Better Learning through Collaboration and Assessment: Development of an Interdisciplinary Study Abroad Experience

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Abstract **- Collaboration between Biology and Mechanical Engineering Professors at Gannon University has resulted in the creation of a team taught course which studies Panama from an engineering-technological and a biological-environmental perspective. This course, ENG 201 Engineering and Biological Wonders of Panama, uses a multidisciplinary approach to allow students to study both the Panama Canal and diverse biological ecosystems. It includes weekly seminars during the semester and a week long study-abroad experience in Panama, and is open to all students and majors. Students bring different disciplines into the course and are encouraged to meet course requirements by introducing elements of their own major into the assessment tools. This course was offered for the first time in Spring 2008, and has included both enrolled students and adult participants. Student assessment included weekly quizzes, a travel journal, and an interdisciplinary team paper. This article outlines course objectives, planning process, description and selection of activities, budgetary concerns, and assessment techniques. Pre- and post-surveys were administered to assess course learning. Emphasis was placed on the collaborative process for the faculty, including learning new classroom approaches, and interaction with University support services. A critique is presented that includes benefits, challenges and lessons learned.**

Index Terms – Interdisciplinary, Panama, mechanical engineering-biology collaboration, study abroad.

INTRODUCTION

Faculty from the Mechanical Engineering and Biology Departments have developed an unique study abroad experience open to students from all majors at Gannon University. This experience was taught for the first time in Spring 2008 and exposed students and participants to the Panama Canal and the diverse biological ecosystems found in Panama from both an engineering and a biological perspective. This collaborative experience has meant that both teachers have learned new approaches to teaching and how to adapt technical material for both major and non-major students.

This article presents a model that could be adapted to interdisciplinary student travel experiences within the United States and to those occurring in foreign countries.

COURSE DEVELOPMENT

I. Origins of the Course

ENG 201, Engineering and Biological Wonders of Panama, is a two credit course offered in the Spring Semester. It includes weekly seminars and a week long study abroad trip which takes place during Gannon University's Spring Break. This course grew out of discussions between two faculty from different departments (Mechanical Engineering and Biology); these discussions revealed shared interests in travel, collaboration, and student engagement. Recently, the President and the Provost released Gannon University's Strategic Plan II, which outlines University goals for 2009-2013 [1]. The second goal of this plan is to "Distinguish the University: Gannon will be recognized for its academic excellence and uniqueness as a Catholic institution of higher education while committing itself to enhancing its diversity and global perspective." More specifically, the fourth aim of the second goal is to "Internationalize the University by creating an environment of cultural diversity through coordinated programs that strengthen students', faculty and staff's global awareness and requisite skills for fully contributing as world citizens." ENG 201 specifically fulfills these objectives. Moreover, students are able to hear Spanish spoken in a native context and to experience life in a vibrant Central American culture. Additionally, it is an interdisciplinary course from both a faculty and a student perspective, as ENG 201 is open to students from all majors and programs at the University. Once a basic framework for the course had been sketched out, it was taken to the departmental chairs and the college dean for approval to develop the proposal into a full course.

II. Academic Approval Process

Every university has its own academic approval process. It is important for faculty from different disciplines to

carefully follow such processes. In the case of ENG 201, the following procedure was followed:

- **Departmental Approvals**: The course proposal was taken to the Biology and the Mechanical Engineering Departments for approval. The Biology Department decided that it did not meet departmental criteria (reason for this denial are outside the scope of this article); however, the Mechanical Engineering Department approved the course as a lower level elective.
- **College Academic Affairs Committee Approval:** The proposal was then taken to the Academic Affairs Committee (AAC) of the College of Science, Engineering and Health Sciences. The AAC is composed of members from all the various disciplines within the college. After reviewing the course proposal, the AAC requested modifications to the course proposal. Once those modifications were implemented, the course was approved. At Gannon University the AAC is only a recommending body. Final approval rests with the College Dean.
- **Dean Approval:** The Dean reviewed the proposal and approved it, pending development of catalog and registration course booklet descriptions. Once these were completed, ENG 201 was approved as an official course, beginning in the Spring 2008 semester.

INTERACTION WITH UNIVERSITY SUPPORTIVE SERVICES

In developing and implementing any study abroad course, approval must be obtained from several university offices. The first step is to meet with the Risk Management Officer of the university to determine university requirements for study abroad experiences. One such requirement typically will be a waiver of liability for each participant. Another requirement may be use of official university signage or symbols in advertisement for the course. It is important to find out any and all university policies regarding students and faculty who travel abroad. Additional point to discuss with the risk management officer concerns insurance coverage for all participants. Other questions to ask the Risk Management officer include: what would happen to a faculty or participant who became ill and needed to be transported home, what is the faculty's or the university's legal responsibility to a participant who is arrested, and what to do if one or more of your participants is delayed coming through immigration or by officers of the Transportation Security Agency and becomes separated from the group.

It is also suggested that faculty meet with the Director of the university's study abroad programs. This officer will typically offer resources which can assist faculty planning study abroad experiences and perhaps offer travel grants for the student participants. They may also be helpful in recruiting students to your experience. In the case of ENG 201, both offices at Gannon University stressed that in all study abroad trips, regional experts were to guide all field work or any activity where participants are likely to encounter local hazards. This is also a point stressed by the Council on Undergraduate Research [2].

Another office to seek out is that of the university Registrar. Typically new courses need both a catalog description and an advertisement for the registration booklet. Interdisciplinary courses can often carry two course numbers, if each department involved has given it a major specific course ID. In such cases, it is important to make sure that the course is cross referenced under both sections of the catalog and registration booklet.

Finally, it is important to advertise the course within the university and the local community so as to attract the number of students needed to cover all course expenses. Course faculty are often the best recruiting tool, as they can enthusiastically promote the study abroad experience. Additionally, faculty should approach the university's campus student newspaper and the university's radio station, as additional advertising venues to reach students and members of the local community. In the case of ENG 201, the student business manager of the university newspaper, the Gannon Knight, created ads to run in the paper, and the Operations Manager of WERG-90.5, Gannon University's radio station, developed underwriting for broadcast on the station.

COURSE DESCRIPTION AND OBJECTIVES

Engineering and Biological Wonders of Panama is a two credit course that includes weekly seminars and a travel trip over spring break in Panama. This course enables the student to explore the technical design of the world famous Panama Canal and the diverse biological ecosystems found in Panama, including the rainforest and the waters and beaches of the Pacific Ocean. Participants stay in Panama City and travel on day trips to different locations within Panama.

Three course objectives follow. At the end of this course, students are able to:

- describe and explain the schematics, technical design, operations, mechanics, of the Panama Canal;
- understand the effect of the expansion of the Panama Canal on the engineering operations, the ship traffic patterns, and the local environment (both in terms of the human population and on plant and animal life);
- describe, classify, and differentiate some of the plants, animals and insect life, found in the ecological systems of Panama, especially the rain forest and the marine life of the Pacific beaches.

These course objectives are accomplished through class seminars and discussions, group and solo activities, interactions with class members and the people, places, sights, sounds and wildlife of Panama.

This course is designed to serve as a study abroad experience. Students and participants travel to another country and learn both from each other and from the country

and culture of Panama. Students encounter the people of Panama, and learn through interaction about the history and traditions of this country. A major part of the class involves a cooperative learning [3]-[4]. Students and participants of this course are expected to be active learners who pursue ideas beyond the minimal boundaries of class presentations.

In the class presentations before the trip, the main activities, terminology and concepts are studied; therefore, the students become knowledgeable before obtaining first hand exposure. Participants attend seven one hour lectures. The topics of these lectures are presented in Table 1.

TABLE I
LECTURE TOPICS

Lecture	Topic
1	Introduction
2	Course Expectations
3	Panamanian History and Culture
4	Panamanian Ecosystems I
5	Panamanian Ecosystems II
6	Panama Canal I
7	Panama Canal II
Spring Break	Panama Adventures
8	Trip/Course Summary

STUDY ABROAD EXPERIENCE

The activities selected for the course/trip highlight the attributes that make Panama an excellent outdoors learning classroom. The interdisciplinary nature of the Panama Canal construction and operations tied to its dependence and interactions with the ecological systems presents an unique opportunity to explore the connections between two fields: engineering and biology.

Panama is a country just fifty to 120 miles wide, a bit smaller than South Carolina. Panama has played a major role in world commerce for centuries due to the canal. It is also a tropical paradise. Forty percent of population lives in the sophisticated metropolis of Panama City yet ten minutes away is a rain forest [5].

I. Description of Activities

During the weeklong study abroad trip, students and participants are 100% active learners: they collaborate with each other, with the faculty, with the guides, and with the entire Panamanian environment. In addition to the expertise provided by the course instructors, participants of ENG201 have local experts to expand on the material presented in the course. Table 2 presents the schedule of activities while in Panama.

A description of each one of activities follows.

- **Valle de Anton**: This town sits inside a dormant volcano. Participants will be able to visit the Sunday market and the local zoo, El Nispero, where the golden frog is displayed.
- **Beach Resort**: Located an hour and a half southwest to central Panama's Pacific coast, this all-inclusive Panama vacation resort features seven beach-front swimming pools. Participants relax while they explore the resort from a biological prospective. A fauna-flora scavenger hunt is a required activity while at the resort.

TABLE 2
ACTIVITIES DURING THE WEEKLONG STUDY-ABROAD EXPERIENCE

Day	Activity	Category
1	Arrive Panama	Travel day
2	Valle de Anton and Beach Resort	Culture, Biology, Relax
3	Beach Resort and Market	Biology, Culture, Relax
4	Barro Colorado Island	Biology and Engineering
5	Miraflores Locks and Punta Culebra	Engineering and Biology
6	Panama La Vieja, Casco Viejo, Museum	History and Engineering
7	Free	
8	Depart Panama	Travel day

- **Market**: A handicraft market is a great place to learn about the local culture. The biggest market in the city occupies the space of gym of the Balboa YMCA.
- **Barro Colorado Island:** It is the largest forested island in the Panama Canal waterway, and is part of the Barro Colorado Nature Monument (BCNM), site of an internationally recognized biological research station. The wildlife at the island is extremely diverse. There are thousands of insect species, hundreds of birds species, and more than 120 species of mammals, nearly half of which are bats [6]. A guide from the Smithsonian Tropical Research Institute accompanies the students and participants during the hike through the rainforest. Figure 1 presents one of the highlight of the hike in 2008: a visit to the biggest, and oldest, tree on the island. The participants embark a boat and sail through the Lake Gatun, part of the Panama Canal waterway, to reach the island.

FIGURE 1
SPRING 2008 GROUP AT BARRO COLORADO, SMITHSONIAN TROPICAL RESEARCH INSTITUTE

- **Miraflores Locks:** The Panama Canal is considered the eighth manmade wonder of the world [7]-[8]. At the Miraflores Visitor Center, the students observe the canal in action as locomotives tie onto mammoth ships pull them safely through the locks (refer to Figure 2). Participants visit the exhibitions at the Visitor Center.

A required second activity related to the canal's operations and type of vessel is performed.

- **Partial Transit through the Panama Canal:** Participants sail on a vessel through two sets of locks and experience first-hand the mechanical operations of the Canal. During this activity, students time the intervals of transit through the locks; observe the construction of the gates (original rivets are visible) and the hydraulic arms used to open and close them. Observations of the flow of water into the chamber (ships are lowered and raised using gravity), and the procedures to secure (line and cable handling) the vessel in the chamber are witnessed by participants.

FIGURE 2
SPRING 2008 GROUP AT THE MIRAFLORES LOCKS, PANAMA CANAL

- **Causeway**: This is the southern entrance of the Panama Canal. This long, narrow two lane road was built from excavated material during the Canal construction. Participants tour the Naos Island Laboratories. These laboratories, located next to Panama City and near the Pacific entrance of the Panama Canal, contain an extensive seawater system for research on marine organisms, a well-equipped molecular biological research facility, and laboratories for both marine and archaeological research. Participants will visit the Punta Culebra Nature Center, an open-air museum focusing mainly on marine science and education, conservation and interpretation of marine coastal environments.
- **Panama La Vieja**: This is the site of the first city of the Panama Isthmus established by the Spanish at the beginning of colonization. These extensive ruins are what remain after English privateer Henry Morgan finished sacking the town in 1671 [9]. Refer to Figure 3.
- **Casco Viejo**: This is the site where the Spanish built their next city in 1673. Participants walk through the French Plaza, commemorating the thousands of French canal workers who lost their lives in their country's unsuccessful attempt to build the canal in 1884. Casco Viejo is a colorful neighborhood of narrow streets and charming buildings. A diverse variety of architecture can be observed, including French, Italian and Spanish colonial styles [10].
- **Panama Canal Museum**: This museum has ten permanent exhibition rooms where the testimonies of the history of the inter-oceanic route and the construction of the Panama Canal are presented. The objects and materials related to the history, construction, technology and operations of the Panama Canal have been carefully selected.
- **Free Day**: Participants are free to enjoy the capital and environs at their leisure: explore the city, go shopping or just relax. In the past, participants have done a large array of activities, including bird watching, hiking in the Metropolitan Park, a day trip to Isla Taboga, and a day trip to Portobelo in the Caribbean Sea side.

FIGURE 3
SPRING 2009 GROUP INFRONT OF THE CATHEDRAL TOWER, PANAMA LA VIEJA

Since the 2008 offering of the course, the main activities have not been modified; they are connected to the objectives of the course. However, a half-day transit has been incorporated to the experience for 2010.

II. Budgetary Concerns

When running a study-abroad course, money is always a concern. If the development of the study-abroad course is initiated by the university or a college, there will typically be a startup budget. In the case of ENG 201, where the faculty initiated the discussion, all the expenses must be covered by the fee paid by the participants; this includes the faculty expenses while in Panama. It is imperative to calculate both the minimum numbers of participants needed to offset faculty expenditures and the maximum number of participants that can be safely taken on the trip. In this course, five participants are required to cover the expenses for one faculty.

If the course is organized by a travel agency, the overhead cost is much higher. Several quotes were obtained from travel agencies; the lowest quote was $2500.00 per

participant. The decision was made by the faculty not to use a travel agency. Students and participants pay $2000.00 to travel to Panama. This covers all transportation, hotels, entrance fees, all breakfasts, all but one lunch and two dinners, and all tours and guides. The cost of the trip has remained unchanged since the first year it was offered. This is achieved through careful management.

It is very important to have a surplus of approximately $100.00 per participant. This allows for any unexpected expenses, accidents or delays. For example, if flight connections are missed coming or going to the country of interest, additional hotel stays will be required. Any money left over after the study abroad experience, should be returned to the participants.

ASSESSMENT TECHNIQUES

Table 3 presents the number of students and participants in ENG201 since its first offering in 2008. The group has been very diverse ranging from college students, engineering faculty, and members of the American Association of University Women (AAUW). The students have come from different majors: engineering, communications, business, biology, physical assistant and physical therapy. Adult participants are not enrolled as students but attend all classes and activities. If attendance is not possible, PowerPoint presentations are provided weekly to these participants.

TABLE 3
YEARLY NUMBERS OF STUDENTS AND PARTICIPANTS

Year	Enrolled Students	Adult Participants	Total Travelers
2008	2	8	10
2009	2	3	5
2010	4	9	13

Student assessment included weekly quizzes, a travel journal, and an interdisciplinary team paper.

- **Quizzes**: Prior to the trip, a quiz is given weekly and is based on previous class material. Two quizzes, in the form of scavenger hunts, are given during the trip. This subtly keeps the students focused and engaged while on various trip activities.
- **Paper**: As ENG 201 is an interdisciplinary course, it is anticipated that students from a variety of majors will enroll. To foster collaborative learning, students will work in teams with students from different academic disciplines. Each team will explore one topic from a variety of disciplinary perspectives. After returning from the trip, the team will write a paper on the selected topic incorporating the different academic perspectives. Table 4 lists the topics selected by students each year the course was run.
- **Travel Journal**: Students will keep a journal for the course. Students are expected to use their creativity and ingenuity to make this as complete, interesting, and personalized as possible. Use of photographs, maps, drawings, color, etc. is encouraged. No one format is required; submissions can be in print or digital format. Upon the completion of grading, the journals will be returned to the students as a keepsake or memory book of the experience.

TABLE 4
TEAM PAPER TOPICS

Year	Topic
2008	The Panama Canal – One of the seven wonders of the world: A management perspective
2008	A World United, A Country Divided: Recruitment of Workers for the Panama Canal and Communications
2009	Barro Colorado Handicap Observation Deck

The average class grades for 2008 and 2009 are presented in Figure 4. Faculty expectations for student achievement are that 70% of students enrolled in the course will achieve a "B" or higher grades in all assessment techniques. This standard was met.

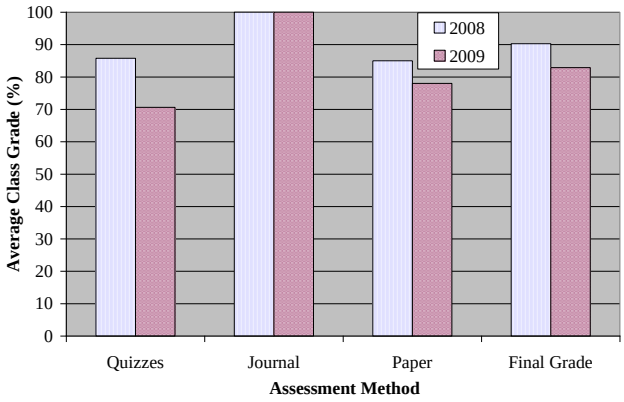

FIGURE 4
STUDENT ASSESSMENT. DATA SHOWN ONLY FROM ENROLLED STUDENTS.

A pre-survey was administered to the participants during the first meeting without any warning. This action allowed faculty to obtain a true measure of the participants' knowledge before taking the course. Participants took the same survey after returning from Panama. Once again, no notice was given to the students. The results of the pre- and post surveys are presented on Figure 5. An increased in the number of correct answers in the survey was observed for 2008 through 2010. Therefore, course objectives were achieved.

Comments from the post-course survey provide useful qualitative information about student and participant learning. One question from the survey, "What did you learn about Panama from this trip?", yielded the following comments:

- "Design of new canal includes multiple basins of water as holding tanks and tugs (no locomotives)."
- "We learned the method of how the ships are transported through the canal and the timing."
- "We learned about the eco-system and the great Panama Canal engineering feat… Great days filled with adventure and new things."

- "…friendly people, fascinating animals, colorful birds, bright butterflies and gorgeous flowers and trees."
- "The Canal is an amazing structure."
- "The Canal is a wonder that everyone should see."
- "The country is much more diverse than expected."
- "Multiple research projects by the Smithsonian Tropical Research Institute are educating all of us."
- "Brilliant engineering of the canal: determination of size; use of concrete with thickness to withstand the test of time; 700 ton door locks that operate on a lawn mower size motor; only 8 min of fill time using gravity with fresh water (not salt water); use of locomotives to guide and stabilize ships."
- "Panama is a country of very unique flora and fauna. Other countries from the equatorial zone are inferior compared with Panama in this regard."

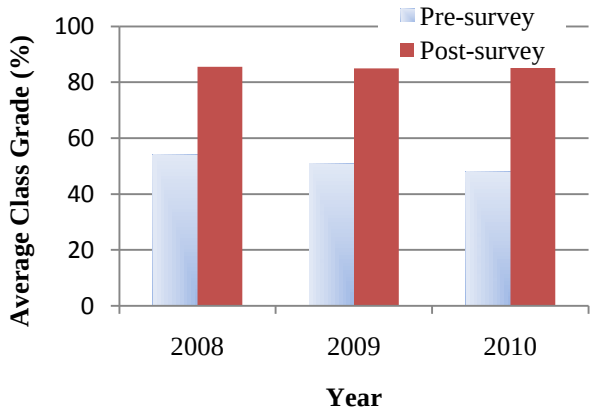

FIGURE 5
PARTICIPANTS RESULTS OF PRE- AND POST-SURVEYS (DATA SHOWN FROM ALL PARTICIPANTS)

COLLABORATION BETWEEN FACULTY

Team teaching a course is both a rewarding and a challenging situation, especially when the instructors are from different disciplines. Topics to be negotiated between instructors include delivery of information, grading scales, classroom expectations, assessment methods and course activities. It is important to keep the lines of communication open and to involve each other in all decisions.

One of the benefits of collaboration is learning new teaching approaches and assessment techniques which can then be applied to discipline specific courses taught by each instructor. It is important to keep in mind that a successful collaboration builds upon the strengths of each faculty member.

BENEFITS, CHALLENGES, AND LESSONS LEARNED

I. Benefits

This study-abroad experience provides students, faculty, staff and members of the community with the opportunity to learn about Panama and the connection between engineering and biology. It raises the profile of the University as well as the Departments involved.

ENG201 enhances student experiences and deepens the tie between the University and its future alumni. In addition, students become aware of cultural differences, and develop respect for diversity.

A successful collaboration between faculty can lead to future interdisciplinary projects.

II. Challenges

When developing and running a study-abroad experience, it is important to keep in mind that there are many factors beyond the control of the instructors. A list of the major challenges follows.

- **University rules and policies:** Some institutions offer a large array of study abroad courses; in those cases, policies are in place, faculty developing a study abroad experience need only to become informed. When there are no consistent policies, it is recommended that the faculty keep their Chair, Dean, and Risk Management Officer informed at all times to avoid any problems.
- **Different teaching styles:** Every faculty must be willing to adapt their teaching and to share control of the class to make the course successful.
- **Keeping it interesting for all participants:** It is important for faculty to understand the expectations of the participants, and make changes if needed.
- **State clearly the course expectations:** As with any other course, this is a must. The additional responsibility of students visiting a foreign country makes this a more relevant item in term of student and participant behavior, not only on trip activities but at all times in the foreign country.
- **Personalities and differences in age:** It is recommended to allow time for interaction amongst the members of the group before the travel experience. Having the course function as a unit will enhance the experience for all participants.
- **Awareness of respectful behavior of participants while in a foreign cou**ntry: Every member of the group must be careful to follow the laws and customs of the country that the group is visiting.

II. Lessons Learned

After two consecutive successful study abroad courses, the most relevant and adaptable lessons are listed.

- **A reserve fund is a must:** Emergencies can happen at any time and it is important to be prepared. One thousand dollars is a reasonable emergency fund.
- **A guide is not always needed:** During the first trip, a guide accompanied the group every day. It was unnecessary at several locations. This will only be learned with experience.
- **Faculty are responsible for everything while on the trip:** A response plan in case of emergency must be prepared.

- **Feedback from participants should be taken seriously and can greatly improve the experience for future trips:** In addition to student evaluations for the course, make sure that you have an exit survey for all the activities during the trip. This will allow you to modify activities and improve the experience.
- **Learning never ends:** Even after running the course several times, there is always room for improvement and enhancement of the course.
- **Advertising is the key to enrollment.**
- **Direct recruitment of students is effective:** This has proven to be the most effective recruitment tool.
- **Communication is imperative:** Always copy the other instructor when emailing the participants or university administrators. This will avoid duplicate efforts and allow one faculty to answer any questions when the other faculty is absent.

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