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## What Do Reflective Essays Tell Us About Student Learning Outcomes From Inquiry- and/or Design-Based International Engagement Projects?

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# What Do Reflective Essays Tell Us About Student Learning Outcomes From Inquiry- and/or Design-Based International Engagement Projects?

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## Abstract

International inquiry- and/or design-based projects are increasingly recognized as a high-impact teaching and learning approach. However, if not incorporated well into STEM curricula, such as ABET-accredited engineering degrees, they may result in more time to graduation. A popular approach is to incorporate these experiences in capstone design-project courses, but assessment of the international activity learning outcomes can be challenging. The objective of this study was to assess if open-ended student reflections can serve as an assessment tool that allows instructors to capture the rich and complex outcomes of international project-based design activities. Qualitative methods (NVivo and BEVI) were used. In the NVivo approach, emergent themes were identified from 45 reflections authored by students who conducted international inquiry- and/or design-based engagement projects. Students' trips to their respective locations lasted between 2 and 8 weeks. In the BEVI approach, a longitudinal follow-up survey was administered 5 or more years after graduation. Reflective essays captured a wide spectrum of student learning outcomes gained from project-based learning (mostly knowledge and skills) and service-learning (mostly attitude and identity) and can thus be used as a sole assessment tool. Outcomes of international project-based service-learning include not only developing an empathetic attitude but also moving to action consistent with the aroused empathetic feelings and thoughts. Five or more years after graduation, the empathy observed soon after the international project can still be found in former students.

In the early 2000s, there were urgent calls in higher education to provide international experiences to students in STEM (science, technology, engineering, and mathematics) majors. The 2002 Open Doors Report of the Institute of International Education reported that only 10.7% of U.S. college graduates (154,168 students) participated in a study abroad experience. Humanities, social science, fine or applied arts, and foreign language majors accounted for 51.5% of students studying abroad, whereas business and management majors accounted for 18.1% of students. Physical science, computer science, and mathematics majors accounted for 9.1% of these students, whereas engineering majors accounted for merely 2.7% of students participating in a study abroad experience (4,136 graduates). Those 4,136 students represented only 4% of all U.S. engineering graduates. In response to the largely unmet need for international experiences for engineering majors, the first author developed the *3p*-Innovations inquiry- and/or design-based program. The *3p*-Innovations program provides international experiences within the ABET-accredited (Accreditation Board for Engineering and Technology) undergraduate engineering

curriculum at the author's institution without increasing the time to graduation. ABET is a nonprofit, ISO 9001-certified organization that accredits college and university programs in applied and natural science, computing, engineering, and engineering technology.

Klawe (2019) eloquently provided the answer to what holds STEM students back from studying abroad:

STEM students often have a harder time fitting a semester abroad into a tightly sequenced required program of study, according to IIE's [Institute of International Education] 2009 white paper, *Promoting Study Abroad in Science and Technology Fields*. Other reasons named in the report include a lack of encouragement from academic advisors, difficulty in obtaining credit at the home institution for STEM courses taken abroad, and fewer science and engineering-related study abroad programs overall. Yet another hurdle is language. Because STEM students often have to take more courses in their major,

they don't have as much opportunity to take a series of language courses, and that often limits their study abroad options. (para. 4)

Despite these challenges, it is critical for engineering students and other students majoring in STEM disciplines to develop global competencies. *Global competence* refers to skills, values, attitudes, and behaviors that underpin students' capacities to thrive and solve problems in a more diverse, interconnected world (Kisaalita, 2020).

Several arguments have been made in support of broadening all undergraduate experiences to include the development of global competencies. First, winds of globalization and the "flattening" of the world have broken down economic, political, and social systems such that economic growth and opportunity are now found more abundantly in international rather than domestic markets. This trend has led companies to do business with worldwide rather than domestic viewpoints (Friedman, 2007). Second, today's students will likely be in leadership roles before the middle of this century, when the population explosion in developing economies will exacerbate disparities in health care, food, energy, and water security; these disparities will occur not only between developed and developing countries but also within developed countries like the United States (Jansen & Pudlowski, 2009; Sprecher, 2011). Future leaders will be in a better position to meaningfully address these issues if the development of their global competencies begins now and is a key dimension of their undergraduate experience.

The purpose of this paper is to present efforts made to understand the extent and impact of learning that stems from inquiry- and design-based international engagement. A combination of purposefully crafted classwork and international engagement is presented, and the benefits and challenges of this program are discussed.

### **Development and Implementation of 3p-Innovations**

Over the course of 9 years, an international section of a design-project course was developed and implemented. The success of this course led to an additional offering of a summer experience program. Lessons learned from the development and implementation of these courses led to the creation of 3p-Innovations. This process is described in detail below.

### *An International Design-Project Course*

To address the needs identified above, the lead author developed an international section of the required capstone design-project class (ENGR 4920), which is typically geared toward senior undergraduate students. Given that the number of hours in ABET-accredited engineering degrees is typically at the institutional limit, it is challenging to add a course without taking one away. Relatedly, removing a course may violate ABET accreditation. It is therefore convenient to offer new experiences in existing required courses.

The prerequisite for ENGR 4920 was ENGR 2920: Engineering Design Methodology, in which students were taught the fundamentals of design. In standard ENGR 4920 sections, students were expected to complete a design project under the supervision of a professor. Sections were formed around design problems that were sometimes contributed by contacts in industry or other professors. As is typical of many capstone engineering design-project courses in U.S. engineering schools, students were grouped into teams of three to five members to work on different projects. Each project was mentored by a faculty member and constituted a section of the course. Table 1 presents the general requirements for ENGR 4920 at the time of the intervention.

Additional requirements were built into the international section as characterized by the following elements:

- real-life international problems
- web-based resources to provide the problem context
- working in a multidisciplinary team environment (e.g., engineering and economics majors)
- in-country peer support, providing an international team environment
- design team members traveling and presenting the solution concept to the international customer and gaining a better appreciation of the context firsthand, for 1–2 weeks
- special training in human-centered design, intercultural communication, and development engineering through directed readings
- pre- and posttesting with instruments/scales (e.g., Interpersonal Reactivity Index; Davis, 1980)
- a two-page reflection (of at least 800 words) at the end of the semester

**Table 1.** General ENGR 4920 Requirements

### Course Requirements

At the end of the semester, the design team must prepare the following: a) written document detailing the design solution, b) oral presentation with computer-based visuals, c) poster.

Each student must maintain a design notebook using the format as taught in ENGR 2920.

The instructor serves as a mentor for the team. The role of the instructor is to offer advice and encouragement but not to tell the students how to perform the design. The design problem must be open-ended.

A team manager can be elected by the team or selected by the instructor.

Periodic meetings between students and instructor are expected. The frequency of meetings and the form of interim reports provided by the students are at the discretion of the instructor.

The instructor determines the grading policy for the students in the section. The instructor must develop a method to determine the contribution of each team member to determine his or her grade. The students must be aware of this policy. Peer evaluation has been very effective in determining the contribution of the team members.

A midterm status report from each design team will be held with presentations of 15 minutes with 5 minutes for questions.

The final presentations will be held at the end of the semester and will consist of 30-minute presentations and 10–15 minutes for questions.

Outside evaluators will be present for final presentations as well as University of Georgia engineering faculty. The evaluators will also review the posters. Instructors may provide names of individuals who might serve as evaluators.

Students in the international section participated in an overseas trip scheduled during spring break. During the trip, the students appreciated the context of the problem firsthand, engaged customers/community, and presented solution concepts. Additionally, the students worked with the customers/community as equal partners in deciding the best concept to pursue. Equal partnership was achieved through several deliberate practices: Contributions from all were equally valued; in group discussions, individuals refrained from speaking again until at least three others had spoken; decisions were made by consensus, and so on. When the students returned

to the United States, they completed the analysis for the “best” concept and sent the final report and a video-recorded final presentation to the customers/community by the end of the semester.

#### *The Summer Experience Program*

To move promising designs forward, a new team was assembled the following year and started where the former team left off. To facilitate the positioning of promising designs/solutions on a commercialization trajectory, a summer experience component of the program was added. Summer experience program participants were required to apply to the program, and they were not necessarily

students from the international section of the design-project course. In fact, in most summers, the team was entirely new. Due to the competitive nature of the summer program, there were more applications received than spots available. Students who were not accepted into the program were introduced to external programs, such as Duke University's Engineering World Health program. Most summer program participants petitioned for academic credit through ENGR 4980, directed study course (Table 2), which counted toward either a science or engineering elective depending on what students did overseas.

The summer experience program involved fabrication and testing locally (in the United States) as well as overseas. During the overseas 8-week stay, students field-tested their designs among users. Utilizing translational research methods, they inquired and conducted usability studies toward improving the design. The main difference between the ENGR 4920 international section and the summer experience was twofold: (a) The longer overseas stay permitted deeper involvement as opposed to just generating solution concepts, and (b) translational research and usability studies brought the students closer to the communities they were serving.

### *3p-Innovations*

Linking the freshman seminar and the international section of the capstone design-project class gave birth to an informal development engineering program, housed in the first author's lab/studio, named *3p-Innovations*. The *p* stands for poverty-alleviating, prosperity-/wellness-building, and planet-sustaining. The lab/studio came up with this characterization and uses several *3p-Innovations* "filters" to choose the projects pursued. First, the project must have high promise to alleviate poverty (lifting up those earning \$5 per day or less). Second, the project has to have potential for building prosperity/wellness (market potential in millions of households to support job creation and healthier lives). Third, the project has to be planet-sustaining (nonpolluting, powered manually or by renewable energy, etc.). In the past 7 years, two additional courses have been added to the informal program (Table 2): (a) Human Factors in Biomedical [and Other] Device Design and (b) Development Engineering and Sustainability. These newer courses are split level (senior/graduate). Undergraduate and graduate education is integrated in some projects to facilitate arriving at a commercialization-ready device or solution (Kisaalita, 2016; Kisaalita, 2020).

### *Empathy*

A wide net of instruments/scales was cast in the pre- and posttesting of students who worked on regular capstone design projects (control) and students who worked on the international projects and/or participated in the summer experience program (experiment). In a sister paper reporting the analysis, the single measurable quantity that came closest to capturing the difference between control and experiment was empathy (Kisaalita et al., in press) as defined in the social work context (Gerdes et al., 2011). It was hypothesized that similar results could be achieved in a freshman seminar with local (United States-based) projects that allowed students to take on the perspective of socioeconomically disadvantaged members of their own community. In the social work field, the full extent of empathy is not simply a feeling or attitude. Empathy culminates with a decision about what to do with one's aroused empathetic feelings and thoughts (Gerdes et al., 2011). Analysis of the freshman seminar students' reflective essays conclusively supported the view that stepping into someone else's shoes successfully aroused students' empathetic feelings and thoughts. The majority of these students made decisions about what to do with the arousal (Kisaalita, 2018).

Prior work has demonstrated the success of service-based project learning in the freshman seminar in the context of empathy development, as deciphered from student reflections. Here, the authors explored if open-ended reflections from ENGR 4920 international section and summer experience program participants could tell us about student learning outcomes, especially empathy. More specifically, the objective of this paper is to determine whether open reflective essays reveal the full extent of learning outcomes from inquiry- and/or design-based international engagement projects.

### **Background Theory**

Cognitive scientists who study how people learn have found that reflective activities enhance learning (Bransford et al., 2000). In one of the most influential models of learning, the learning cycle presented in Kolb (1984) integrates reflective activities: Abstract conceptualization (e.g., solution concept generation) leads to active experimentation (e.g., design simulation or laboratory experimentation to determine required material properties), concrete experimentation (e.g., testing of a prototype, observing how the customer reacts to the solution, etc.), reflective

**Table 2.** 3p-Innovations Program Courses

<b>Course number (Credit hours)</b>	<b>Comment</b>	<b>Full course title and brief description</b>
FYOS 1001 (1)	This course was restricted to a maximum of 16 students to foster better faculty-student interactions.	<b>Things You Can (or Should Not) Do to End World Poverty</b> Ninety percent of the world's designers spend all their time working on solutions to problems of the richest 10% of the world's customers. The goal of this seminar is to engage students in discussions of pros and cons of changing this by exploring the broad meaning of poverty and the arguments for and against lifting others out of poverty.
BIOE 4710/6710 (3)	This course was designed to also serve students enrolled in the Certificate in Sustainability.	<b>Development Engineering and Sustainability</b> Introduction to what you should (or should not) do to come up with transformative sustainable technology-based solutions to problems at the nexus of water, energy, and food in low-resource settings.
BIOE 4720/6720 (3)	This course also serves as an elective for students majoring in mechanical and biomedical engineering. One of the topics covered is the introduction to entrepreneurship.	<b>Human Factors in Biomedical Device Design</b> Introduction of the application of human factors and ergonomics in the design of biomedical [and/or other] devices as well as the regulatory framework for device pre-market approval.
ENGR 4920 (4)	This is a required course of all engineering majors.	<b>Capstone Engineering Design Project</b> Engineering design experience including completion of a design project under the supervision of a project director.
ENGR 4980 <sup>a</sup> (3)	The course is designed for individual-directed study.	<b>Directed Readings and/or Projects</b> The syllabus is built for the individual student project activities.
GRSC 8100 (2)	This course is open to any graduate student. The mentored students in the program can take this or any other equivalent (e.g., ENTR 7510).	<b>Technology Commercialization</b> Universities increasingly strive to turn their most innovative laboratory research into usable products and services. Students are introduced to the Technology Transfer process and learn about the opportunities and challenges unique to faculty and student entrepreneurship.
ENGR 8980 <sup>b</sup> (3)	This course is designed for individual-directed study.	<b>Advanced Topics in Engineering</b> The syllabus is built for the individual student project activities.
<sup>a</sup> Undergraduate students participating in the summer component of the program were awarded academic credit through this open course designation. <sup>b</sup> Graduate students participating in the summer component of the program were awarded academic credit through this open course designation.		

observation (thinking about what has been learned), and back to abstract reconceptualization.

The learning that comes from international projects such as those offered under 3*p*-Innovations should be consistent with any project-based learning. However, because these projects also involve serving customers/communities, they can also be thought of as project-based service-learning. Bringle and Hatcher (1995) defined service-learning as a:

course-based, credit-bearing educational experience in which students (a) participate in an organized service activity that meets identified community needs and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility. (p. 112)

This definition is consistent with the well-accepted project-based service-learning construct in Kolb (1984). According to this construct, learning must begin with motivation, upon which theory, application, and analysis are founded. Bielefeldt et al. (2010) pointed out that, accordingly, project-based service-learning “should offer a rich learning environment for engineering students; one that fosters not only their cognitive development, but provides strong opportunities for social and moral development” (p. 536). Bielefeldt et al. (2010) have further provided a conceptual schematic of some noted student learning outcomes gained from project-based learning (mostly knowledge and skills) and service-learning (mostly attitude and identity). Therefore, project-based service-learning combines the four outcomes of knowledge, skill, attitude, and identity. Since empathy is considered an attitude (Batson et al., 1997; Strobel et al., 2013; Walther et al., 2020), it was reasoned that student reflections captured immediately following a project-based service-learning intervention should provide insight into students’ attempts to reconcile learning in the conceptualization and experimentation phases of the capstone projects with their developing professional identities as engineers, particularly in regard to the development of empathy traits.

## Methods

The focus of this study was on student learning outcomes as demonstrated by students’ reflective essays and responses to a longitudinal survey. In

particular, the authors were interested in assessing whether open-ended student reflections can serve as an assessment tool that permits instructors to capture the rich and complex outcomes of international project-based design projects.

## *Participants and Projects*

Over the course of 9 years, 45 students in the international section and the summer experience program participated in 15 design projects. With the exception of two project trips to Costa Rica, the remaining 13 projects came from Africa, in particular sub-Saharan Africa. Projects were conducted in Burkina Faso, Kenya, Morocco, South Africa, Tanzania, and Uganda—covering almost all of the ecological subregions of Africa (World Bank, 1996). All projects’ technical results have been described in peer-reviewed publications coauthored with students. A few examples are the hand-operated Argan nut cracking device from Morocco (Kisaalita, Shealy, et al., 2010), the renewable energy-powered evaporative cooler for milk freshness preservation from Uganda (Kisaalita et al., 2018), and the solar-powered incubator for hatching guinea fowl eggs from Burkina Faso (Kisaalita, Bibens, et al., 2010). Complete descriptions of all the projects and associated publications can be accessed at the 3*p*-Innovations website (<https://3pinnovations.uga.edu/>) or in Kisaalita (2020).

## *Data Collection and Analysis*

As already mentioned, reflective essays were part of the learning outcomes assessment. In order to maintain the highest level of open-endedness possible, no prompts were used for these essays. The rationale for providing no prompts was the need to capture the best and/or most accurate unsolicited dimensions deemed important by students as opposed to directing what should be important to them. Our institutional review board (IRB) considered the component of our study involving student reflections to be the “use of existing de-identified data, previously collected as coursework, for research purposes” and returned a “Not Human Research Determination” to our IRB approval application, indicating, “the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.”

NVivo, a qualitative data analysis software program, was used to analyze 45 student reflections. Thematic analysis techniques were used to identify key themes (Aronson, 1995).

Emergent codes were reviewed and validated by the research team as described below. Student reflections for short (2 weeks) and long (8 weeks) stays were pooled because quantitative pre- and postanalysis showed no statistically significant difference between the two with respect to intercultural communication apprehension and world-mindedness (Kisaalita et al., in press). Also, there were many more short-stay (29) than long-stay (16) students.

To explore students' development of empathy, reflection essays were analyzed following an approach published by Litke (2002) and previously used in the freshman seminar study (Kisaalita, 2018). Briefly, two coders (Kisaalita and Mativo) reviewed the reflections and identified units belonging to common themes. Units were discernible, isolated thoughts expressed by the students. In some instances, a whole paragraph could constitute a single theme. In other instances, multiple themes could be expressed in a single paragraph or, in rare cases, in a single sentence. The coders met and reconciled differences. Also of interest was whether the themes observed in postproject reflections could be found in the same students many years later, calling for a longitudinal follow-up.

A longitudinal follow-up of students 5 or more years after graduation was conducted through the Beliefs, Events, and Values Inventory (BEVI). The BEVI (<https://thebevi.com>) was developed by Dr. Craig Shealy of James Madison University. Although the inventory may be used with students immediately after an experience, such as a study abroad experience, the open-ended questions included in the inventory were most relevant to this study and its central questions. These three questions were:

1. Describe which aspect of this experience has had the greatest impact upon you and why.
2. Is there some aspect of your own "self" or "identity" (e.g., gender, ethnicity, sexual orientation, religious or political background, etc.) that has become especially clear or relevant to you or others, over the years, as a result of this experience?
3. How are you different as a result of this experience?

Both the University of Georgia (IRB ID MOD00003165) and James Madison University institutional review boards approved the implementation of the survey.

## Results and Discussion

### General Themes

The NVivo thematic analysis techniques identified six dominant themes from the 45 reflections: (a) building relationships abroad, (b) intercultural communication, (c) being different, (d) human-centered design, (e) better understanding of engineering, and (f) acknowledgment of Western perspectives. As students reflected and reasoned on their experiences and the resulting changes in themselves, original personal benchmarks emerged. Generally speaking, these benchmarks indicate the impact of perspective-changing experiences on students' lives. Determining whether students share similar benchmarks after participating in similar experiences can lead to the generation of helpful themes. The themes that emerge indicate the possible effects of student involvement in a particular experience.

According to Jugder (2016), the thematic analysis approach in NVivo supports answering research questions from two perspectives: first, from a data driven perspective and a perspective based on inductive coding, and second, from a research question perspective to check if the data are consistent with answering the research questions. Inductive coding allows research findings to emerge from repeated patterns or themes found in the raw data (i.e., the reflections) without restraints imposed by structured methods (Thomas, 2003). Coding in NVivo enables consistent capture of key ideas about the data with respect to the research question and represents some level of patterned response within the data set (Braun & Clarke, 2006). It assigns significance to some themes over others based on how frequently each theme occurs in the material being analyzed. Normally, themes are combined into groups and results presented as a node for each broad idea. Within NVivo, the Auto Code Wizard generated themes of recurring similar words from the reflections. Each theme or node was made to retain only the relevant words through a filter. The themes that evolved from our data are shown in Table 3, accompanied by sample quotes.

The items identified under *building relationships abroad* focused mostly on partner communities' openness and empathy toward the students. Some students talked about how being in a place so out of their comfort zone forced them to rely on the kindness and hospitality of others. Interestingly, many students expressed how people in the community were kinder than they were anticipating; they talked about how they were

**Table 3.** Themes and Sample Quotes

Themes	Sample quotes
Building relationships	<p>"We were welcomed into their homes, given coffee and food at every meeting. They gave us everything they had, they welcomed us kindly and generously..."</p> <p>"I have learnt that if you want friendship with your neighbors you have to accept the difference of cultures."</p> <p>"I have built bridges over borders."</p>
Intercultural communication	<p>"There were so many differences between home and this place, yet the people there were just people; I found they were not that different from me."</p> <p>"Instead, what I found were caring women who welcomed us with open arms and readily gave us a job cracking nuts right alongside them."</p> <p>"I believe it was sitting with the women, feeling their pain that motivated me the most towards action."</p>
Being different	<p>"Being a white person over there did feel weird, almost uncomfortable at time. Everyone would stare at us..."</p> <p>"From some people I did get a feeling like they were trying to take advantage of us."</p> <p>"I have always had a hard time understanding that as I have not faced much discrimination in my life. I will probably never completely understand it but can at least gain a small insight on what it feels like to be different."</p> <p>"I felt nothing short of lazy when a laborer at our work site dug a ditch in an hour without complaint, when the same task would have taken me three or four."</p>
Human-centered design	<p>"Most important to the project lay not only in the physical mechanism of the incubator, but to the processes, people, and resources available in the country."</p> <p>"After our visit, we definitely realized that the information we gathered was only possible through our visit to the communities."</p> <p>"In general the phrase 'put yourself in someone else's shoes' has a new meaning for me in engineering and life. After all, to solve a problem you have to know the customer and what is important to them."</p>
Better understanding of engineering	<p>"Engineering is not about designing a solution to a problem – it is about people."</p> <p>"... realize the importance of this project and how it can make a real impact on these people's lives."</p> <p>"I feel this area is where the most valuable lessons came from. Resourcefulness is an engineer's best asset. If you can get creative and not be intimidated by seemingly impossible problems the results can be surprising."</p>
Acknowledgment of Western perspective	<p>"It's only fair that I help change Uganda for the better, because in several ways, Uganda did just that for me."</p> <p>"I often found myself feeling guilty that the materialism of the Western World, of the United States in particular, has indirectly corrupted many African countries."</p> <p>"I began to feel stupid forever complaining about anything in my life."</p>

prepared for and expected to see the poverty of the developing world, but they were not prepared for the people living in poverty to demonstrate such humanity, openness, and empathy toward the students. Students recounted many stories of other people's lives that touched them and/or surprised them. The events often centered around mealtimes spent together; dining with community members and being welcomed into their homes seemed to be a critical moment of connection for many students.

The items identified under *intercultural communication* revealed that, in many cases, students' projects seemed to be the first engineering projects they had encountered where communication was an inherently critical part of the solution. Students talked not only of verbal communication but also of nonverbal communication; some discussed the need to have an understanding of the local culture before proceeding with their design. Especially in Costa Rica, where the language barrier seemed more prevalent, many students discussed the difficulties of conversing in a language other than their native tongue. This forced them to step out of their comfort zone and resulted in a hyper-focus on language, both verbal and physical, as students tried to communicate through phrases and gestures. Other students discussed the difficulties of communicating without technology, especially email, to clarify questions.

The items identified under *being different* conveyed students' uncomfortable experiences with people staring at their Caucasian features, trying to take advantage of them because they were perceived as rich Americans, or treating them with undeserved graciousness and privilege. Some students identified the trip abroad as their first experience as a minority. "Difference" in this context seemed to be both physical and cultural; interestingly, this perceived difference was also true for people whose ethnic backgrounds matched those of local community members (e.g., those of Latino heritage visiting Costa Rica). In Uganda, some students expressed feelings of inadequacy around their inability to do physical work like the local laborers.

The items identified under *human-centered design* again revealed that, for many students, this project represented the first time they were confronted with working in a culture so different from their own. This brought center stage the notion that success in these cases depended on social considerations—on interacting with the community and getting to understand their needs.

Many students spoke to the necessity of local knowledge (Indigenous knowledge) that could not be obtained through their textbooks.

The items identified under *better understanding of engineering* suggested that working on an engineering project in the developing world may have the potential to change and expand students' perspectives of what it means to be an engineer. Many came away with new resolutions to use their skills to serve others. Interestingly, this project also seemed to provide a place for students who entered engineering precisely because of this desire to help others—a place for empathy within engineering. Students talked about this being their first time feeling like a real engineer or feeling like they were doing something important. Students' reactions to community members' ingenuity and resourcefulness were particularly interesting; they seemed impressed by community members' ability to solve problems without much technology. One student even said, "These people are true engineers."

The *acknowledgment of Western perspective* code yielded mixed signals. Some students consciously recognized the need to avoid "Americanizing" problems. Many students were aware of how Americans appear spoiled to others, and some expressed a sense of guilt about how spoiled Americans are. Students also expressed a sort of guilt around how the "materialism of the Western world" has corrupted the "nostalgia of the developing world." This conceptualization of the developing world as nostalgic compared to "real life" back home was a clearly present subtheme. Some students expressed frustrations with the inefficiencies and corruption of the countries they were in, and they wondered why issues could not be fixed with more efficient economies/governments/and so on.

Taken together, these six themes are consistent with student learning outcomes gained from a combination of project-based and service-based experiences as noted in Bielefeldt et al. (2010), including knowledge (better understanding of engineering), skills (human-centered design, intercultural communication), attitude (building relationships abroad), and identity (being different, acknowledging the Western perspective). The projects' low-resource nature and cultural differences, which may have been absent from similar projects conducted in the United States, seemed to produce the dimensions captured in the Westernization and intercultural communication

codes. The mapping of the six dominant themes from the reflections onto Bielefeldt et al.'s conceptual schematic of published learning outcomes from combined service- and project-based experiences strongly supports the view that reflections can be used as an assessment alternative to often time-consuming pre- and posttest instruments.

How were students' experiences in this program different from students' experiences in traditional course-based study abroad programs? Students enrolled in the New Jersey State Consortium for International Studies program found that their international experience fostered a desire to travel more, more cross-cultural competence, and clearer plans, as reported in Hadis (2005):

[Students] have also increased the frequency with which they travel, both domestically and internationally. Respondents also felt personally more independent, outgoing and friendly toward people from other countries. Also, on a personal level, career plans showed more clarity after studying abroad. Plans for graduate studies seemed to have made an inroad as a consequence of study abroad. (p. 9)

Additionally, students who studied abroad through the Ireland Program identified "personal enrichment, travel opportunity, graduate school acceptance, job procurement, and awareness of global issues and cultural diversity" as predominant themes of their experiences (Langley & Breese, 2005, p. 314).

While our thematic analysis did not directly identify empathy as a key theme, tenets of emerging empathy development can be seen in students' focus on outward relationships and interactions with others, an emphasis present across all themes. The key distinguishing outcome, as compared to the more inward-driven outcomes discussed in the existing literature above, seems to be an enhanced empathetic attitude. To further explore the emerging empathy development, the reflections were again analyzed with an explicit focus on empathy, as outlined in the next subsection.

### *Empathy*

All 45 reflections were read as described in the Methods section with a focus on identifying not only empathy but also its culmination into a decision about what to do with aroused empathetic feelings and thoughts. Out of the 45 reflections,

36% (16 students) exhibited empathy-related decisions. These decisions could be divided into three themes: (a) a "commitment" to continue making a difference in the lives of people like the community members, (b) reciprocating the way the students were treated by the community back home, and (c) listening more than talking. Eleven responses were coded to the first category, three to the second category, and two to the third category. The following three quotes are illustrative of the first category:

Plans for my future now include seeking out opportunities to stay connected to Costa Rica and also to develop new connections with places where I could positively impact the quality of life of its citizens.

I resolved myself to help the farmers we had met, and maybe in turn help the country become just a little better. It is only fair that I help change Uganda for the better . . . it has definitely changed my outlook, not only as an engineer, but also as a citizen of the world.

Dilemma: Should I move to Uganda and live there? Alternatively, should I just go on with my life as before? . . . maybe not back in Africa, but wherever the situation presents itself—this MUZUNGU is ready for the challenge.

The following two quotes illustrate the second and third categories, respectively:

I want to reciprocate the help I had. . . . For example, there is a foreign student in one of my classes. Previously, I would have been nice and would have carried out a conversation but shied away from getting to know him. Now I look forward to the challenge of helping him to acclimate to the American culture.

In the future I defiantly plan to work on the skills of being the listener rather than the person who wants to add to the conversation. I must find the happy medium.

It is unlikely that this is an issue of preselection—that is, that students selected the international design project because they already had comparatively higher

empathetic attitudes. Evidence in support of this view comes from a sister paper reporting a controlled study (Kisaalita et al., in press) that administered several pre- and postexperience empathy-surrogate scales, such as the World-mindedness Scale (Sampson & Smith, 1957), which showed a statistically significant pre- and postexperience difference.

#### *Longitudinal Follow-Up*

The students were contacted 5 or more years after graduation to gauge whether traces of their feelings after returning from their study abroad experiences were still present. Of the 45 students that reflected on their overseas experiences, only 25 could be located and were sent a survey. The survey comprised three questions (presented above in the Methods section):

1. Describe which aspect of this experience has had the greatest impact upon you and why.
2. Is there some aspect of your own “self” or “identity” (e.g., gender, ethnicity, sexual orientation, religious or political background, etc.) that has become especially clear or relevant to you or others, over the years, as a result of this experience?
3. How are you different as a result of this experience?

Of the 25 invited participants, nine responded. The most common response to the first question was: “interaction with others from a different country.” Other responses included, “new and eye-opening,” “helping me identify valuable and harmful aspects of my own life,” and “greatest impact upon me experiencing poverty and work ethic abroad.” These responses suggested that students created new lenses to evaluate self and others.

Responses to the second question revealed a better picture of where the interactions and experiences led. The experiences gave students not only a realization of their own self-worth but also a desire to give back to the underprivileged. For example, one student stated, “After I got home, I gave a large portion of my stipend to a charity in Uganda that buys food for orphan children.” Another student wrote, “I truly believe that we as species need to help each other on daily basis striving towards the betterment of humanity.” In the words of a third student, “I now understand that my position/location/wealth can help others if I step out in faith and just be willing to help others.” Students moved to act immediately—and not only once but on a continued basis. They saw

it as an obligation. In other words, their empathy was aroused, and they continued to be empathetic to others.

Responses to the third question captured what the experiences meant to students in totality. Three themes emerged: (a) appreciation for other cultures (“I learned a lot including an appreciation for other cultures and regions of the world”), (b) empathy with others (“I ... try to actively help”; “willing to serve others in need both locally and internationally”), and (c) preparation and development of an intentional search for opportunities to help where needed (“taken necessary skills for humanitarian engineering,... something already continued in my professional career”; “I am counting on my job allowing to further this personal interest and growth as a human being”). These results are very encouraging. They show that a third of the students who participated in project-based service-learning cultivated empathy that stayed with them throughout their careers. Some are intentionally seeking careers that enable them to exercise their empathy. Given the low number of participants in the follow-up part of the study, further longitudinal studies will be needed to obtain more conclusive results.

#### *Implications for Practice*

Many students in this study believed that the study abroad experience changed their views of the world by allowing them to visualize situations through multiple perspectives. The results from this study support two practice implications. First, study abroad programs such as 3p-Innovations can be successfully integrated into ABET-accredited programs, providing the desired global experience without delaying graduation. Second, if analyzed with the right tools, reflective essays are capable of revealing deep learning outcomes and can be a cost-effective assessment alternative. However, further structured comparative studies for reflective essays and validated global competence measures will go a long way in persuading practitioners to rely on reflective essays for assessment.

#### **Concluding Remarks**

Reflective essays are an effective tool for capturing the entire spectrum of student learning outcomes gained from project-based learning (mostly knowledge and skills) and service-learning (mostly attitude and identity) and can be used as an effective assessment tool, either as an alternative to or in combination with traditional quantitative pre- and postassessments. Thematic analysis of

student reflections supports that an outcome of international project-based service-learning is not only developing an empathetic attitude but also moving to action consistent with the aroused empathetic feelings and thoughts. Five or more years after graduation, participants have continued to express the empathy that was first observed soon after the international project.

The ultimate objective of any academic program is for students to gain the ability to transfer classroom learning into practice, for which they will be required to construct and apply knowledge toward solving problems. Proponents of problem-based learning (or project-based learning) argue that most acquired knowledge, skills, and dispositions are cultivated by the student (Gijsselaers, 1996, Mativo & Smith, 2011). However, if the student experience is deemed this important to their future, the question remains: What is the educator's role in helping students pull information together for assimilation and application? The study outcomes presented in this paper strongly suggest that organized experiential learning potentially has a high return in terms of providing participants with an opportunity to develop and maintain an empathetic culture in design activities.

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