



Engineering Economics International Experience for Community College Students

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Abstract

McLennan Community College's engineering program has seen sustained growth since its reboot in 2009, in great part thanks to the multiple research and travel opportunities we are able to offer. One of these opportunities involves the incorporation of a course section of Engineering Economics which includes a highly structured, faculty-led, short-term study abroad experience to Australia and New Zealand, which took place in May of 2015. The Engineering Economics course in AU/NZ builds on the foundations of an already-established program at McLennan Community College. Besides the aforementioned benefits of having an experience of this magnitude, the course-specific objectives of the trip highlighted the international aspects of Engineering Economics and the relationship between course concepts and real-world situations, both domestic and abroad. Most of the course content was delivered prior to departure to enable students to focus their attention toward case studies involving important landmarks, international corporations, and site-specific environmental issues abroad. All students participated in the experience, not only by visiting interesting places and hearing about their history and relevance, but by working on short case studies, engaging in discussions about the economic consequences of alternatives not typically seen in the US, and through various methods in which they were expected to document their experience. Honors College participants were additionally tasked with conducting their required academic cooperatives in which they developed case studies in a topic of their choosing, pertaining to the study-abroad portion of the course. Although the experience was brief, anecdotal evidence leads us to believe the international travel component successfully enhanced the course's learning objectives, while additionally contributing to a student's broad understanding of the international components impacting many contemporary economic factors, providing a unique experience with case studies while in the field using real data for real-world applications within the confines of cultural awareness and global perspectives.

Introduction

McLennan Community College's engineering program has experienced strong, steadfast growth since its reboot in 2009. This sustainable growth is partially credited to the department's promotion of real-world experiences, which enable our students to participate in undergraduate-level research and study-abroad opportunities that set McLennan's engineering program apart from other institutions. One of these opportunities involves the incorporation of a course section of Engineering Economics which includes a highly structured, faculty-led, short-term study abroad experience to Australia and New Zealand, which first took place on May of 2015 and is scheduled again for May of 2016.

MCC's engineering program added the Engineering Economics course to its curriculum during the fall semester of 2013, in order to coincide with the addition of six Associate degrees in numerous engineering fields—some which required the Engineering Economics course for

program completion. The Texas Board of Higher Education added Engineering Economics to the Lower Division Academic Course Guide Manual (ACGM) during the fall semester of 2011 and, although the course is generally included within the schedule of an undergraduate's junior year (within a four-year program), our college offers the course during the students' sophomore year. The course's learning outcomes were also provided in the ACGM, which are the following:

1. Apply different methods to calculate the time value of money.
2. Construct cash flow diagrams for a given problem.
3. Estimate total revenue, total cost, and break even points.
4. Calculate the uniform series payment, given principal, interest rate, and pay period.
5. Perform project evaluation, including cost/benefit analysis.
6. Articulate principles of taxation and depreciation.
7. Perform capital budgeting, cost comparisons, and replacement analyses.
8. Solve problems at a level consistent with expectations of the engineering economics portion of the Fundamentals of Engineering exam

Engineering is a global and interdisciplinary field. Accreditation boards and engineering education institutions across the board have called for a more well-rounded engineering education, expressing the need for engineers that are better equipped to understand the impact of the global economy on engineering solutions, as well as the social and global context of the profession itself⁷. In order to create students that are better prepared to handle the constantly changing global economy successfully, international study programs such as the one described in this paper should be encouraged.

Engineering economics is, for a wide variety of reasons, a great fit for study-abroad. While most of the content that is provided to the regular (non-travel) face-to-face sections is also covered for the engineering students in the study abroad program prior to departure, these students get an opportunity to explore the topics at greater lengths and from an international perspective. Throughout the travel portion of the course, during the various tours, site-visits, and activities, the discussions, projects, and experiences contributed to the students' ability to see the connections between the concepts learned in class and their global relevance and application.

Background

Study abroad programs take many shapes and forms, and can be found at most four-year universities and many community colleges in the United States as well as internationally. The benefits of international experiences for students in general have been well documented^{1,3,4,5,6,8}. Some of the benefits include:

- Improved cultural diversity awareness
- Enhanced skills for competitiveness in the job market
- Increased independence, flexibility, and adaptability
- Refined global perspective
- Intercultural understanding
- Increased student interest and retention

- Improved tolerance for ambiguity^{1,3,4,5}

In spite of the well-known benefits, engineering students are some of the least likely to participate in study-abroad programs compared to their business/humanities counterparts^{2,5,7}. This is partially due to the rigor and rigidity of the typical engineering curriculum, which makes it difficult for students to take off for a year, semester, or even a summer. While there may be multiple reasons for the lack of participation, there are many initiatives that are being implemented by four-year universities to encourage engineering students to participate.

During the fall of 2013, Texas Tech, one of our strongest four-year transfer partners with which we share an articulation agreement, instituted an International Experience Initiative requiring each engineering student to participate in an international experience while enrolled as an undergraduate—a concept that McLennan Community College agrees is a necessary step toward producing the next generation of engineers.

One of the types of study abroad experiences that has been rapidly growing is the short-term study abroad experience, which typically last 2 – 12 weeks^{6,7,8}. Their growing popularity can be attributed to their lower cost and because they allow students who don't wish to delay graduation or are unable to leave for a long period of time to participate. There have been studies that document the benefits that study abroad programs of this short length have^{1,4,8}. It appears as though most research looking into short-term study abroad agree that one of the main benefits is that it can increase students' interest for further international experiences. Olson and Lalley state that “a faculty led, highly structured, two to three week study abroad experience for students in their early year of their college careers could greatly benefit these students by opening their eyes to a wide berth of opportunities such as internships abroad, studying a second language, longer international experiences in their later years, and a reduction of travel anxiety”.⁴

For all the reasons listed above, in 2014 MCC's engineering faculty began looking into the possibility of putting together an international travel course. Although international travel courses are somewhat uncommon at community colleges, they are even rarer in engineering. The majority of students in our program lack the financial resources and/or lack the time and the flexibility to go abroad for a semester or a summer. Many of them have part-time or full-time jobs; some of them are parents. In any case, we worried that some of our students would be unable to participate in the study abroad options offered by Texas Tech and other four-year institutions, and would miss out on the benefits these provide. Thus the decision was made of keeping our program in the two-to-three-week range. Additionally, if students apply to participate in any travel course while attending McLennan Community College, many of them qualify for considerable financial aid.

The uncertainty about the number of students that would be willing to participate led to the decision to join an already existing study tour: the Australia/New Zealand Overseas Experience, which at that time was only for students wishing to get credit for Macroeconomics or Microeconomics. The faculty leader agreed to let us take our students along. We originally believed we would only find three or four students able to go. However, news that a four-year institution to which a large quantity of our students transfer to would be accepting our course as

one that completes the International Initiative they require spread, and thus, ten students had signed up before we had to cap it. While this seems like a small number, the short-term study abroad experience was originally designed to take a maximum of 16 students, including the economics students. Therefore, engineering students ended up being the majority of the participants, to the surprise of all involved.

Description of the short-term study abroad program

The Overseas Experience to Australia and New Zealand course was first developed in 2011, and was composed of the economics instructor, two trip leaders, and a combination of for-credit and continuing education students. The program has grown much since, taking 16 for-credit students and three faculty in 2015. The 2016 cohort has already been put together, and will be encompassed of 26 students (13 of which are engineering students) and 4 faculty. Besides the aforementioned benefits of having an experience of this magnitude, the course-specific objectives of the study-abroad program were highlighted by the international aspects of Engineering Economics and the relationship between course concepts and real-world situations, both domestic and abroad.

In order to accomplish this, most of the course content was delivered prior to departure to enable students to focus their attention toward case studies involving important landmarks, international corporations, and site-specific economic issues abroad. The course is offered as a hybrid flex-track, starting at the beginning of February. Details about the course structure are discussed in the next section. The group departed on this international experience after final exams, in May.

The travel course had a highly-structured itinerary, featuring a wide variety of locations and experiences. Locations were picked based on the learning objectives and each instructor's goals. Overall, the instructors wanted the students to visit as many places as possible that would enhance their understanding of the course topics. The engineering economics and macroeconomics students spent most of the time on the same itinerary items, but split up at times to focus on course-specific activities. Major "tourist attractions" were visited as well, but the instructors always strived to find ways to link course content to the visit. For the engineering students, topics related to engineering economics are not difficult to come by. For example, the group participated in an architectural tour of the Sydney Business District, which often referred to the importance of sustainable design and the high cost of real estate in that area, leading to discussion about decision-making in construction and building design. When visiting the Agrodome in Rotorua, NZ, we talked about the benefits of eco-tourism, as well as the current situation with the exporting of milk from New Zealand by China.

A typical day on the trip consisted of a brief meeting in the morning, to get ready for the day's activities, followed by visiting sites and going on tours, and in the evening, when time allowed, each instructor would meet with the students to discuss the day's activities and the lessons learned. This was the best time to assess whether the students were connecting the dots. Students were allowed some "free" time, but they were tasked with utilizing their time wisely to complete their assignments and visit particular locations.

Course structure

All students participated in the experience, not only by visiting interesting places and hearing about their history and relevance, but by working on short case studies, engaging in discussions about the economic consequences of alternatives not typically seen in the U.S, and through various methods in which they were expected to document their experience. The course was divided into two main parts:

I. Pre-departure: The focus of the period before departure was to cover the course content. The class, taught as a hybrid course, was split into weekly modules. Students were tasked with following the course calendar by watching lecture videos, completing homework assignments, and taking tests. Additionally there were several projects meant to incorporate the international experience into the course material. These projects required student to complete a portion of the project before departure. During the eight meetings prior to the overseas experience the instructor explained the projects. This time was also used to talk about the cultural differences, international aspects of engineering economics, currencies and exchange rates, behavioral expectations, traveling logistics, and other relevant topics. It is important to note that many of the students had never traveled outside the country. Some had never traveled by plane before, and a few had never even left the state.

II. During and Post-Experience

- a. *Case study*: The instructor set-up a case study about the Sydney Opera House. Case studies have always been used in this course to assess the application of engineering economy tools. In previous semesters, the instructor utilized the case studies supplemented with the textbook. This time, however, a case study was written for this specific course. The case study covered important background information about the history of the Sydney Opera House, as well as set-up a case study in which the students, in teams, were asked to answer questions about how to handle renovation expenses. The students had to write a report and do a presentation while abroad.
- b. *Videologs*: The students were tasked with recording 1 to 2 minute long educational videos of various locations we visited. The objective of this project was to encourage students to research the places we were going to in advance. They had to prepare and memorize a script prior to departure, and film at the location using a GoPro camera. The students were told to briefly comment on something interesting, engineering-wise and/or engineering-economics-wise. After the students came back from travel, they did some basic editing and turned in their videos.
- c. *Geocaching*: Students had to go geocaching in Sydney and Rotorua, with the objective of doing some “purposeful exploring” on their free time. Although this might not appear to be relevant to engineering economics, students were asked to write a paragraph about the place they found each cache at, from an engineering perspective. Since they had to collect at least 10 caches, they put their pictures

and descriptions on a report. Interestingly, this project greatly benefited the students from the “study-abroad” perspective: they had interesting conversations with locals, they learned how to move around a new city, and they found fascinating places even the instructors did not know about.

- d. *Participation and discussions:* As mentioned previously, an important part of the experience involved meeting as a group after the day’s activities to talk about the experience and the lessons learned. This was key to helping the students see the connection between the course material and the locations visited. This was also a great opportunity to present “mini case studies.” The instructor used this time to propose scenarios based on facts learned during the tours, and have students come up with solutions and/or allow for a discussion about its implications. For example, the class visited a gold mine which had been having trouble in past years due to the fluctuations in the price of gold. The class discussed ways in which one could determine the price of gold that would keep the mine open, as well as strategies the company could use to avoid being in that position to begin with. These conversations served as useful ways to assess to students’ understanding of engineering economy principles. Additionally, it served the instructor as useful feedback for future travel courses for potential case studies, places to visit (or not visit anymore), and ways to better engage the students during the trip.
- e. *Honors College case studies:* Three of the engineering students participating in this experience belonged to the Honors College, which requires students to do a yearly academic cooperative, such as a research project, for credit. These three students had to complete an engineering-economics-themed research project parallel to taking the course. They were in charge of developing case studies in a topic of their choosing, pertaining to a particular study-abroad location. Each one chose their own topic. The key component of the case study project was that they needed to find a real case study in the places we were visiting. For example, one of the students chose to look at the redevelopment of the ANZ Stadium (formerly Sydney Olympic Stadium). Then, the student researched relevant background information, both historical and financial, as well as proposed a scenario for their case study. In the ANZ Stadium case study, the student adopted the point of view of an independent consultant asked to help a committee decide which combination of new development features for the stadium would be the most financially beneficial long-term. The students doing this project completed the bulk of the work before going on the trip, but also collected data and spoke with experts during the site visits, finishing their analyses a few weeks after the trip ended.

The future of the program

This experience served mostly as a pilot program for future short-term study abroad courses in engineering. The completion of course learning objects was assessed via various grading rubrics for each of the assignments, projects, and discussions both pre-departure and post-arrival. Assessment of student engagement during the trip was done mostly from the instructor's observations and as well as discussion quality during the end-of-the-day meetings. Additionally, after the trip, students were asked to indicate via survey which had been their favorite and least favorite activities. The instructors were pleasantly surprised to find that many of the more educational activities, such as visiting a geothermal power plant, had been rated very highly.

Feedback from students about the short-term study abroad experience indicates, according to the instructor, that it succeeded at contributing to a student's broad understanding of the international components impacting many contemporary economic issues. Unfortunately, methods to quantify the degree to which students increased their global awareness were found lacking for this, the first (of hopefully many) engineering international study abroad experience at this community college. Also given the very small sample size, findings would have most likely been found to be difficult to generalize. However, the instructors hope to from now on, as the program continues and grows, find more reliable and consistent ways to assess global awareness, which is why for future trips the instructors plan to use the Global Engagement Measurement Scale (GEMS), developed by the University of Delaware's Institute for Global Studies³ or similar assessments.

Due to the increasing popularity of this program, the Engineering Economics Overseas Experience course to Australia and New Zealand will be repeated in May of 2016. Furthermore, the engineering faculty is currently working on developing an engineering-specific program to various location in the UK. However, in an effort to improve the course, several things will change for the 2016 course:

- a. *Travel Guide Project*: although the objectives of the videolog project from the 2015 Overseas Experience were accomplished, there were several issues, such as difficulty with sound editing, student editing inexperience, unexpected weather, and itinerary changes, which made the instructors rethink whether this was the best way to engage the students. This discussion led to the development of the Travel Guide Project, which will allow students to research and write about the places they will be visiting before departure, and will give them a chance to pay closer attention to details when visiting the sites. Students will have to take pictures for the travel guide, write chapters as a team as well as individually, and make edits after getting back. Additionally, there will be a section of every article written devoted specifically to engineering economics. Students must find at least two different ways in which the course materials relate to a particular place, and then must explain why it is interesting and relevant. For example, if a student is writing about the Sydney Harbor Bridge, they can write about how toll prices were determined based on maintenance costs, as well as the fact that construction went over budget. This will allow for case study-type discussions to be fruitful during the experience.

- b. *More engineering-specific sites added:* The instructor have gone through great lengths to find tours/sites/experiences that are more technical in nature. While this travel course is the same length as the 2015 program, students will get to experience a more engineering-intensive experience during the 2016 trip.
- c. *Multidisciplinary presentations:* The 2016 course will be different that previous travel courses in that various other fields will be joining the group. The 2016 cohort has students from engineering, environmental science, theatre, and sociology. While this can make the logistics a little more complicated, it also provides new experiences for the students. Each major will have to deliver a field-specific activity that the other students will have to complete. For example, engineering is focusing on sites of engineering heritage in Sydney and is requesting that the other students go find a markers for each of them, all which are near the Sydney Harbor.

Conclusion

We strive to provide McLennan Community College's students access to the same opportunities that students at four year universities have. Study abroad opportunities offer our students a wide range of benefits, not the least of which are a competitive edge when transferring to four-year universities, or when applying for internships. This travel course, on top of all the benefits of study abroad mentioned previously, additionally helps our students because, without the shorter length and the smaller price tag, many of them would never have such an opportunity.

Although the experience was brief, and the number of students who participated on this short-term study abroad experience small, anecdotal evidence leads us to believe the expected outcomes associated with this international travel component successfully enhanced the course's learning objectives. This further contributed to students' broad understanding of the international components impacting many contemporary economic factors, providing a unique experience with case studies while in the field using real data for real-world applications within the confines of cultural awareness and global perspectives. Through this program, students personally experienced extensive learning opportunities, highlighting the benefits of study-abroad experiences through increased cultural awareness, a refined global perspective, and an enhanced ability to navigate the changing global landscape.

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