Determining Student Learning Across a Range of Experiences During a Study Abroad Module

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There is increasing demand and a critical need in the workforce for globally competent engineers—those who are trained to work in international and intercultural contexts with engineers who define problems differently from themselves\(^1,2,3\). To meet those workforce demands and needs, Virginia Tech offers a program which integrates an on-campus, semester-long experience with a two week international experience in a course for first year engineering students. This study focuses on understanding the range of learning experiences from the perspectives of enrolled students that occurred during the two week international module.

Throughout the two weeks students traveled through Italy, Switzerland, Germany, and France engaging in local culture and customs during visits with engineering businesses and universities. These visits, intentionally selected by the program faculty director to align with course learning objectives, can be categorized as: 1) engineering focused (i.e., visiting companies), 2) academic (i.e., visiting universities), and 3) cultural (i.e., visiting a range of sites while emphasizing relationships with engineering). In this paper we explore how students’ learning experiences varied across those different kinds of visits. Results can inform leaders of similar short-term international experiences of engineering students as they make learning-centered decisions about how to best plan and balance program itineraries.

Related Literature on Study Abroad Programs

There are several examples of institutions developing international engineering programs to help develop global engineers. Jesiek et al.\(^4\) studied three such study abroad programs, including a one month study abroad, 7 month study and internship abroad, and 10-12 week research abroad. The authors used a quantitative instrument (Miville-Guzman Universality-Diversity Scale) to indicate levels of cultural diversity openness, awareness, and appreciation. Using pre- and post-tests, the authors showed that participants in the study abroad programs have higher levels of cross-cultural competence compared to a baseline group of first-year honors engineering students. This same study also showed that immersive study abroad programs enhance students’ cross-cultural competencies.

Similarly, in a six institution study, Ragusa\(^5\) found that students who were most globally prepared, as measured by the Engineering Global Preparedness Index, had international experiences in engineering and international travel in their personal lives. Mohtiar and Dare\(^6\) also described how an immersive experience that weaves together an international exchange with service learning to address grand challenges positively influences students’ global competencies.

For shorter-term experiences, like the program under investigation in this paper, Kamdar and Lewis\(^7\) conducted three types of assessments for a three-week trip consisting mainly of site visits that align with the participants’ area of study. Those assessments of long-term goals, short-term goals, and using a pre/post cultural intelligence survey found that exposure alone to international
settings was not enough to meet their program goals. The authors suggest that short-term international experiences need to include pre- and post-trip support in the form of student research and exploration of the anticipated locations and experiences as well as time after the trip to reflect and draw on what was learned during the trip.

In summary, there is strong support that study abroad and other types of international experiences have the potential to positively impact students’ global competency. Although quantitative studies like those previously discussed assist researchers and practitioners in making broad, generalizable comparisons of the impact of international experiences, there lacks a depth of understanding regarding what students are learning from these experiences and which aspects of the programs contribute most to learning. Qualitative research is better able to go in depth and explore an area that is not well-known. An excellent opportunity to explore and better understand this aspect of learning presents itself in the study of student-authored journals that were written during students’ experiences of a short-term international trip. These journal entries provide a window into students’ thoughts by illuminating learning experiences that caught the students' attention for a reflective moment. Something worthy of note to the student may indicate a moment of learning or the construction of mental models related to a particular concept or experience. Thus, our goal in this paper is to link students’ perceptions of learning opportunities with different aspects of the study abroad experience. We use qualitative analysis techniques to explore this ill-explored space and address the following research question

RQ: How do students describe their learning experiences across different types of visits during a short-term international trip?

Background on the Rising Sophomore Abroad Program (RSAP)

RSAP consists of a semester-long preparatory course during the spring semester followed by a two-week international module. The course prepares students for their international experience by engaging them in discussion on topics such as: 1) defining what it means to be a globally competent engineer; 2) communication and culture; 3) understanding international engineering work; 4) country pre-visit overviews; and 5) skills for independent travel abroad.

During the month of May, RSAP participants embark on a two week in-country experience throughout Italy, Switzerland, Germany and France. To broaden their knowledge of engineering with an added international perspective, students participate in a diverse array of technical visits, lectures, and tours. These experiences were intentionally chosen to demonstrate a broad base of engineering industries (e.g., automotive, food processing, robotic, etc.) in other countries and cultural experiences in each country destination. The visits were also chosen to align with the five course objectives:

Immediately after the RSAP experience, student participants will be able to:

1. Define ‘global engineer’ and the skills needed to function successfully as an engineer in a range of different cultural settings.
2. Identify global challenges, technological problems, and business opportunities and their implications for American engineers.
3. Describe how differences in political, technological, social, educational and environmental contexts influence engineering practice.
4. Observe and appreciate cultural diversity and how culture impacts engineering in a global society.
5. Engage in a professional environment in an international location.

In this paper, we explore what students learned from the intentionally chosen visits during a two-week international trip. Visits falling within each broad category are shown in Table 1.

Table 1. Visits, lectures, and tours for RSAP: Europe 2015.

<table>
<thead>
<tr>
<th>Country</th>
<th>Visit Type</th>
<th>Visits/Lectures/Tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>Engineering Focused</td>
<td>Lamborghini Museum and Factory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Barilla Academy and Factory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Italian Fashion School in Milan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last Supper painting</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Engineering Focused</td>
<td>Grimsel Power Plant Tour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Entlebuch Biosphere Tour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bodensee Solar Boat Lake Cruise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lake Constance Region &amp; Conservation Efforts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>University of Lucerne</td>
</tr>
<tr>
<td>Germany</td>
<td>Engineering Focused</td>
<td>Deutsches Museum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Innovation Academy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hilti Drilling Company</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMW World</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KUKA Robotics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brewery Factory Tour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neuschwanstein Castle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dachau Concentration Camp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Institut National des Sciences Appliquées (INSA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strasbourg Cathedral</td>
</tr>
</tbody>
</table>

Data and Methods

Thirty-six first year engineering students participated in the two-week international module and submitted reflective journals as part of a class assignment. These students were selected to participate in the program from an applicant pool of 135 students. As a requirement of the program, each participant was asked to complete a daily journal that consisted of students’ observations, thoughts, and documentation of what they did and learned during each day of the program. Throughout the international module, students were also asked to respond to five prompts, and these responses were included in the journals. These prompts are shown in Table 2 with the corresponding day of the trip that the prompt was given. Of the thirty-six participant
journals, 13 journals were analyzed for the current paper. These 13 journals were selected based on the ease of analyzing text journals versus photos of hand-written journals as well as a purposeful selection identified by the program director, who suggested students who provided more thorough, reflective entries and therefore might provide the most useful data for addressing the research question.

Table 2. Prompts given on different days of the trip

<table>
<thead>
<tr>
<th>Trip day</th>
<th>Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What are your expectations for the trip?</td>
</tr>
<tr>
<td>6</td>
<td>What differences have you seen with respect to business, culture, and technology between Italy and Switzerland?</td>
</tr>
<tr>
<td>8</td>
<td>What role do you think ethics should play in your role as an engineer?</td>
</tr>
<tr>
<td>11</td>
<td>What differences have you seen with respect to engineering business, culture, and technology between the companies you’ve seen and the United States?</td>
</tr>
<tr>
<td>14</td>
<td>What are your immediate takeaways from this international experience?</td>
</tr>
</tbody>
</table>

The qualitative data were analyzed using the software NVivo. Four journals were initially coded using an inductive process that allowed initial codes to emerge from students' writing. Next, these emergent codes were grouped into themes within the categories of type of visit. To enhance the validity of this process, a data audit was performed by an outside researcher. For example, within Academic Visits, four themes emerged: design differences, academic comparison, similar tools, and importance of global experiences. These themes were defined and entered into a codebook, which was used by the researcher to code the remaining nine journals. Once all 13 journals were coded, both examined the quotes (i.e., qualitative data) that were labeled with each theme to ensure that they aligned with the definition of the theme and provided adequate evidence of the presence of that theme in the students' writing.

The author who coded the journals did not participate in the international module and thus had an outsider’s perspective on what students wrote. This author does have prior experience with the RSAP program in an administrative capacity but has never visited the places being written about by the students. This author has also taught one of the first-year engineering courses at Virginia Tech and is therefore familiar with some of the participants’ prior knowledge of engineering and design.

Results

The following sections are organized around the three categories of visits and include tables that summarize the names of themes, definitions of those themes and the patterns of what students described found within the themes. Some themes were small enough that there were no patterns found within them and simply stand alone. The themes without patterns were less prevalent than the themes with patterns, with the exception of the Academic Theme: Desire to Go Abroad. The categories, themes and patterns are presented in no particular order.
Engineering Focused Visits (EF)

As shown in Table 1, the disciplinary focus of Engineering Focused Visits varied greatly—contexts ranged from automobile plants to robotics factories to solar powered boat excursions. Within students' descriptions of these visits, we identified six major themes (see Table 3).

<table>
<thead>
<tr>
<th>Themes</th>
<th>Theme definition</th>
<th>Patterns within themes</th>
</tr>
</thead>
</table>
| Professional/Business Landscape     | Noticing various issues and topics related to the professional realm and the companies visited (e.g. types of customers, company pride in product, company comparisons) | • Gender role differences  
• Marketing  
• Global business  
• Interpersonal skills  
• Diverse product purposes  
• Interview advice  
• Company culture |
| Experiencing Processes              | Noticing processes in the machinery and how things work (efficiency) and move    | • Process performance  
• Comparing processes  
• Multiple disciplines |
| Linking educational experience to professional practice | Thoughts about their career path, noticing applications of their 1st year class | • Engineering interest  
• Personal goals  
• Connecting to a class |
| Learning about a non-engineering profession | Commenting about a profession other than engineering (e.g. brewmaster) |                                                                                       |
| Understanding Scale                 | Noticing the size of and/or energy required for different machinery and mechanisms, or products | • Effort  
• Electricity  
• Physical size |
| Social Responsibility               | Commenting on environmental and/or social issues related to the visits           | • Alternative energy  
• Waste  
• Environment |

**EF Theme 1: Professional/Business Landscape.** This theme was applied to comments regarding issues and topics related to the professional realm and the companies visited. Within this theme there were several topics that emerged around how the companies and the people within the companies operated. The topics that students wrote about indicate that they were both listening closely to the tour information as well as seeing elements that stretched beyond what they were told by guides.
Some students noticed the gender role differences at the Lamborghini factory. For example, a student noted that, "Solely men worked as technicians for building the car while women worked on stitching and interior. It was interesting to see the social construction of gender roles in Italy and within the company itself." In addition to the diversity of human resources within companies, students were surprised about the diverse product purposes at the different companies visited. For example, one student commented on the following with respect to the robots at KUKA: “What surprised me about their products was how diverse their purposes were. There were some that were used in the automotive industry, in hospitals, and even some that functioned as amusement rides.”

Other students noticed marketing features during the visits. For example, at the Hilti Drilling Company some students pointed to sales and marketing, an aspect of production that was not emphasized in their engineering courses. One student describes what they learned in excited detail:

“Everything about Hilti's corporate culture and what they do and the opportunities intrigued me. I learned that Hilti has a direct sales model meaning they don't sell in stores, only at Hilti. This keeps their price high. It also gives the customer better service in that they can fix a tool within 3 days and have it back to the customer which no other company has. This is because Hilti has the luxury of making their own promotions and guarantees. The presenter told us that they have roughly 10,000 products but they don't promote their products to normal consumers. They're mainly considered with big corporations because their products are so expensive and like to sell them in sets so they sell a higher quantity because companies have more money to spend . . . Hilti spends 10-15 million dollars in the development stage of products. However it only takes less than a year to get a return on investment for them.”

Another student identified international differences in marketing during the tour of the Barilla pasta factory:

“The most interesting fact I learned from the tour was the differences in marketing tactics between the U.S. and Europe. Since Italians especially value pasta, the titles of each pasta are the original names and different sizes are denoted with numbers. The variety is also larger for them than in the U.S.”

Another set of patterns in the journals focused on students’ recognition of how these visits brought engineers from a variety of backgrounds together, which requires a distinct set of skill sets. Students recognized how places like the Hilti Drilling Company demonstrated that engineering is a global business, with "workers from all over the world there. Speaking multiple languages and possessing such a broadened skill set. It makes me realize how far we have to go as American engineers. Having an open mind about working overseas, learning different languages, cultures, mannerisms, and ways of life really.” This same tour emphasized that "teamwork and open-mindedness are important," which helped students recognize that interpersonal skills are essential for success in the modern workforce. Although those outcomes
are emphasized in on-campus coursework, the ideas tend not to resonate with students until a manager in the workforce identified the importance. Students also took on interview advice for their future careers from these visits, such as the following about finding a company with the right fit:

“Aside from all the technical conversations we had, one of the most important things I took away from our visit with Hilti is the interviewing advice we were given. We were told to just be ourselves because if you try to be someone you're not to fit a position in the company you're applying for it will be apparent in the interview and ultimately you won't be happy with the job.”

Although relevant, but not specific to the interview pattern, many students made comments on aspects of companies across multiple visits that can be grouped as company culture. These comments refer to the attitude of the company employees towards its products. For example, one students noted, "I was seriously impressed by Lamborghini’s facilities. The pride that they take in their cars shows that they put in the effort to build quality machines." Other students within this pattern identified the culture towards its employees as being noteworthy:

“The best part is how they treat their employees. Many companies that are of the magnitude that they are lose touch with the people who work for them. Hilti, however, has an entire system to ensure that everyone is as happy, and well trained as possible.”

With eight patterns, the Professional/Business Theme shows that the engineering focused visits provided a wide variety of learning opportunities and experiences for the participants to see the profession and business practices in an authentic setting. These experiences also provided useful knowledge that can be applied in students’ futures.

**EF Theme 2: Experiencing Processes.** This theme includes all instances where students notice processes in machinery and how things work, often including comments on efficiency. Process performance refers to the student noticing the quality of processes (like manufacturing and power production) and the procedures that the company will follow to reach that quality. As one student notes, “And the constant hours of testing they have to go through before they even get to be sold is crazy! This is what I meant by the quality and precision of work in other countries and how seriously they take it.” Other aspects of this pattern include noticing less than efficient practices, such as noting waste product on the floor of the factory room.

Some students compared the processes they learned about between different types of companies as well as between different companies of the same type. These comments were identified as the Comparing Processes pattern. Examples of each comparison are as follows:

**Example 1:** “I really enjoyed getting to see the different manufacturing processes throughout the day. It’s interesting to see how two completely different processes can both be equally successful [Referring to Lamborghini and Barilla].”

**Example 2:** “I was surprised at how small the [Innovation Academy] plant was. After seeing the giant [Grimsel] hydropower plant in Switzerland, this one looked like a little shack. It was still impressive though… They have the whole process down to an art.”
From the KUKA visit, a student learned that the products are used in many fields of applications and that multiple disciplines are needed to make the robots:

“We just visited KUKA Robotics and we were given a presentation by a PhD engineer who is now a product manager. There's a lot of applications for the robots such as entertainment, manufacturing, and personal service. We saw the robots in action on the tour and they were able to lift heavy weights and rotate them in multiple directions. A lot of mechanical, electrical, and computer science skills go into making the robots.”

These visits gave students the opportunity to see what engineering and the products of engineering look like in reality in terms of the time, effort and collaboration required to produce the robots and cars at these companies. The variety of visits also enabled students to put individual visits into a larger context. By visiting more than one type of power plant, for example, students could see that there is more than one way to produce power across a large range of scales.

**EF Theme 3: Linking educational experience to professional practice.** This theme refers to education in both the traditional classroom and the experiential learning sense. Links to various aspects of professional practice emerged between the students’ first year engineering classroom experiences, both the Spring course and their other first-year engineering classes, and the international module (i.e., connecting to a class). For example, one student referenced a project that was assigned in the first year engineering program during the visit to Lamborghini:

“Lamborghini used a line tracking technology to navigate small robots around the factory and it was the same line tracking technology we used in 1st year engineering.” Another student connected the group's solar-powered boat tour to a class project from the previous semester:

“From research I've done on solar panels for two classes second semester I knew that most solar panels only run on about 30% efficiency which is not very cost effective. The man who was telling us about the boat told us that this boat ran on about 30% efficiency as well so I'm glad the research I did was accurate.”

Within this theme, some students focused on their engineering interest. The visits that are the subject of these comments are the hydropower plants, KUKA Robotics, Lamborghini, and Hilti Drilling Company. Students talked about their interests ranging from general comments like “that’s what I want to do” to a very specific discussion of the product supply line at Lamborghini:

“As an ISE major, the fact that they have such an awesome product supply line makes me really excited. They divided major tasks into sections, evenly divided with 75 minutes per each station with the cars automatically shifting after the 75 minutes. But, the best part was the leather cutter that was automated to scan the leather chunks, analyzing where the imperfections were and the sizes of slices needed for the car and automatically fitting the most surface area of usable leather to the shapes necessary.”
Some students’ discussion of the connection between visits and their interests took similar ideas a step further to their *personal goals* for their careers. For example, one student expressed a future interest in pursuing robotics:

“It is so cool to think of the future of robotics, and I want to be a part of it. I have been thinking about this for some time but after receiving my bachelor’s in Computer Engineering I think my best course of action is to obtain a Master’s in Robotics. Robotics are the future and the jobs that are the most secure are the jobs that create, service, and innovate robots.”

**EF Theme 4: Learning about a non-engineering profession.** This theme was only applicable to one experience from the international module: a tour of a local brewery in Munich, Germany. Students were struck by the complexity of the brewing process and the credentials required to be a Brewmaster—it was an example of how a preparation of engineering can lead to any of a number of career options. As students described, “It was so cool—way more complex and sophisticated than I expected. It actually takes a lot of math and science to be a brew master.”

Another student summarized the curricular preparation of the brewmaster:

“One of the most interesting things he told us was the education he went through to become a brewmaster. He said he had to go through about 8 years of school to become a brewmaster and most of the classes he was taking were chemistry and fluid mechanics and thermodynamics. These are some classes that all of engineers have to take…”

**EF Theme 5: Understanding Scale.** This theme applies to instances in which students mention size at an engineering focused visit and/or the energy or effort required for different machinery, mechanisms, or products. There were a variety of scales mentioned by students, which became the patterns listed with this theme. The *physical size* of factory machinery and products, as well as the size of the hydropower plants and volumetric flow rates of the water, were noted by students, often with enthusiasm. “We got a tour of Grimsel’s plant, seeing the turbines as well as the water intake, which was my favorite part. Something about seeing water move at 32 cubic feet per second is pretty awesome.”

With regards to the power plants, students also noted the capability of the plants of varying sizes to provide large scales of *electricity* to their surroundings. “In the Alps we took a biosphere tour of how water electricity works on a smaller scale. We were able to see each aspect of how it works and the fact that they were able to provide 450 houses with electricity was impressive.”

There was also mention of the *effort* the companies put into generating electrical power or creating their products:

“I really enjoyed our tour of [Hilti]. The part we saw was all R&D and was very impressive. What our guide said about them testing all of their products thoroughly was very true. Each one was run through tests that required them to do the same tests over and over again to make sure it could perform the tasks perfectly every time. They also
run several tests to make sure they are durable, and can survive falls and other impact
damage.”
In this regard, the pattern fit within the "Understanding Scale" theme because students were
surprised at the sheer number of times testing occurred during the R&D process.

**EF Theme 6: Social Responsibility.** This theme was applied to comments about environmental
and/or social issues related to the engineering focused visits. Students noticed that *waste*,
*alternative energy*, and the *environment* were important considerations for many of the
companies they visited and toured.

As one student noted about *waste*:

“*I noticed that both Lamborghini and Barilla don't like to waste material. I don't know*
*much about recycling in America but there seems to be a big emphasis on recycling in*
*Europe. In Lamborghini the leather they don't use for the interior of their cars is sold to*
*other companies that use leather for shoes or bags and things like that. At Barilla the*
*production of the boxes is also on the assembly line. The boxes are made to be 5 grams*
*and if they're not 5 grams then the system pushes them aside to be altered and put back*
*into production.*”

One student reflects on the difference in prevalence of *alternative energy*: “*I really enjoyed*
*seeing another source of alternative energy and seeing that these forms are not only possible, but*
*they are very functional and efficient. It makes me question even more why we don’t do as many*
*things like this in the states.*” Finally, following a tour of a biosphere reserve in Switzerland,
another student reflected on the impact of the *environment* on energy production:

“*At the conclusion of our tour of the Entlebuch Biosphere my biggest takeaways are the*
*impact of geography in energy production and the sheer beauty of this region. The Alps*
*make it difficult to string power lines together and the Swiss have a heart for*
*sustainability so they've turned to clean energy. They make use of wind, solar, soil,*
*hydroelectric, wood, and natural gas for energy.*”

**Academic Visits**

The international module included three academic visits in three countries, as shown in Table 1.
Students described these visits primarily in terms of comparison to their prior experience within
higher education. These descriptions fell into four themes, two of which were broad enough for
patterns to emerge (see Table 4 on the next page).

**Academic Theme 1: Design Differences.** This theme was applied to descriptions of differences
in design between countries visited or between a European country and the United States. All
sections coded with this theme refer to the group's visit to the Fashion School in Milan, which
consisted of a lecture focused on global differences in product design. Most students discuss the
differences in the *purpose of design* between countries. For example:
“The Milan Fashion School was very different from what I expected. Despite this, I did learn some interesting things, such as how different cultures, such as Italian, German, and American, design their products with different purposes in mind. In hindsight, I can recognize these purposes in the products’ design. It also makes sense that Americans care the most about how things look.”

Some students mention that learning about these different ways of viewing design changed their own perspective on design, which we designated as the “opened my mind” pattern, such as the following example:

“Italians are revolutionary and radical – instantiating a global environmentally friendly diet, manufacturing custom cars, and creating designs unlike any other country. It was a fascinating culture as a whole. I learned to open my mind and dream bigger beyond basic style and functionality.”

**Table 4. Themes and patterns within Academic Visits**

<table>
<thead>
<tr>
<th>Academic Visits</th>
<th>Themes</th>
<th>Theme definition</th>
<th>Patterns within themes</th>
</tr>
</thead>
</table>
| Design Differences | Noticing or describing differences in design between countries visited, or between a European country and the US | | • Purpose of design  
• “Opened my mind” |
| Academic Comparison | Noticing or describing academic experiences in European settings and comparing to the US (either similar or different). Can also include curriculum comparison. | | • Curricular  
• Extra-curricular  
• Cost  
• Demographics  
• Physical size |
| Similar Tools | Noticing tools used in academic settings that are similar to ones they use themselves, such as software, machines or equations | | |
| Desire to Go Abroad | Mentioning a desire to study abroad or return to the place they’re visiting | | |

**Academic Theme 2: Academic Comparison.** While visiting the three schools, the students noticed and wrote about the curricular, extra-curricular, cost, demographics, and size of the schools as compared to their home institutions. The primary curricular comparison was that INSA, in France, has study abroad as one of its requirements for graduation. There was also an extra-curricular comparison which noted that the events and organizations students participate in are similar to those at Virginia Tech. The comments on demographics noted that there are more women and more variety in culture at INSA and the University of Lucerne in Switzerland.
relative to the U.S. institutions. Students also noticed that some campuses were smaller and tuition is cheaper than at their own institution. As one student noted:

“The cost of college there is much lower, just $800 CHF a semester. They also do an apprenticeship with a company before school and begin that around 17-18 and start school at 20. At Luzern University they are exposed to many different cultures due to the diversity of their classmates and the city itself. We don’t get that so much at VT.”

**Academic Theme 3: Similar Tools.** This theme focuses on students' reflections that pointed to similarities between the tools, software, and equations that were similar across contexts. As one student noted, “Listening to some of the projects the students worked on was really neat especially because they said they had used Matlab and C++!” Students recognized that although language barriers may have been in place across contexts, programming could be seen as a consistent way in which engineers communicate across contexts. They began to recognize that the programming they completed in their own courses actually enabled them to join a much larger community of practice that spanned the globe.

**Academic Theme 4: Desire to Go Abroad.** During their reflections on the academic visits, students commented on their desire to either return to the school they were visiting or to study abroad somewhere in the future. As one student noted, “After our tour, we had a meet and great session with students both from Lucerne and their international students. Hearing about their experiences was very interesting, and it really made me want to experience study abroad again even more than I already wanted to.” Whetting students' appetites for future international experiences is one of the major drivers for offering this experience in their first year of study, and it appears as if that early exposure may have been successful. We intend to continue following up with program alumni to determine whether students do, in fact, act on those desires and engage in longer-term international experiences in the future.

**Cultural Visits**

There were four specific cultural visits built into the international module, in addition to city tours where guides provided historical and cultural information about the location. Four themes emerged, two of which were broad enough to produce patterns (see Table 5 on the next page).

**Cultural Theme 1: Seeing Details.** This theme applies to students noticing details of the artwork and architecture at the places they visited. These details fell into three patterns: *overwhelming detail, social commentary,* and *appreciation.* The way students write about what they saw gives an indication of the connections they made to the visits. The descriptions of *overwhelming detail* of artwork and architecture indicates that the students were looking closely and paying attention and sometimes experiencing an emotional response to the level of detail they saw. For example, one student describes the detail of the Last Supper painting: “The painting itself is magnificent. The details, lifelike attitudes of the disciples and Jesus, and the three dimensional effects are spectacular.”
The implication of a *social commentary* in the sculptures and paintings shows that the students are thinking beyond just what they see and to a higher level regarding what the artwork or cultural site means, either socially or to them individually. For example, one student noticed details in Milan street paintings and commented on the distasteful images being presented:

“There are four main buildings in the mall that meet in the center to form a plaza [in Milan, Italy]. If you stand in the plaza and look up you have a perfect opportunity to view one of the most disgusting depictions of art. Each corner at the top of the building that faces the plaza depicts a different painting. They all share the common theme of a god or goddess, a white god or goddess, being served by a slave, a black slave.”

Finally, students' descriptions also showed an *appreciation* of the work that was necessary to develop the art and architecture, which indicates that students are looking deeper than the surface. One of the journal entries emphasized the work that must have been required to construct such details:

“The details on the inside and outside were so precise and took 17 years to make even though it still is considered not finished. It blew me away to be in the presence of such structure of beauty that the engineering behind it is still at a lost to me how it was accomplished.”

**Table 5. Themes and patterns within Cultural Visits**

<table>
<thead>
<tr>
<th>Cultural Visits</th>
<th>Cultural Visits</th>
<th>Theme definition</th>
<th>Patterns within themes</th>
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| Seeing Details  | Noticing details of artwork and architecture | - Overwhelming detail  
|                  |                  | - Social commentary   
|                  |                  | - Appreciation        |
| Social/Cultural Responsibility | Typically referring to the visit to Dachau. Having a personal connection to the Dachau visit or making general statements about social responsibility | - Relate to engineering  
|                  |                  | - Morality            |
| Processes of Creation | Commenting about how something was made or built |                      |
| Infrastructure Differences | Commenting on differences in road and building organization, how cities look |                      |

**Cultural Theme 2: Social/Cultural Responsibility.** This theme primarily emerged from the visit to the Dachau concentration camp. The students responded strongly and emotionally to this visit in many ways that we have grouped into two patterns. The first is by relating the atrocities of the Holocaust and specifically what they learned at Dachau to the ethical responsibilities of engineers (pattern: *relate to engineering*). These reflections that related the visit to engineering
were likely in response to the prompt given by the program director which asked, “What role do you think ethics should play in your role as an engineer?” For example, one such reflection noted the following:

“This is an example of how engineering can be used to do horrible things. The solution behind this misuse of engineering and misplaced sense of moral, ethical, and utter disregard for human rights is for all humans to understand that their actions always affect others. We have to learn from our past and not suppress it in order to continue on into a better future for the human race.”

Although the visit was emotionally jarring for many students, their reflections moved beyond engineering to the much broader pattern of morality:

“I'm glad I was able to learn more and expose myself to this because it's a major part of our history as humans but it was emotionally despicable for me. I could not hold myself together by any means in the beginning. I have no relations to any German ancestors that I know of but that didn't matter. It was still human-kind slaughter. It was inhumane and it wasn't even 100 years ago. It was just horrible to realize how close this was to my life and how that mentality has not completely been wiped out from the minds of everyone even now.”

**Cultural Theme 3: Processes of Creation.** This theme emerged from students commenting on how an object or building was made or built. Some students seemed to be coming from the perspective of an engineer admiring architecture, and others were admiring the work that goes into building or creating something. In all cases, the students’ comments show that they are thinking about design and construction outside of the classroom setting and, in the case of the Duomo in Italy and the Neuschwanstein Castle, outside of the present time. Something that is easy to miss in engineering classes is the context and reality of building such large-scale structures under very different constraining conditions. These experiences of seeing and thinking about how something was made gave the students an opportunity to make that connection in an informal and exploratory way. One student, for example, puzzled over the placement of the Neuschwanstein Castle relative to other building elements:

“What I really loved about the castle excursion is the bridge that had amazing views of the surrounding landscape and the castle. In my mind, I focused more on how they built the bridge and why people put it there rather than the castle itself, which might be because of the bridge’s younger age.”

**Cultural Theme 4: Infrastructure Differences.** This theme emerged from the comments on differences in road and building organization as well as the general layout of cities. These comments indicate that the students are reflecting on the norms of the culture they come from as compared with the norms of the culture they are experiencing. For example, one student pondered why the roads and cars are different: “As we are touring, I notice there are a bunch of roundabouts and tiny cars in Europe in general. This is probably because of high populations and little space.” Another student similarly points to infrastructure differences:
“The major difference between American and Italian architecture is the lack of grass in Italian cities. Even in New York City you will see patches of green in front of brownstone townhouses.”

Although these differences may seem minor, they demonstrate that the program goal of identifying the importance of contextual differences could be realized through both formal and informal activities. Whether students were on a site visit at an engineering firm or paying attention to their surroundings as the group traveled between cities, the program sought to help students continue to recognize differences and consider their implication for their future engineering careers.

**Concluding Discussion**

The preceding results demonstrate that analyzing student-written journals provides a great deal of insight on the variety of learning opportunities that were enabled by this short-term study abroad program. Although the program intentionally included a variety of different types of visits, it was unclear what students believed they gained from those different kinds of experiences. We believe these results demonstrate the value in offering a range of types of experiences, as analyses identified certain patterns of learning that were unique to certain kinds of visits. Moreover, because this group of 36 students consisted of engineers with different disciplinary interests, incorporating visits that catered to different fields of engineering was a key element of program planning. This variety seemed to be a positive attribute of the program, as the visits that were selected appeared to resonate with students’ engineering and career social/cultural interests. They were able to draw important distinctions between disciplines yet recognize how complex problems require interdisciplinary approaches that involve engineers from a variety of background and perspectives.

Across the three types of visits, there is evidence that the students also learned about the cultures of the specific countries they visited, which was another goal of the program. Because engineering varies by country in terms of its social positioning and its educational structure, it was important to help students recognize those differences in this program so they might be able to mitigate certain challenges when they are asked to collaborate on multinational teams as they enter the workforce. For example, the following themes all pointed to country-specific details and differences: Academic Comparison, Design Differences, Professional/Business Landscape, Social Responsibility, and Infrastructure Differences. Although the exact number of visits might vary for similar short-term study abroad programs, it is important to provide a variety of different experiences to facilitate the variety of learning opportunities showcased by these themes.

**Limitations**

One of the activities that we hoped to learn more about is the nature of students' free time. There is always a delicate balance between over- and under-planning students' time abroad. Much learning can happen in informal circumstances, and we investigated students' reflections about their free time. Much of the emphasis, however, was on meals and food differences, which is an
important aspect of culture but lacking in depth and difficult to analyze in terms of understanding students' learning. In future program offerings, the program director will ask students to be sure they describe what they learn in their journals during both formal and informal educational settings in the program.

From a research design perspective, the primary limitation of this study is that it focuses on only one source of qualitative data: student authored journals. Because of this reliance, there is no opportunity to triangulate with other sources to confirm whether the themes and patterns that emerged from this analysis would also emerge following interviews, for example. Thus, this research could be improved by following up with the participants either through individual interviews or focus groups. This analysis would allow us to learn more about students' interpretations of different experiences and to further explore some of their reflections on which they might not have elaborated in their journals. As the journals were only one element of extensive data collection on the program, we do plan to connect these results to a variety of quantitative measures administered to students as well as analyze students' final reflective assignments once they returned to the United States.

**Implications for future short-term study abroad programs**

As discussed in the introduction, research investigating study abroad programs tends to be quantitative and thus tends to be somewhat shallow in identifying students' learning within these programs. Kamdar and Lewis suggest that opportunities for reflection are important for improving student learning from a short-term international trip. Through this study, we have found that such student reflections also can be used as part of an overall program evaluation. By looking directly at what students choose to write about and how they describe their experience, we can learn about their learning. From a continual improvement process, program leaders can then identify specific activities that "worked" from the perspective of meeting the program's objectives in planning subsequent itineraries. Findings from this approach to evaluating a short-term study abroad program can provide guidance in ensuring that the appropriate balance of types of activities are included in plans so that students can develop in a variety of ways.

**References**