and Villanova University was established three years ago. The initial collaborative efforts were focused on a telehealth humanitarian development project. More recently, faculty members at UNI and Villanova have obtained funding to develop joint courses to teach both sets of engineering students the design of technologies to benefit and improve the lives of rural Nicaraguans. Prof. Maria Virginia Moncada, Head of the Electronic Engineering Department at UNI spent the fall 2013 semester at Villanova University working with ECE and Business School professors developing course materials for a new Design Seminar course focused on developing technologies for Rural Nicaraguans. The first iteration of this course was offered to nine Villanova ECE students and eleven electronic and computer engineering students at UNI during the Spring 2014 term.

This paper will present details of the course syllabus, sample materials and our experiences in running this joint course for the first time. Student feedback on the course is also provided.

Introduction

Villanova University faculty and students have been engaged in service learning projects in Nicaragua over the last ten years. These projects have been centered in the rural communities surrounding the town of Waslala, Nicaragua, located in North Central Nicaragua. These communities comprise about 50,000 people who are primarily farmers. There is very little infrastructure in this region with unpaved roads, no access to electricity in many of the communities and one cell phone tower which provides reception to most of the region but sometimes requires walking 30 minutes to an hour to obtain reception.

For the past ten years, Villanova University's Colleges of Engineering and Nursing have partnered with the local parish in Waslala to design and implement gravity-fed clean-water distribution systems from sources located above the animal grazing line and to impart health education to the community and to volunteer community health workers. More recently, Villanova electrical and mechanical engineers have also traveled to the communities around Waslala to explore power generation using small scale hydroelectric systems.

Four years ago, Villanova University received a Sustainable Vision grant from the National Collegiate Inventors and Innovators Alliance (NCIIA) to develop and implement a tele-health system in the region around Waslala to improve access to quality health care for the members of the communities in that region. A system was developed and implemented and details of the project can be found in references [1] and [2]. One of the byproducts of this project was the development of a partnership with the Universidad Nacional de Ingenieria (UNI) in Managua, Nicaragua, the largest and most prominent engineering school in Nicaragua.

It was recognized that there are many needs in the rural communities in Nicaragua and a proposal was written to NCIIA for funding to support the development of technologies to enhance the quality of life for rural Nicaraguans. The proposed project was to develop a two course sequence for both UNI and Villanova engineering students. The first course in the sequence was to be focused on providing the contextual background for students, especially at Villanova University, and orient them towards how to identify technology-based, entrepreneurial projects suitable for rural Nicaraguans. The second course was to be focused on the development of sustainable business models for the base of the pyramid customer. In addition, students would prepare a proposal for their capstone design project in the first semester course and then execute their design work in parallel with the second course on sustainable business model development. The projects were to be worked on jointly by teams comprising Villanova students and UNI students. Venture Well (formerly NCIIA) funded the proposal in January 2013 and the first offering of the first course took place in the Spring 2014 term. This paper describes progress to date on this project.

Previous International Collaborative Education Initiatives

Much work has previously been done in global education. In Europe, the Erasmus project has encouraged students to travel to different countries within the European Union to take classes at universities outside their home institutions [3]. There have also been several papers written describing international curriculum development efforts [4-7]. There have also been many research partnerships between universities in which students and faculty have performed research at partner institutions. More recently, there has been a lot of work in the area of developing collaborative tools where students from various institutions work together on common design projects [8-12].

At Villanova University, we have had several initiatives in inter-university collaborative senior design projects. Our initial foray into this area was with Purdue University's Electrical and Computer Engineering department. This initial project was of limited success because of some lack of coordination between the two groups, different sets of expectations/requirements, and a lack of interaction between the student teams at the two institutions. We subsequently developed project work in coordination with the University of Dayton. Again, our initial attempt in this area had limited success primarily because of lack of coordination/interaction between the two teams. The second iteration of the project work with the University of Dayton was initiated with a face-

to-face meeting over a weekend in a central location, Seven Springs Resort, near Pittsburgh, Pennsylvania. The students were engaged in various social activities as well as team building exercises. This face-to-face interaction proved invaluable in helping the students to bond and resulted in a more successful collaboration between the students on their design project. This type of face-to-face meeting has been incorporated in subsequent project work with the University of Dayton and has continued to foster closer collaboration of the students at the different universities.

Preparation for the First Course

During the fall 2013 semester, Prof. Maria Virginia Moncada from UNI took a Sabbatical Leave to attend Villanova University as a visiting professor. During this time, she attended several entrepreneurship classes, including a Creativity and Innovation course, an engineering entrepreneurship class, and a Social Entrepreneurship class. The first two courses were taught in the College of Engineering and the third class was taught in the Villanova School of Business.

Also, during her visit to Villanova University, Prof. Maria Virginia Moncada participated in weekly meetings with Profs. Singh, Dougherty and Klingler to discuss the course content for the first course in the two course sequence. An outline of the week-by-week course content is shown in Table 1. During her visit, she also prepared course materials for the classes related to Nicaraguan culture, technology sectors in Nicaragua, current sustainable development programs in Nicaragua, and the design process.

Table 1. Class Schedule for First Course

<u>Date</u>	<u>Topic</u>
Jan. 14	Introduction/Course Overview/ Nicaragua: Geography, Culture, History and Socio-economic Analysis
21	Energy, Environment and Telecommunications Sectors in Nicaragua
28	Introduction to Entrepreneurship
Feb. 4	Current sustainable development programs in Nicaragua
11	Current sustainable development programs in Nicaragua (cont'd)
18	The design process
25	Customer needs/identification/interviewing process
March 4	SPRING BREAK in Nicaragua
11	Project proposal development

18	Project proposal development (cont'd)
25	Project proposal development (cont'd)
April 1	Project proposal development (cont'd)
8	Project proposal development (cont'd)
15	Draft Oral Presentation due
22	Final Oral Presentation
29	Final Written Proposal due

The course begins with an introduction to Nicaragua including its geography, history, culture and politics. The Villanova students were given an assignment after this first class to determine the impact of the country's civil war on the economic development of the country relative to other countries in Central America. The next class in the course focused on a description of various technology sectors in Nicaragua, including the energy sector, especially the renewable energy sector, and the information technology and communications sectors. The third class was an introductory presentation to entrepreneurship presented by Dr. Klingler. The fourth and fifth classes included guest lectures from technology-based organizations, non-governmental organizations (NGO's) and for-profit companies based in Nicaragua. The sixth and seventh classes focused on the design process and understanding the "voice of the customer", respectively. Also, Villanova students acted the roles of rural Nicaraguan and Villanova student to simulate interviewing rural Nicaraguans for learning what their lives are like and to uncover what technologies they could benefit from.

All of these classes from the first semester's course were taught to Villanova students since UNI students were on semester break during this time.

After the seven weeks of classes, four of the students in the class traveled to Nicaragua with Prof. Singh. After arriving in Nicaragua, the students met with the students at UNI and the initial socializing took place. Over the course of the next week, students and professors from UNI and Villanova travelled together to various sites, including rural locations and did homestays in rural communities. They got to both interact with each other and with local rural Nicaraguans. A picture of the Villanova and UNI students at the entrance to a Solar Center in Totogalpa is shown in Figure 1.



Figure 1. Villanova and UNI students at the entrance to the Solar Center in Totogalpa, Nicaragua

At the end of the week, a debriefing session was held to discuss the potential project opportunities that had been uncovered and a total of almost thirty projects were proposed. Another important consequence of this visit was the development of close relationships between the UNI students and the Villanova students.

Workshop for UNI students

Professors Singh, Klingler and Dougherty traveled to Nicaragua during the first week of January, 2014, to deliver a workshop on entrepreneurship to the UNI students. The 2.5 day workshop built upon an exercise conducted by Prof. Moncada in which the students had to visit a market commonly visited by tourists and interview the people working at the stalls in the market. The students learned topics such as value proposition, “voice of the customer”, opportunity recognition, prototyping, elevator pitches, and they heard the life story from a successful Nicaraguan entrepreneur, Vladimir Delagneau, Chairman of Tecnosol. They also heard about tech transfer/business incubation services available through UNI. This workshop also gave UNI students exposure to the Villanova professors and vice versa, another opportunity for relationship building.

When Dr. Singh traveled down to Nicaragua over Spring Break, he was able to reconnect with the students having seen them only two months earlier.

First Course Implementation

The first course in the two course sequence has been implemented for the first time during the spring 2014 semester. The first two classes were delivered to the Villanova students remotely over Skype by Prof. Moncada from her office at UNI. The internet connection was good and she came across very clearly. The third class was delivered on campus by Dr. Klingler and the guest lectures from the NGO's and companies in Nicaragua were also presented over Skype. Finally, the design process was jointly presented by Dr. Singh and Prof. Moncada, with Prof. Moncada presenting over Skype.

Eleven electronic and computer engineering students at UNI have been selected to participate in this program. Nine electrical and computer engineering students from Villanova are enrolled in the class at Villanova. Prior to the Spring break trip, a Facebook page was set up for the group and the students from each of the universities were encouraged to post messages and biographies on this page. While there was some initial activity prior to the trip, the postings have increased tremendously since the students met each other in Nicaragua.

Assessment Survey

A short survey was administered to the Villanova students taking the class after the first four classes. Six questions were asked of the students:

1. Have you developed a good sense of the Nicaraguan context for your senior design project?
2. Do you have a good understanding of the energy and information and communication technologies sectors in Nicaragua?
3. Did you find the presentations from the companies/organizations doing work with rural Nicaraguans helpful?
4. Did you find the presentation technology working in the presentations from Nicaragua?
5. Do you feel that you are starting to connect with the UNI students?
6. Do you have an understanding of the special challenges of working with the "base of the pyramid customer"?

All but one of the questions were very positively answered, particularly question 3. The question that was answered with least enthusiasm was question number 5. However, the situation has changed dramatically in this particular regard following the trip to Nicaragua.

Project Selection

Both the Villanova and UNI students went through a down-select process to finalize their senior design project choices. They were given almost 30 projects to choose from (based on the ideas and opportunities that they uncovered from their visits to rural Nicaraguan communities). They were asked to fill out a decision matrix where the components of the matrix and weighting of each field were:

1. Project alignment with electrical/computer engineering fields (weighting – 1)
2. Interest in the technology (weighting – 1)
3. Skill set to work on the project (weighting – 1)
4. Social impact (weighting – 0.5)
5. Business opportunity (weighting – 0.7)

Five projects were selected and were assigned students from Villanova University and UNI as follows:

1. Solar charge controller design (one Villanova student, one UNI student)
2. Design of a tele-health and remote education system on a smart phone platform (one Villanova student, two UNI students)
3. Design of a neo-natal incubator (three Villanova students, one UNI student)
4. Design of a local area network to provide Internet access to a school in a remote community (four Villanova students, two UNI students)
5. Design of a solar water pumping system (two UNI students)

Issues in Collaboration between UNI and Villanova Students

The student groups have been meeting with their advisors at both UNI and Villanova University on a regular basis. As one can imagine, there have been issues regarding communication. Oftentimes, UNI students do not have access to the Internet at home and sometimes there can be significant delays in responses from them to the Villanova students. Also, Skype calls have sometimes not been reliable. Times of the calls have sometimes been inconvenient for one or other of the parties. The UNI students had the week of April 14th off for the Easter Holy Week. While Villanova students also had time off for Easter from April 17th to April 21st, they were working in the early part of the week and given that the final proposal and presentation for the Villanova students were due April 29th, this holiday came at a critical part of the semester for the UNI students.

Nevertheless, all mixed Villanova and UNI students progressed well. The communication has generally been good. The solar charge controller team has made good progress even though the students never met each other (the Villanova student did not travel down to Nicaragua in March) until October 2014 when they were half way through their project design. Regular weekly meetings with the advisors proved important to keep the students on track. The students were also meeting with each other over Skype and Facebook at other times during the week. All of the mixed UNI/Villanova student teams presented their project proposals jointly with the UNI students presenting over Skype.

In the case of the UNI students, they have a somewhat different protocol for the format of their proposals compared to the Villanova students. This has meant that each student has had to follow

the format of the proposal for their respective institutions. There has also been little communication between the UNI and Villanova team advisors.

The technical design has been performed over the summer and fall semesters and the final prototypes will be demonstrated by the end of the fall term.

Conclusions and Summary

A new two course senior design sequence focused on the development and commercialization of technologies for rural Nicaraguans is under development as a joint program between Villanova University and UNI. The first course is half way through being implemented in its first iteration and has so far gone forward very successfully with good student satisfaction, good bonding between the UNI and Villanova students, and many viable project ideas being generated.

The students have selected projects and in most of the cases, teams of UNI and Villanova students are planning to work on projects together. The student teams have been meeting remotely and working on their project proposals. They finalized their project proposals and gave their presentations jointly with the UNI students presenting over Skype. They are now completing their project designs and most of the students are taking a second course on the commercialization of their technologies.

The face-to-face interaction of the students had a catalytic effect in establishing a good relationship between the students and social media are serving to maintain those relationships. While there are cultural and language barriers that make the collaboration challenging, it remains to be seen how the product deliverables work out. We plan to report on this at a future conference.

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