

Barriers to Engineering Study Abroad in Switzerland

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Introduction

Why are there not more engineering students studying abroad? Study abroad programs have been around for a long time, yet most students do not choose to take part in them with only 1 in 10 U.S. college students decide to study abroad [1]. Such programs are far more popular with students studying business or other STEM majors.

Engineering changes the world. Engineers have the ability to solve problems within the world as well as unintentionally cause them. That is why it is essential for engineering graduates to have a sense of the effect of their designs on the world around them. This is so important that the Accreditation Board of Engineering and Technology (ABET) requires that engineering students have “an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors” as well as “an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.” [2] These requirements necessitate an understanding of engineering design as well as ethical reasoning to make the appropriate judgements. Most U.S. engineering programs tend to rely on general education courses to provide a baseline of social, global, and cultural context, but with the increased emphasis in assessment and accreditation, there has been a push to improve outcomes regarding student understanding of the impact of engineering designs and responsibilities with respect to the world. [3]

The way to gain the best understanding of culture and society on a global scale is to experience it. Experiential learning through some form of study abroad is the ideal method of gaining an accurate understanding of another culture; however, living outside of one’s native culture is also the best way to appreciate and understand it as well. Despite how effective a study abroad experience is at improving student outcomes in this area and the documented benefits of study abroad programs, it is still uncommon among engineering programs [4]. This paper discusses the barriers discovered while trying to improve student exchange with a program in Switzerland and discusses a possible alternative/solution to enable sustained and reliable student exchange for engineers at our institution.

Types of Study Abroad Programs

Work has been done to survey the different types of study abroad programs that exist. According to [4], there are nine different categorizations that they observed. They also pointed out that the categorizations are not all inclusive and that some programs fall into more than one category. A summary of the formats that they observed included:

- Dual Degree – Typically used for graduate level work where students obtain a degree from both institutions.
- Exchange – Students are exchanged and take regular courses at each partner institutions and requires parity of exchange to ensure there is no net expense to either institution.
- Extended Field Trip – Typically 1-3 week tour involving visits to various countries, companies, and/or institutions.
- Extension – The home institution operates an extension campus in the abroad country, offering courses taught by faculty from the home institution.
- Internship or Co-op – Student works abroad.
- Mentored Travel – Group of students travel under the guidance of a faculty member.
- Partner Sub-contract – Similar to the exchange option, but this does not require parity. Instead, there is an agreed to compensation for providing courses to students.
- Project-based Learning / Service Learning – Students travel abroad to work on a project that aims to aid the abroad society. A common example is Engineers Without Borders.
- Research Abroad – Students are placed in an abroad laboratory and conduct work under the guidance of a faculty member.

The Program

The School of Engineering at Grand Valley State University (GVSU) has a partnership with Zürcher Hochschule für Angewandte Wissenschaften (ZHAW) in Winterthur, Switzerland. In English, their name translates to the Zurich University of Applied Sciences. The study abroad program between GVSU and ZHAW is currently a combination of dual degree for graduate students and exchange for undergraduate students.

For this exchange partnership, it is necessary to maintain parity with the number of students visiting from each university. Problems arise from barriers to student participation at a partner university. In this case, students from GVSU found it difficult to participate. One of the main barriers is created by the cooperative education program. At GVSU, the cooperative education program is mandatory, taking place in alternating semesters with course work.

Challenges

Exchange programs face a lot of challenges. Due to the requirement to maintain parity, a barrier at either institution is felt by both. For this reason, scaling is a challenge for most institutions resulting in a practical limit of around 5 students per university. In the case of GVSU and ZHAW, we have experienced a significant challenge in this regard. The exchange program set a

target of 4 students, but interest has been predominantly one-sided with ZHAW students visiting GVSU more often. This stems from challenges faced at GVSU with recruiting students. Recruiting students to take part in a study abroad is difficult. According to some literature, the number of engineering students who elect to participate is growing, but it is still far more rare for them compared to non-STEM students. Having visited the partner institution and discussed this program with students, several obstacles are preventing participation, which include:

- *Timing of semesters:* At ZHAW, the fall and winter semesters start and end approximately a month later than they do at GVSU. This results in ZHAW exams occurring at the same time as the start of the following semester at GVSU.
- *Time to graduation:* The engineering program at GVSU is lockstep with a mandatory co-op program, leaving no semester without a required course that would need an equivalent option to be available at ZHAW.
- *Difficulty transferring credits back:* Getting credit for required core courses are complicated by the differing structure of courses between institutions. Swiss universities tend to have students enroll in twice as many courses covering half as much content. As a result, students would need to take two courses in back-to-back semesters at ZHAW to be equivalent to a course at GVSU. This problem is further complicated by the links between required core courses and ABET accreditation assessments.
- *Expense:* Unlike many other study abroad countries that have a lower cost of living than the US, Switzerland is one of the most expensive and is comparable to the most high-cost cities in the US.
- *Language:* While it is common for language students to learn the language of their host institution, it is very uncommon for engineering students. Additionally, the challenge is compounded by their use of Swiss-German, which is different enough from Standard High German that people from Germany visiting Switzerland cannot understand it. This comes as a shock when one prepared for the trip by trying to learn German prior to leaving the US, and it also limits the utility of tools like Google Translate, which do not have a “Swiss-German” option. Bottom line, it is harder to communicate and engineering students from GVSU are limited to course options that are offered in English by ZHAW.

Dual degree programs are less challenging to implement. There are typically few concerns with maintaining parity. There are few challenges with course sequencing due to pre-requisites, and there is more flexibility in degree requirements with fewer mandatory core courses. However, language and expense barriers remain for participants from GVSU.

Possible Solutions

For this particular exchange program, most of the courses offered in English at ZHAW are upper-level courses that could be counted as engineering electives or lower-level courses that would satisfy general education requirements. To be prepared for the upper-level courses, engineering students from GVSU would need to have completed their core 300-level course work; consequently, the only semesters a student could take these courses are the Fall, Winter, or Summer of their last year. Unfortunately, our engineering students are on co-op in the Fall and in senior project in the Winter and Summer terms. One of them would need to be used to avoid delaying graduation for a student who participated in it. Given the relationship between

assessment of ABET outcomes and the senior design courses, the best option was to focus on the co-op semester.

The co-op program at GVSU is mandatory and requires a student to work full-time with the same employer for three rotations, with the last one during the Fall semester of their senior year. This structure is very limiting for study abroad. At present, we are exploring ways of making the co-op program more flexible such as:

- Allowing the third rotation to be a study abroad experience with a significant project.
- Allowing students to work part-time over multiple semesters as an alternative to full-time in one to meet the requirement.

The main concern with adding flexibility is the impact on some of our partner co-op employers. Some rely on the current structure to make participating logistically feasible. Small firms tend to appreciate having one full-time co-op employee around all year. This is done with three students at different points of their degree program with the following typical schedule:

- 1st Co-op – Summer
- 2nd Co-op – Winter
- 3rd Co-op – Fall

Altering the structure of this would have a logistical impact on the employer. Many of the large employers are not concerned, but smaller employers would be less inclined to employ students as a result. To mitigate the impact and avoid issues maintaining 100% co-op placement for students, it is critical to consult with our partners as we make changes.

When it comes to the remaining issue of expense, the host institution is offering a stipend to assist with living expenses, but participating will still cost more than attending their home institution. Also, students who participate in lieu of working at their co-op employer will lose that opportunity to earn income.

The final issue of timing of semesters is somewhat mitigated by the timing of the holiday break at GVSU. Though not ideal, ZHAW has offered to be flexible with offering remote exams to our students who need to return to start at GVSU during exam week at ZHAW.

Discussion

There is a significant benefit to participating in experiential learning while in college. Experiential learning can take many forms including study abroad, project-based learning, co-operative education, and internships. For students at GVSU, the co-operative education program is a hall mark of the program, providing students with professional experience while completing their degree requirements. Much like a co-operative education program, study abroad seeks to have students learn through experiences outside of the classroom. Just as cooperative education immerses students into a professional culture, study abroad immerses students into a non-American culture.

In addition to being generally prepared to enter the engineering profession, graduating engineering students are required by ABET criterion to be able to consider global, social, and cultural factors in their designs and ethical decisions. The best way to gain understanding of the differences between societies and cultures in the world is to experience them firsthand. This is why study abroad is valued highly among employers with significant international operations.

Most of the barriers to participating in study abroad were made worse by our mandatory co-operative education program. Many study abroad programs utilize summer as a time to avoid many of the constraints imposed by required core courses; however, this is not an option when the students are alternating between co-op and course work semesters without a free summer. That is why careful modifications to our co-operative education program are necessary to allow study abroad options for undergraduate engineering students to be successful.

Works Cited

- [1] Institute of International Education, "Open Doors 2022: Report on International Education Exchange," Institute of International Education, 2022.
- [2] ABET, "Criteria for Accrediting Engineering Programs, 2022-2023," 2022. [Online]. Available: <https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/>. [Accessed January 2023].
- [3] President's Council of Advisors on Science and Technology (PCAST), "REPORT TO THE PRESIDENT -- PREPARE AND INSPIRE: K-12 EDUCATION IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) FOR AMERICA'S FUTURE," The White House, Washington, DC, 2010.
- [4] A. Parkinson, "Engineering Study Abroad Programs: Formats, Challenges, Best Practices," in *2007 ASEE Annual Conference & Exposition*, Honolulu, HI, 2007.