2018 ASEE Mid-Atlantic Section Spring Conference: Washington, District of Columbia Apr 6

Project-based study abroad programs in Engineering Technology: Challenges and lessons learned

Dr. Marcia Ford, Murray State University

Dr. Marcia Ford is an assistant professor in the Telecommunications Systems Management (TSM) Program at Murray State University in Murray, Kentucky. She teaches undergraduate and graduate information communication technology and cybersecurity courses. Her research focus is intelligent personal assistants and smart home devices. Her interests also include developing and leading study abroad opportunities for Murray State students.

Prof. Kevin T Perry AIA, Murray State University

Kevin Perry is a Registered Architect and Professional Engineer with over ten years of AEC experience in Kentucky and Tennessee. He is currently an Associate Professor of Engineering Technology at Murray State University in the Department of Industrial and Engineering Technology and the Advisor for the AGC student chapter. He teaches courses in Sustainable Design, Reinforced Concrete Design, Structural Steel Design, Construction Materials and the Senior Design capstone course for students in Architectural Engineering Technology, Civil Engineering Technology and Construction Engineering Technology. His research interest are the in the areas of construction materials and emerging technologies for the construction and design industries.

Mr. Brian Giltner, Murray State University

Lecturer in the Institute of Engineering at Murray State University. Mr. Giltner is also a practicing civil and structural engineer with over 28 years of experience.

Ms. Melanie McCallon Seib, Murray State University

Melanie McCallon Seib is the Director of Education Abroad at Murray State University, where she has collaborated for office growth and study abroad program curriculum integration for nearly 17 years. She spearheaded creation of faculty recruitment, training, financial, and support structures at MSU to enable innovative faculty to build project-based learning programs abroad.

Project-based study abroad programs in Engineering Technology: Challenges and Lessons Learned

Marcia Ford, Kevin Perry, Brian Giltner, and Melanie McCallon Seib

Murray State University

Abstract

Experiential learning is increasingly an important offering at many universities. Project-Based Learning (PBL) is one method to deliver this learning type, and this paper discusses the challenges and lessons learned from a series of international, study-abroad PBL offerings in Engineering Technology. Faculty in the Architectural Engineering Technology, Civil Engineering Technology, and Telecommunications Systems Management programs at Murray State University reflect on their study abroad program successes and practices. The study abroad programs were 16-week (3 credit hour) courses with instructional period throughout the semester, with travel occurring during spring or summer breaks. All five study abroad programs concluded with students traveling to the international partner's location and providing a unit of work or deliverable. Topics discussed in this paper are student recruitment, project identification, finding international partnerships, program expenses, equipment logistics, knowledge transfer, and project sustainability.

Keywords — Project-based learning, Engineering Technology, Study Abroad, Experiential Learning

Introduction

Murray State University (MSU) is a four-year public university located in Murray, Kentucky. MSU serves an 18-county region located in western Kentucky, which is considered one of the most economically distressed areas of the United States[1]. The eighteen counties of MSU's service region have a lower income per capita than the national average, with 15 counties having a lower per capita income than the state of Kentucky[2]. For the 2015-16 academic year, MSU had a student population of approximately 11,000 students, with 50% of those students from the 18-county service area[3]. Located in MSU's Jesse D. Jones College of Science, Engineering and Technology, the Institute of Engineering (IoE) offers five-degree tracks, Engineering Physics, Engineering Technology, Physics, Engineering Graphics and Design, and Telecommunications Systems Management. The Telecommunications Systems Management (TSM) program offers graduate and undergraduate courses in information communication technology (ICT) data and voice network design, implementation, and support. Undergraduate students can specialize from four different concentrations: cybersecurity, database administration, wireless, and system administration. In 2017, TSM conferred 26 baccalaureates and 26 master's degrees. The Civil Engineering Technology (CET) program offers students practical and applied education in the Architecture, Engineering, and Construction (AEC) industry at the undergraduate level. Students can select tracks in Architectural Engineering Technology, Civil Engineering Technology, Construction

Engineering Technology, and Environmental Engineering Technology. The Civil and Construction Engineering Technology tracks are ETAC/ABET accredited. In 2017, this program enrolled 163 students and conferred 38 baccalaureate degrees.

Experiential learning is an increasingly important offering at many universities. It is the process of learning through experience combined with critical reflection of that experience. Examples of experiential learning techniques include, but are not limited to, project-based learning, service-learning, study abroad, and internships. IoE CET and TSM programs require internships and senior capstone projects as a part of their curriculum. However, few IoE students participate in study abroad programs. Prior to 2014, only 10% of MSU summer study abroad students were in STEM fields. Due to unavailability of STEM study abroad course offerings, these students did not enroll in STEM programs abroad, but instead, as honors college with a MSU study abroad requirement, enrolled in university studies courses abroad and STEM courses locally. STEM students certainly had the desire to study abroad but the lack of abroad STEM course availability hindered participation. In 2013, CET and TSM faculty began to integrate PBL into study abroad programs. IoE faculty wanted to create a global educational experience that would have a positive, long-term impact on students' professional skills, worldviews, and work readiness that was not possible in Western Kentucky. For the 2014 study abroad summer programs, STEM student participation increased to 18% with 63% of those students taking courses in STEM. Experiential learning is offered at many universities due to its long term educational and professional benefits. Therefore, the purpose of this paper is to discuss the challenges and lessons learned from five different IoE study abroad project-based learning programs, so that other engineering educators may benefit from their experience and develop their own programs.

Experiential Learning Program Descriptions

The IoE PBL study abroad programs were faculty-led programs where faculty with the assistance of MSU's Education Abroad Office (EAO) staff, organized U.S. and in-country travel, lodging, extracurricular activities, meals, and program budget. In addition, the faculty collaborated with on-site industry professionals to identify project requirements and scope of work. Faculty-led programs were designed with instructional period throughout the semester and travel occurring during spring or summer breaks. Students were permitted to substitute these programs either as a senior capstone or technical elective course. In the spring semester of 2013, engineering technology students, for their senior capstone course, were tasked with developing a design for an ecological and sustainable resort located in San Jose de David, Chiriqui Province, Republic of Panama. A Panamanian property representative provided CET faculty the eco resort design requirements and criteria. Students created feasibility studies, preliminary designs, estimates, and presentation drawings. During Spring Break, faculty and students traveled to David, Panama, where they presented their preliminary designs to a 'property owner' and Panamanian representatives. The 'property owner' offered feedback and suggestions to the students on how to improve and complete their designs. When classes resumed after Spring Break, students completed their designs, presented their final projects to the entire class, and sent a copy of their final work to the representatives in Panama. This program had an enrollment of 4 males and 4 females. In Spring 2015, a similar opportunity emerged for an Eco-Resort in Placencia, Belize. Again, in this senior design course, students researched the project, locale, and presented their final projects to the resort owners in Belize during Spring Break. Students' final projects were emailed back to Belize eco-resort owner with possible incorporation into an actual construction project.

This program had enrollment of 1 male and 7 females. The CET Spring 2017, PBL study abroad was a follow-up of the 2015 Belize Eco-Resort project and a new project with a library in Belize. The major focus of this PBL study abroad was to assist a library system with field measurements of their existing library facility in Belize City, Belize. The existing structure was built in the 1880's and underwent various modifications over the years. However, the original construction and modifications were never documented with design drawings. The students took field measurements of the facility, along with photographs, to clearly document their findings. The students summarized their work and presented it as papers, presentations (such as PowerPoint), videos, or other methods that conveyed what they had learned. This program had an enrollment of seven students-2 males and 5 females-with two faculty from IoE. During Spring semester of 2013, TSM offered its first PBL study abroad program. Originally, the TSM program was offered as a study abroad program to London, but due to low student enrollment the program was cancelled. With approval from the education abroad office and the CET faculty, the three TSM London students were permitted to participate in the CET PBL study abroad to Panama. TSM students developed and presented their ICT solution for the El Salao Eco-Resort in David, Panama. TSM's second PBL study abroad program was during the Spring semester of 2014 to San Ignacio, Cayo District, Belize. TSM students responded to a primary school's Request For Proposal (RFP) with their proposed designs and solutions. This project was unique in that the TSM students obtained used network equipment, refurbished that equipment, and configured the network equipment before departing for Belize. This course had an enrollment of 12 students, 10 males and 2 females. The most recent TSM PBL study abroad program was during the spring semester of 2017 to Belize where students responded in writing to a Belizean library's trouble ticket RFP. At the conclusion of the semester, students traveled to Belize and presented their solutions to library's chief librarian and staff. This course had an enrollment of 6 students-3 males, 3 females- and two TSM faculty members.

Challenges and Lessons Learned

The Challenges and Lessons Learned section is divided into three themes: Partnerships, Program Development, and Student Engagement.

Partnerships — Partnerships are defined as the partnerships between faculty and international partners, faculty and program providers, and faculty and EAO office staff. Finding an international partner willing to collaborate on student projects can be challenging. One solution is to use reliable, outside program partners for nascent programs. This introduces faculty to PBL study abroad, without the responsibility of organizing travel and lodging, allowing them to focus on the PBL aspect of their program. The Education Abroad Office staff routinely interfaces with the program providers and may offer guidance when selecting a program provider. Once faculty participate in a PBL study abroad, they may feel more confident to lead their own program, and a program provider may not be necessary. For example, the provider Center for Engaged Learning Abroad (CELA) assisted the TSM faculty in identifying and scheduling extracurricular activities, lodging, and local travel for the 2014 TSM program. With contacts in Belizean communities, CELA was able to connect TSM faculty with Succotz Village school administration. Educational cooperatives are another resource for identifying international partners. The Consortium for Belize Educational Cooperation (COBEC) is a cooperative of U.S. and Belize educational institutions with a membership of 12 Belizean and 24 U.S. universities and junior colleges[3]. During COBEC conferences, the IoE faculty–along with Belizean faculty–identified several potential PBL

projects. Other international partner challenges, typical of any customer/client relationship, are communication, cultural differences, and project site infrastructure limitations. Communication challenges are differences in language or dialect, email responsiveness, inadequate Internet speeds, unreliable cellular service, and in the case of Belize, the monetary cost of international phone calls. MSU faculty concluded, when communicating with Belize international partners, that the use of landline telephones alleviated most of the communication barriers. Cultural differences regarding business attire, punctuality, and conducting meetings also presented challenges for faculty and students. For example, in Belize meetings were more relaxed and informal, with less time constraints, as compared to meetings in Panama, which were more professional and punctual. Faculty site visits permitted faculty to interact with their hosts, absorb local culture, and share that knowledge with their students prior to in-country travel. Site visits also permitted faculty to survey infrastructure such as electricity, internet access, and transportation options. If faculty site visits are not possible, candid conversations between faculty and international partners about business and social norms are necessary. It was the experience of IoE faculty, that Belizean and Panamanian partners were not offended by questions but were eager to share their culture. Project sustainability is another PBL study abroad challenge. With the exception of TSM Belize 2014, IoE faculty defined sustainability as the continuation of the international partnerships with the introduction of new projects over time. The TSM 2014 program included long term support operational sustainability. However, due to knowledge transfer perceptions and personnel turnover operational sustainability was not successful. As a result, TSM faculty transitioned from project implementation to design/solution unit of work. Another critical partnership for successful PBL study abroad programs is the relationship between university EAO offices and the engineering faculty. University regulations and academics are not mutually exclusive. Faculty may view the EAO as attempting to exert too much control, while EAOs view faculty as trying to skirt the rules. To reach middle ground successfully, it is essential that both sides understand there are standards in each field. Education abroad is its own field of scholarship and research, with a recognized set of Standards of Good Practice[4]. It is unrealistic for EAO staff, however knowledgeable, to understand the facets of every academic field. Their job is to support innovation in education by helping the faculty identify learning outcomes that incorporate location and culture. Unfortunately, many university campuses do not have the capacity to support faculty-led programming abroad and may leave a host of questions unanswered for faculty attempting to create PBL programs abroad: How are program fees collected from students? How is payment sent to another country? What is the support network if an emergency arises abroad? Faculty stepping into programs abroad for the first time should consider these challenges. If a developed EAO does exist with these support structures in place, working within these reasonable structures, the goal is to protect faculty and students. PBL projects are designed by the faculty leaders and the role of the EAO is to establish rigor in program design and project development[5].

Program Development — After identifying an international partner and project, program development presents its own set of challenges such as: program scheduling, number of participating students, activities, assessment, student recruitment, and travel logistics. The lesson learned by the IoE faculty was meet with the EAO staff to discuss faculty-led program proposal, student application procedures, study abroad application deadlines, and study abroad program lengths (in days). Once the study abroad program length is determined, faculty should establish project scope, objectives, and tasks. Project creep can be avoided by sharing the project scope and objectives with co-faculty and international partners. Students' daily tasks and activities should be clearly defined so as to prevent the loss of focus in low-performing when on-site. The program

should be developed balanced between academic, cultural, and extracurricular activities, so that students have free time to explore on their own. When reviewing student study abroad applications, the process should be selective to ensure that the best students are afforded this opportunity. It is advisable to create a generic course and syllabus for all academic study abroad programs, such as TSM 388 International Experience in Telecommunications Systems Management. The use of dedicated course prefixes and numbers reduces enrollment and course substitution confusion. When in-country, mishaps or incidents will occur. When faculty say "leave that snake alone", the student will disregard the warning, touch the snake, and get bitten. In times such as this, it is beneficial to have two faculty members on the program, one to stay with the group and the other to travel to hospital with the snake bitten student. Reducing the cost of the PBL study abroad program will assist with student recruitment efforts. Study abroad program locations closer to the continental United States (Central America) should be investigated to help reduce travel cost such as flights, hotel, and food.

Another difficult task of program development is the assessment of students, partnerships, and the program itself. High performing TSM students preferred letter grades where low performing students preferred Pass/Fail. For proper assessment and equitable course substitution, it is suggested by the IoE faculty member that PBL study abroad programs use letter grades in lieu of Pass/Fail. A crucial aspect of experiential activities is learning through reflection. Simple methods for student assessment are daily reflective writing, presentations upon returning home, or a simple survey/questionnaire. Reflective writing is an excellent method for students to capture their experiences and learning. Reflection is not limited to writing but includes sketches of sights and locations. The hectic pace of a short-term (7 to 10 days) program, with many activities and travel events, may not allow adequate time for reflection. Therefore, it is helpful to dedicate time within the daily schedule for reflection. Faculty can support student uniqueness and creativity when assigning presentations by permitting the use of PowerPoint, video blogs, storyboards, etc. for reflection documentation. CET faculty incorporated the ABET-ETAC student learning outcomes into their course. ABET ETAC requires that each accredited program meet the Engineering Technology (ET) student outcomes[6] and program specific outcomes[6]. Project based learning combined with a study abroad addresses many of the student outcomes such as applying engineering technology skills, ability to design systems, and the impact of engineering technology in a global and societal context. The Belize 2017 PBL study abroad program focused on ET outcomes (g - an ability to apply written, oral, and graphical communication and j - a knowledge of the impact of engineering technology solutions in a societal and global context.) The ABET student outcomes[6] for engineering programs (EAC) can also be added to a study abroad program. It is best to select 1-2 student outcomes for evaluation, and then in future programs, expand to additional outcomes.

Student Engagement — For the purpose of this paper, student engagement is a student's level of attention, curiosity, interest, and passion during pre-, peri-, and post periods of a PBL study abroad program. Pre-program student engagement challenges are students' reluctance in enrolling in the program, and their adaptability to customer-centric projects. Students are often reluctant to participate in study abroad programs due to cost of the program, fear of international travel, possible disruption to graduation timeline, intimidation of PBL, and the lack of confidence. Another pre-program challenge is keeping students focused on their project: due to their inexperience, some students cannot visualize their final product and become overwhelmed with project uncertainties, while some students find critical thinking difficult, such as 'how do I apply

what I know to the customer needs?' To help students overcome pre-program hurdles, recruitment strategies should include: introducing yourself and your program at student organizations, online and on-campus classes, and study abroad fairs. During these sessions, PBL program objectives, extracurricular and academic activities, should be discussed along with, how this course fits into their graduation plan. Faculty can quickly answer students' questions if they are familiar with study abroad scholarships, application processes, and how university scholarships and grants apply toward the cost of the program. Recruitment strategies should also include discussing the program with the faculty advisors. If they are knowledgeable about the PBL study program, they are more likely to encourage advisees to participate and permit course substitutions. Peri-program student engagement challenges are: students lose focus due to shift in attitude (they think it's vacation), they get tired of working in teams and sharing personal space with other students, and finally, they are reluctant to accept in-country differences such as cuisine and hotel accommodations. Students need 'downtime' from academic work, professors, and each other. Therefore, downtime should be incorporated into the program schedule. Post-program challenges were students' loss of passion to complete their project. For many students, knowing their final grade and graduation was dependent on completing their project motivated them to finish.

Conclusions

The saying 'some of the most rewarding experiences are sometimes the most difficult' epitomizes PBL study abroad for faculty and students. For faculty the pressures of preparation, planning, organizing, and problem-solving can be overwhelming. Students are also overwhelmed with the academic and personal challenges of PBL study abroad. However, upon returning to Murray State University, faculty members and students acknowledged the positive effect of experiential learning in their personal and professional lives. IoE faculty are currently planning their next study abroad programs. TSM faculty are developing an eight-week program to Regensburg, Germany, during the Fall semester of 2019. The goal of this interdisciplinary problem-based learning program is to investigate European and German Smart City initiatives in an attempt to identify solutions for Western Kentucky's rural and small-town community problems.

References

1. Delta Regional Authority. *Distressed Counties and Parishes*. 2017 [cited 2017 February 20]; Available from: http://dra.gov/funding-programs/states-economic-development-assistance-program/distressed-counties-and-parishes/.
2. Kentucky Center for Education & Workforce Statistics, *2015 County Profile Reports Public Access Data File*. 2015.
3. COBEC. *COBEC - Consortium for Belize Educational Cooperation* 2017 [cited 2017 February 20]; Available from: http://www.cobec.org/.
4. The Forum on Educatiion Abroad. *Standards of Good Practice for Education Abroad, 5th ed. (2015)*. Available from: https://forumea.org/resources/standards-of-good-practice/.
5. S.E. Spencer and K. Tuma, *The Guide to Successful Short-Term Programs Abroad, 2nd Edition*. 2007, Washington DC: NAFSA.
6. Accreditation Board for Engineering and Technology. *Criteria for Accrediting Engineering Programs 2016-2017*. [cited 2018 March 1]; Available from: http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/#outcomes.

Author 1 Marcia Ford

Dr. Marcia Ford is an assistant professor in the Telecommunications Systems Management (TSM) Program at Murray State University in Murray, Kentucky. She teaches undergraduate and graduate information communication technology and cybersecurity courses. Her research focus is intelligent personal assistants and smart home devices. Additional interests include developing and leading study abroad opportunities for Murray State students.

Author 2 Kevin Perry

Kevin Perry is an Associate Professor in the Institute of Engineering at Murray State University. He teaches undergraduate course in Architectural Engineering Technology, Civil Engineering Technology, Construction Engineering Technology, and Interior Design. Professionally, he is a registered architect and licensed professional engineer and practiced in those areas before joining the faculty at MSU.

Author 3 Brian Giltner

Brian Giltner, P.E., S.E. is Lecturer in the Institute of Engineering at Murray State University. Mr. Giltner is a licensed structural engineer and professional engineer (civil engineering) and has practiced full-time for 23 years before heading to academia. Mr. Giltner is a member of the American Concrete Institute.

Author 4 Melanie McCallon Seib

Melanie McCallon Seib is the Director of Education Abroad at Murray State University, where she has collaborated for office growth and study abroad program curriculum integration for nearly 17 years. She spearheaded creation of faculty recruitment, training, financial, and support structures at MSU to enable innovative faculty to build project-based learning programs abroad.