

Broadening STEM Students' Perspectives, and Recruiting with Blended Learning and Study Abroad

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Abstract:

In order to encourage students to consider STEM careers, and to broaden the perspectives of students in STEM curricula, a multidisciplinary team of four faculty members created a six credit course in International Project Management for a class of students with a variety of academic interests. Graduate students seeking Professional Master of Technology degrees were integrated with undergraduate students majoring in Aeronautical Technology, Engineering Technology, Technology Management, and General Business. Pedagogical techniques included face-to-face as well as both synchronous and asynchronous distance delivery, in addition to a faculty-led European study tour. In order to stimulate students' creative application of project management techniques, this one-week European field trip included visits to the Porsche and Mercedes museums in Stuttgart, Germany, a cog railroad ride to the auto-free village of Zermatt near the base of the Matterhorn, attendance at the Geneva Motor Show, and a tour of the archeological dig beneath Saint Peter's cathedral in Geneva, Switzerland. Pre-travel course work included lectures, group projects, and audio-visual presentations, in addition to language and cultural acclimation units. Post travel individual projects encouraged students to apply appropriate project management techniques to the development of plans for international projects in each student's area of interest.

Introduction

In the spring of 2012, a team of four faculty members created, organized, and taught a course in International Project Management. This course was created using best practices from four preceding study tours. By merging an innovative course delivery method, varied faculty perspectives, a diverse student group, and a stimulating study abroad component, the faculty team has broadened the perspectives of students in STEM and other curricula, and forever impacted students' views of their roles in the world.

The faculty team first led a Students in Free Enterprise (SIFE) sponsored study abroad tour to France in 2007. In 2008, the same group led a study abroad tour to Italy. The SIFE international activities continued, with a 2009 trip to Mexico and a 2011 return visit to France. Thirty-two students participated in the first four programs and two earned international first jobs after graduation in part due to these experiences. Topics of these earlier courses were the relationship of culture to U.S. and French farm subsidy programs, the infusion of culture into the Italian

tourist industry, a challenging effort to establish a micro-lending program in the southern Baja peninsula of Mexico, and agritourism in France.

To encourage interest from STEM oriented students, the faculty team built on the success of these earlier marketing related study abroad programs by integrating the best features from the past tours with new topical material, and created an International Project Management course, a six credit, inter-disciplinary, blended delivery, study abroad class. In order to stimulate students' creative application of project management techniques, the one-week European field trip included visits to the Porsche and Mercedes museums in Stuttgart, Germany, a cog railroad ride to the auto-free village of Zermatt near the base of the Matterhorn, attendance at the Geneva Motor Show, and a tour of the archeological dig beneath Saint Peter's cathedral in Geneva, Switzerland.

This paper describes the course goals, program implementation, assessment, results, lessons learned, and finally, next steps.

Supporting Literature

During the planning and development stage of this course, the faculty team chose to employ a variety of techniques intended to invite students to enroll in the course, engage students with the project management tools presented, broaden student perspectives regarding possible career paths, and augment students' global and cultural awareness. Blended learning has been described as the thoughtful integration of classroom face-to-face learning experiences with online learning experiences. The characteristic that makes blended learning particularly effective is that it tends to facilitate building a community of inquiry. Communities of inquiry incorporate three elements: cognitive, social, and teaching presence. The type of interactive dialogue that can be facilitated through blended learning fits the widely accepted processes facilitating critical thinking and higher-order learning.¹ The application of blended learning in this course was augmented by the inclusion of live interactive video and audio conferencing, as well as online posting of class recordings, allowing place and time bound students to participate fully in the group work, exercises, and discussions.

Educational research indicates that high-impact educational practices (HIP) augment student engagement and retention. Such practices include studies of diversity and culture enhanced by experiential learning and study abroad. These activities help students explore different worldviews and cultures.² The inclusion of a study abroad component was planned not only to help students to become interculturally competent, as advocated by Akli,³ but also to enhance the active learning aspect of the course, helping students to engage in such higher-order thinking tasks as analysis, synthesis, and evaluation.⁴

Because a course in International Project Management is a course about managing people of diverse backgrounds who are working in groups, the combination of blended learning and study abroad coupled with diverse sets of faculty and students produced an active and engaging learning environment.

Course Goals

In creating this course, the faculty team sought first to build interest in STEM courses and programs. The interdisciplinary makeup of the team allowed the creation of a flexible course which students could tailor to their areas of interest. Because project management techniques apply across industries and technical academic disciplines, the topic interests students with various backgrounds and academic goals. Since study abroad programs attract substantial percentages of female students,⁵ a study abroad component was expected to help equalize the male/female ratio within the course, and possibly draw students who had not previously considered programs of study in STEM fields. By including graduate and undergraduate students in various majors, as well as face-to-face and distance students, the team intended to attract a diverse student group, thereby enhancing student-to-student learning by providing truly interdisciplinary discussions and experiences. Then, in order to increase student engagement, various pedagogical tools and the experiential study abroad component were applied.

In addition to teaching the fundamental aspects of the subject, the team's intent was to create a truly international project management course by enabling the transformation that occurs in students who study abroad, including:

- Broadening their worldview
- Enhancing their multicultural skills through the study of and exposure to diversity
- Building their marketable skillsets, by enlarging the mental tool kits they offer employers

Regarding faculty development, the team sought to build its experience and network of local and international contacts, and to practice the application of various pedagogical techniques. In order to do this, the team sought to create a comprehensive academically rigorous course that included elements of face-to-face, distance, and hybrid delivery, as well as the international field trip.

Implementation

The team developed the course in two distinct but integrated segments: Course content and study tour logistics. In Study Abroad courses, it is important to positively link the tour locations to the content and learning objectives and to be precise about how the two relate.^{6,7} For that reason, the course content and learning objectives were first selected, then the high level structure of the course was determined based on the authors' prior successful study abroad experience and the experience of others.^{6,8} The high level structure was this: Content presented along with student individual and group activities during pre-trip sessions, a mid-term study abroad field trip, post-trip content and skill practice, terminating in an individual final project chosen by each student based on their own interests and course of study.

Once the content was determined, the team called on their prior experiences abroad to determine the locations believed to be interesting to prospective students as well as demonstrating or allowing for observation of international projects, thus contributing to the learning objectives. The Geneva Motor show was selected as the primary location because it has wide appeal and the team felt that students could observe the results of high impact international projects in many fields including automotive, engineering, marketing and business as well as computer and electronic engineering, all fields that our potential students would identify with. Once the motor

show was selected, the team searched for additional locations and activities that would pique the interest of a wide range of student backgrounds as well as meet the learning objectives.

I. Learning Objectives and Outcomes

As this was a newly developed course combining project management and cultural acuity, the next step was to develop the course learning objectives and expected learning outcomes. The content strategy was for students to develop a broad understanding of project work, methodologies, and processes while also learning how to use basic project tools. Since project management is by nature a team working environment, a significant portion of the content and objectives centered around intercultural understanding and team communication. Within that high level design, the team developed the specific Learning Objectives and Outcomes listed in Figure 1 below:

Learning Objectives: At the end of the course, students will demonstrate the ability to:	Learning Outcomes
1. Explain how projects work and how and where/when project management tools and methods are used	Knowledge, critical thinking
2. Describe basic project related methodologies and list the project phases associated with each (i.e., PMBOK, PRINCE2, Six Sigma, Lean)	Knowledge, professional development
3. Describe typical project roles and responsibilities and the skills and qualities needed to fill those roles	Knowledge, critical thinking
4. Find translations and pronunciations for common traveler interactions and dialogs. Demonstrate the ability to hold a simple conversation in the target language	Knowledge, communication
5. Explain national culture, cultural determinants, dimensions	Knowledge, diversity
6. Illustrate and explain how different national cultures impact group work, attitudes and practices, between the target cultures (German, Swiss, French, Swiss Italian) and the U.S.	Diversity, communication, professional development, critical thinking
7. Describe and explain how the following project tools are used: Project Charter, Root Cause Analysis (5 Whys or Fishbone diagram), Key Success Factors or Critical to Quality Tree, Gantt and PERT charts, Work Breakdown Structure, Detailed Work Plan, FMEA, Status Report/Dashboard. Demonstrate use of the tools	Knowledge, critical thinking, professional development
8. Describe strategies and tactics that can be used to improve communication and cooperation in multicultural business environments	Knowledge, critical thinking, professional development
9. Complete a final project applying the concepts learned to an environment of choice: Develop a comprehensive project plan that includes the following project tools: Project Charter, Root Cause Analysis (5 Whys or Fishbone diagram), Key Success Factors or Critical to Quality Tree, Detailed Work Plan, FMEA, Status Report	Ownership of learning, professional development, knowledge, critical thinking, communication

Figure 1. Learning Objectives and Outcomes

II. Detailed Design

For the pre- and post-trip portions of the course, the team then developed specific content and group activities that supported learning objectives, using a blended learning approach that also worked in a synchronous and asynchronous environment. This meant that students had to be creative in communication and work processes in order to complete class projects on time, which contributed to the understanding of international projects where team members are often located in different time zones and where meetings and work sessions are often virtual. In addition, for projects with extended due dates, teams provided status reports at interim class sessions, with faculty providing coaching on issues that arose, therefore providing skill practice for students in project management tools and processes.

For the study tour segment of the course, the faculty team created a detailed design that documented the amount of time spent each day abroad in group activities with corresponding links to specific learning content. Doing this helped ensure that all members of the team understood how the activities linked to the course content and what discussions needed to be included in order to provide for the reflexive component of the teaching methodology. An example of this design document is included as Appendix 1.

III. Course Delivery

The regular class sessions were delivered both face to face in a classroom one evening each week and via video posted to the university's online learning management system. One of the authors has used this video system for several years and was instrumental in managing the recording process and in arranging for the videos to be posted. Using this system allowed distance students to participate in the course, provided flexibility to students with time conflicts, and allowed students to review content presented during class sessions.

Teaching methods included lecture, demonstration, student online research, video presentation of tools and processes, group projects and assignments, and skill practice. Students used various modes of communication to complete group projects including the group file sharing, chat, and message board functions of the learning management system as well as non-proprietary communication methods. See the list below for examples of methods and assignments.

- Video presentations of various international projects produced on-site in the target countries
- Student groups researched and presented to the class findings on typical project management methodologies and quality management programs typically implemented in project environments
- Video presentation on staffing a project team
- Individual student research on simple conversations and commonly used words in target languages, review and in class skill practice
- Video presentations on national cultures, followed by group assignment to create an illustration comparing two national cultures
- Presentation of project tools followed by group simulation assignment over several weeks to create a project charter and workplan for bringing a group of business people from the target cultures to the local area for business meetings

- Demonstration of fishbone analysis followed by skill practice simulation to find root cause of a technology related problem to which most students could relate
- Final individual project where each student created a comprehensive project plan that included the completion of the proscribed project tools and documents

Graduate students in the course were assigned to one team and completed additional assignments or augmented assignments with research that the faculty team deemed academically appropriate.

Logistics planning for the study tour portion of the course was a critical part of the course development. For short term study abroad tours, a highly structured environment with ongoing reflection, experiential learning, and integration with the local community is recommended.⁶ The authors were committed to this type of environment even though it requires significant time and effort by faculty leaders both in the planning stage and during the time abroad. During the trip segment of the course, typical days began at 6:30 or 7:00 a.m. with group breakfast and preview of the day's activities, aggressive daily agendas that often included travel, gathering points throughout the day to review and reflect on observations as a group and between students and faculty individually, and group activities ending with dinner and discussion between 8:00 and 10:00 p.m. In addition, the faculty team believes that staying in small hotels or hostels and using public transportation allows students the greatest opportunity to experience local culture and interact with people in the target cultures. The team was able to use prior experience in the target countries and at the target locations to begin to build the detailed agenda and to find appropriate lodging and transportation. As with planning for any project, it was critical to check and re-check open days and times for the auto museums, the motor show, the archeological dig, as well as the transportation schedules to ensure the final schedule could be met in the short time allowed. An understanding of the target culture was also helpful with agenda planning. For example, the faculty team was able to rely on published transportation schedules while in some countries and cultures, schedules would need to be more flexible. With short term tours, it was also critical to have back-up plans and ready access to all important contacts for hotels, events, and restaurants. Having four faculty members on the ground abroad also allowed the team to easily separate into smaller groups for meals and other activities when needed.

Assessment

Assessment of student learning involved five components:

- Detailed analysis of student homework, with feedback and opportunities to edit for improvement
- Faculty and student observation and interactive analysis of group presentations regarding understanding and use of various project management tools
- In class periods of discussion and reflection over the techniques being studied and their applications
- In host country periods of discussion and reflection regarding the wide variety of projects viewed and experienced
- Holistic assessment of individual post travel final project plans, with feedback. The Rubric for Evaluating Final International Project Plans is included as Appendix 2

In addition, students submitted online anonymous teaching evaluations, providing feedback on the various aspects of the course.

Results

Sixteen students enrolled in and completed the course. The diverse demographic make-up is summarized below:

- Ten male students and six female
- Three graduate students, all Professional Master of Technology
- Thirteen undergraduate
 - Seven technology management
 - Three engineering technology
 - Two aviation technology
 - One general business
- Three single parents
- Nine had not previously traveled abroad
- Seven non-traditional students according to the National Center for Education Statistics' definition
- Ten first generation college students
- Three minority students
- Four ex-military
- One distance student living in another state
- One with a time conflict with another class
- One student athlete with conflicts between class and games
- One frequently missed class due to family and health issues

The three graduate students all enrolled in this course as their first graduate course. One has since completed a Professional Master of Technology degree, one is progressing toward such a degree, and the third remains enrolled in classes but is not in a degree program. The general business major became a student worker representing the university Office of International Programs in the Study Abroad area. All sixteen students met or exceeded faculty expectations during the course.

The combination of pedagogical techniques employed allowed students with a wide variety of backgrounds, interests, and personal challenges to learn and apply a comprehensive set of project management techniques, to explore a wide variety of industries, and to broaden their view of the world through first-hand experience of major international projects in a variety of locations. Students enhanced both their multicultural and their marketable skillsets, studying language and culture while practicing project management related techniques in diverse virtual as well as face-to-face teams.

Members of the faculty team increased their experience and augmented their network of local and international contacts, while practicing the application of a wide variety of pedagogical techniques. Of course, there were some lessons learned during the process, and there are plans to grow and improve the course over time.

Lessons Learned

Having led five study abroad courses taking a total of forty-eight students to five countries, including thousands of miles traveled by airplane, train, and foot, with innumerable student learning moments, the faculty team has experienced many of their own learning moments.

In the previous four study abroad tours, the faculty team led groups of eight, ten, eleven, and three students respectively. The International Project Management course had the largest enrollment of all; sixteen students. Based on the faculty team's experiences planning and leading the travel, twenty travelers (sixteen students and four faculty members) is the maximum number for easily utilizing small hotels, local 'non-cafeteria' restaurants, and local public transportation. Using these types of services maximizes student interaction with local citizens and is critical in providing students with an authentic international travel experience.⁸

Additionally, the faculty team feels that a 4:1 student to faculty ratio is very appropriate for this type of course. Teams of four students provide a cohesive learning environment and are an excellent size to collectively and safely navigate travel, such as the use of public transportation. Also, when experiencing a student medical issue, the team discovered that the 4:1 ratio allowed for one faculty member to devote time and focus to the student in need while not detracting from the remaining group's learning activities and experiences.

The International Project Management course was the first time in the study abroad series that the international travel was complemented with semester-long classroom sessions. Students were in class three hours each week during the sixteen-week semester. The faculty team has determined that this classroom time is a critical component of the study abroad experience. It not only increases the amount of overall student learning, but enhances the learning that occurs during travel, thus giving the time spent abroad a greater impact. An added benefit to this classroom time is the team building that occurs. Students get to know each other very well prior to spending a week together abroad. Because of this, students are more apt to watch after each other's safety during travel, more likely to seek out unplanned shared learning experiences, more willing to share in discussions and reflections, and most importantly, more driven to learn as a team.

The International Project Management course was the first time that graduate students were integrated with undergraduate students. The faculty team observed more student to student teaching than in previous study abroad trips and this was attributed to the new student mix. The faculty team feels that graduate student skills were boosted because they were given the opportunity to informally teach the undergraduate students. Additionally, undergraduate students learned more, because in addition to professors, textbooks, and other materials, graduate students and their respective viewpoints were added to the undergraduates' learning resources.

The International Project Management course was the first time that course content was made available to students in a variety of forms. The faculty team found that the blended delivery

provided a flexibility that allowed students who would otherwise have been at a severe disadvantage or not have been able to enroll in the class at all because of outside-of-class responsibilities, such as student athletes or single parents, to be effective participants and learners.

And finally, based on the literature⁹ and on interactions with the students during and after the course, the faculty team feels that it is important to continue to bring student focus to the connections among course content, observations and experiences during international travel, and the marketable skills gained in the learning process. Making these connections more obvious to the students will help in their job search by enhancing the way they convey their international experience on a resume and also how they communicate their experience in interviews and conversations with prospective employers. By creating these clear links, the ‘international alumni’ will sell their international skills in the marketplace and fuel a demand for these skills in future graduates.

The faculty team intends to incorporate all these ‘lessons learned’ in future study abroad iterations.

Next Steps

In a spirit of continuous improvement, the faculty team prepared a list of potential enhancements, not only for this course, but for our overall study abroad program. The items on this list range from simple to complex changes, and from immediate to longer term improvements:

- Invite professional staff from the university’s Office of International Programs to visit class early in each semester, sharing advice and helping students with administrative details
- Develop an assessment plan for evaluating students’ personal and intercultural growth
- Create a four course rotation, with each topic being offered in the same semester of every other year, allowing students and academic advisors to plan more effectively
- Make a focused effort in each course, to help students learn to describe their learning experience in terms that are meaningful to future employers on resumes and during interviews

By implementing these enhancements, the authors plan to build on the success of this course, laying the groundwork for a sustainable study abroad program.

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Appendix 1 – Detailed Design of Day 4 of Study Tour

Microsoft Excel - Time of day							
	A	B	C	D	E	F	G
	Time of day	Activity	Academic content	Lecture/ Discussion	Field Trip	FT*.33 = Contact hrs	Total Contact Hours
1	6:30 -	Walk to train station, buy breakfast			0	0	0.00
2	7:00 to	field trip Bern to Geneva Airport	Observations on transportation and building projects in mountain and lake district		2	0.66	0.66
3	9:00 to	Field trip to Geneva Motor Show	Observations on automotive manufacturers, vehicles, marketing and promotional displays, one of a kind car makers		3	0.99	0.99
4	12:00 to	Lunch and guided discussion	discussions on observations from mornings, answer questions	1		0	1.00
5	1:00 to	Field trip in Geneva, harbor geyser and St Peter archeological dig	project observations related to historical projects in geneva,	0	3	0.99	0.99
6	4:00 -	Explore Geneva on your own		0		0	0.00
7	6:00 to	field trip return to Bern	Discussion on observations of the day	0	3	0.99	0.99
8	9:00 -	dinner together			0	0	0.00
9	10:30			1	11	3.63	4.63
10				Total Lecture Hours	Total Field Trip Hours	Field Trip Contact Hours	Total Contact Hours
11							
12							

Appendix 2

Rubric for Evaluating Final International Project Plans

Required document	Not Complete	Does not meet Expectations	Meets Expectations	Exceeds Expectations
Project Charter				
Description				
Goals				
Scope				
Risks/ Constraints				
Roles Responsibilities				
Deliverables				
Milestones				
High level budget				
Additional Sections				
Key Success Factors/ Critical to Quality				
Need/Driver				
Root Cause - 5 Why or Fishbone				
Detailed Workplan				
Project Stage				
Milestone				
Task # / Description				
Duration				
Dependencies				
Planned Start				
Planned End				
Actual start				
Actual End				
Responsible				
% Complete				
FMEA				
Process Step				
Failure Mode				
Failure effects				
Severity				
Potential causes				
Likelihood of occurrence				
Current Controls				
Detection				
RPN				
Action Step				
Responsible				
Action Taken				
New Sev/Occur/Detect				
Status Report				
Accomplishments this week				
Planned Activities Next week				
Risks/Issues/Resolution				
Deliverables/Milestones				

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