



## **An Inductive Qualitative Analysis of Student Interviews on Engineering Global Preparedness**

**Scott Charles Streiner, University of Pittsburgh**

Scott C. Streiner is a full-time doctoral student in the Industrial Engineering Department at the University of Pittsburgh. He conducts research in the field of globalized engineering, including studying offerings in international engineering education, and the extent to which these experiences improve global preparedness of engineering students. Currently, Streiner's research focus is on how best to operationalize and evaluate global programming strategies within the engineering curriculum.

**Dr. Erin McCave, Clemson University**

**Dr. Svetlana V. Levonisova, University of Southern California**

Svetlana Levonisova is a postdoctoral research associate at the University of Southern California. Her research interests include college access and STEM education, internationalization of engineering education, research methods, and institutional effectiveness. She received her Ed.D. in Educational Leadership from the University of Southern California.

**Rachel Elizabeth Savage**

**Dr. Mary E. Besterfield-Sacre, University of Pittsburgh**

Dr. Mary Besterfield-Sacre is an Associate Professor and Fulton C. Noss Faculty Fellow in Industrial Engineering at the University of Pittsburgh. She is the Director for the Engineering Education Research Center (EERC) in the Swanson School of Engineering, and serves as a Center Associate for the Learning Research and Development Center. Her principal research is in engineering education assessment, which has been funded by the NSF, Department of Ed, Sloan, EIF, and NCIIA. Dr. Sacre's current research focuses on three distinct but highly correlated areas – innovative design and entrepreneurship, engineering modeling, and global competency in engineering. She is currently associate editor for the AEE Journal.

**Dr. Gisele Ragusa, University of Southern California**

Gisele Ragusa is a Professor of Engineering Education at the University of Southern California. She conducts research on college transitions and retention of underrepresented students in engineering and also research about engineering global preparedness and engineering innovation. She also has research expertise in STEM K-12 and in STEM assessment. She chairs USC's STEM Consortium.

**Dr. Lisa Benson, Clemson University**

Lisa Benson is an Associate Professor of Engineering and Science Education at Clemson University, with a joint appointment in Bioengineering. Her research focuses on the interactions between student motivation and their learning experiences. Her projects involve the study of student perceptions, beliefs and attitudes towards becoming engineers and scientists, and their problem solving processes. Other projects in the Benson group include effects of student-centered active learning, self-regulated learning, and incorporating engineering into secondary science and mathematics classrooms. Her education includes a B.S. in Bioengineering from the University of Vermont, and M.S. and Ph.D. in Bioengineering from Clemson University.

**Dr. Cheryl Matherly, The University of Tulsa**

Dr. Cheryl Matherly is Vice Provost for Global Education at The University of Tulsa, where she has responsibility for the strategic leadership of the university's plan for comprehensive internationalization. Dr. Matherly co-directs the NanoJapan program, funded by the National Science Foundation in order to expand international research opportunities for students in STEM fields. She is the recipient of two Fulbright grants for international education administrators (Germany and Japan.) She has an Ed.D. in Education Leadership and Culture Studies from the University of Houston.



**Dr. Larry J. Shuman, University of Pittsburgh**

Larry J. Shuman is Senior Associate Dean for Academic Affairs and Distinguished Service Professor of industrial engineering at the Swanson School of Engineering, University of Pittsburgh. His research focuses on improving the engineering education experience with an emphasis on assessment of design and problem solving, and the study of the ethical behavior of engineers and engineering managers. A former Senior Editor of the Journal of Engineering Education, Shuman is the Founding Editor of Advances in Engineering Education. He has published widely in engineering education literature, and is co-author of *Engineering Ethics: Balancing Cost, Schedule and Risk - Lessons Learned from the Space Shuttle* (Cambridge University Press). He received his Ph.D. from the Johns Hopkins University in Operations Research and a B.S.E.E. from the University of Cincinnati. Dr. Shuman is an ASEE Fellow.

# An Inductive Qualitative Analysis of Student Interviews on Engineering Global Preparedness

## Abstract

International experiences are increasingly viewed as an essential component of engineering education. However, limited research has been conducted that leads to 1) a comprehensive definition of engineering global preparedness, 2) determination of how global preparedness is achieved, or 3) delineation of how particular experiences impact the development of students' engineering global preparedness. This paper discusses preliminary research findings from the *second phase* of a multi-institutional research project that investigates how globally focused learning experiences within engineering education specifically impact students' preparedness for global challenges. This multi-pronged research consists of three integrated studies.

Results are reported from one portion of this research that focused on the international education experiences of undergraduate students. Students completed a background questionnaire and two assessment instruments that measured global preparedness. Based on the results of the two assessment instruments, students were selected to be interviewed to explore why they scored "high" or "low" on the respective measures. The purpose was to identify and describe emerging themes related to engineering global preparedness not captured by the questionnaire. Interview participants were selected using a cross-case matching methodology based on their global preparedness measure scores (i.e., high vs low scorers). Twenty-five undergraduate engineering students enrolled at the three collaborating universities were interviewed. Interview data were holistically reviewed with an *a priori* coding schema based on the research objectives and then re-coded according to the final coding schema by multiple research team members for inter-rater reliability purposes, and arbitrated where necessary.

Differences in students' reflections emerged based on the depth of their engagement with the culture and community in the host country in which they had participated in an international experience. The results from this study broaden the knowledge base regarding the contextual factors related to global preparedness and offer the engineering education community insights into the dynamic interaction between students and the international experiences in which they participate.

## Introduction

As companies and organizations continue to increase their global reach, it is vital for newly graduated engineering students to be prepared to enter global workforces. Scholars have consistently argued that higher education in the United States should prepare students for participation in a diverse, cross-cultural society.<sup>1</sup> Engineering programs have an obligation to produce globally prepared graduates who possess well-honed communication skills and the disposition to fully engage and participate in global workforces and international teams.<sup>2</sup> Engineering global preparedness has become an important educational outcome and is a natural extension to concerns by a multitude of national commissions as well as scholars.<sup>3-5</sup> Yet limited research has been conducted that operationally defines engineering global preparedness, specifies the various educational practices for achieving global preparedness, or determines to

what degree global preparedness results from students' personal attributes, prior experiences, or curricular/co-curricular/extra-curricular experiences. Engineering faculty have acknowledged anecdotally that students who participate in study abroad develop cross-cultural skills, knowledge, attributes, and values. However, most evidence about how international experiences and education impact engineering students lacks empirical research to guide educational practices.<sup>5</sup>

This paper discusses preliminary research findings from the *second phase* of a three-phase National Science Foundation (NSF) Research in Engineering Education (REE) project, a multi-university initiative that investigates how globally focused learning experiences within engineering specifically impact students' global preparedness. This expanding body of research consists of three separate but integrated studies regarding engineering students' global preparedness, and is aimed at digging deep into the meaning of the learning experiences resulting from students international and globally focused learning experiences. Specifically, this paper draws upon undergraduate engineering student interview data collected as a follow on effort from an extensive questionnaire of students' demographics, prior international experiences, and global preparedness as measured by Engineering Global Preparedness Index (EGPI) and the Global Perspective Inventory (GPI). Students were selected to be interviewed based on their scores from the EGPI and GPI, in order to explore why they scored "high" or "low" on the two instruments. The purpose of the interviews was to explore emerging themes related to engineering global preparedness not captured by the questionnaire and to further identify what aspects of an international experience are necessary for a meaningful and dynamic student engagement in the experiences. The following research questions were addressed in this study:

1. How do students' motivation to travel, reflectiveness, and social risk-taking during international experiences contribute to their engineering global preparedness?
2. What do students perceive as the most meaningful aspects of their international experiences?

The paper describes a *pilot* study, intended to inform and refine future research direction for our larger study, which will further test hypotheses by inviting 15+ engineering schools to participate in an in-depth study to analyze engineering students' global preparedness using a narrower, more relevant set of contextual factors and international experiences.

## **Review of Literature**

### *Study motivation*

American educational policy makers, employers, and higher education leaders have recognized that engineering graduates must acquire the ability to actively engage with and prosper in the new global century.<sup>6-10</sup> To this end, higher education institutions have invested substantial resources to increase participation in international experiences, both curricular and co-curricular, with the expectation that students who participate in such experiences will develop global competencies that they could not acquire through other means. One can look at the goals set forth in the *Generation Study Abroad Initiative*, a five-year initiative of the Institute of

International Education (IIE), which has goal of doubling the number of American students studying abroad by 2020.<sup>11</sup> A primary motivation for this initiative is to ensure that future generations of the U.S. workforce possess cross-cultural knowledge and are also competent in languages other than English. The *Final Report of the Global Engineering Excellence Initiative* study, which is an industry sponsored study on global engineering excellence regarding the education of the next generation of engineers who will take their place in a global work environment, outlined the challenges that face preparation of tomorrow's engineering workforce.<sup>4</sup> One of these challenges is the need for global competency to become a key qualification of engineering graduates. Consequently, there is an urgent need for research on engineering in a global context. As higher education institutions continue to invest heavily in internationalizing their engineering programs, it is critical to determine with empirical research whether these investments can produce their intended results and what specific program aspects best produce these results.

### *Defining Engineering Global Preparedness*

There is limited consensus on the terminology around global preparedness and it varies by academic discipline. International educational scholars often use the intercultural competence, while the diversity field uses multicultural competence or intercultural maturity. The standard terminology in engineering education research has been global competence. Defining and measuring global preparedness has proven to be even more difficult, generating increasingly divergent approaches that have made reaching a consensus a great challenge among relevant stakeholders. Thus, with an increasing emphasis on global education among higher education institutions, the research community must work to prioritize operationally defining engineering global preparedness.

Numerous scholars have created conceptual frameworks of what it means to be globally prepared. For example, Deardorff developed a grounded theory based model of intercultural competence that she defines as the ability to interact with those from different backgrounds, regardless of location.<sup>12</sup> Her model characterizes intercultural competence as moving from attitudes to outcomes. Jesiek et al. report on three specific contextual dimensions of global engineering competency which includes Technical Coordination, Understanding and Negotiating Engineering Cultures, and Navigating Ethics, Standards, and Regulations.<sup>13</sup> Here, situations and behaviors encountered is the focus, with less emphasis on an explicit list of skills, knowledge, and attributes that help define a globally prepared engineer. Others have taken a list-like-approach to outlining what skills a person should have if they are to be considered globally prepared.<sup>3,10,14,15</sup> Many of the definitions and frameworks identify similar ingredients that can be categorized into five groups: 1) motivation, 2) knowledge, 3) skills, 4) context, and 5) outcomes.<sup>16</sup>

Research by Ragusa is the first that has emphasized measuring *engineering global preparedness*, and through this research she developed and tested an instrument that measures engineering global preparedness with foci on interrelated constructs: engineering global efficacy, engineering global-centrism, engineering global ethics and humanity, and engineering community connectedness.<sup>7,17,18</sup> Previous research by Streiner et al. expands upon these critical aspects of engineering global preparedness to further define engineering global preparedness, defined as the

readiness to engage and effectively operate under uncertainty in different cultural aspects to address engineering problems.<sup>5</sup> Engineering global preparedness brings together the set of congruent behaviors, attitudes, and characteristics in a system, agency, or among professionals, enabling that system, agency, or those professionals to work effectively in cross-cultural situations.

*Alternatives for achieving engineering global preparedness*

There is emergent consensus as to how best to prepare engineering students to succeed in a globalized world. Engineering educators continue attempts to apply integrated, developmental models to promote global preparedness among their student populations. Downey presents a conceptual typology of educational methods for helping students take steps toward achieving global preparedness, which include international enrollment, international projects, international work placement, international field trips, and integrated classroom experiences.<sup>19</sup> Parkinson and Grandin & Hirleman highlight a number of co-curricular opportunities that have been employed at institutions across the U.S.<sup>6,20</sup> A summary of these opportunities is listed in Table 1.

**Table 1.** Co-curricular Opportunities for the Development of Global Preparedness

<b>Grandin &amp; Hirleman</b>	<b>Parkinson</b>
Dual Degree Programs	Double Major or Dual Degree Programs
Exchange Programs	Minors or Certificate Programs
Internships or co-ops abroad	International Internships or Co-Ops
International Extension Campuses	International Projects
Extended Field Trips Abroad	Study abroad and academic exchange
Mentored Travel	Collaborative research projects and global teaming with partners abroad
Partner university sub-contract programs	Service learning projects abroad
Project-based or service learning programs	Graduate level international programs
Conducting Research Abroad	

In addition to the various alternatives for achieving engineering global preparedness, programmatic components and factors of these alternatives also have a significant impact on the quality and meaning of an international experience. Seeking to classify the relative nature of one experience to another, Grandin and Maher outline a list of classification parameters, which includes: short-term vs. long term, English language vs non-English language, degree of cultural exposure/immersion, degree of curricular integration, degree of cultural/linguistic preparation for experiences abroad, degree of engineering-specificity, and degree of institutional/administrative commitment.<sup>6</sup> Research by Engle & Engle reinforces the variation among international experience quality. They first develop a level based classification system for study abroad program types, with each level constituting a blend of program components appropriate to students with roughly similar motivations and prior preparation.<sup>21</sup> Vande Berg also suggests that educators need to intervene by balancing challenge and support, by helping students identify their own program and learning goals, and by formatively assessing their efforts to meet those goals.<sup>22</sup>

Root and Ngampornchai have also explored what students learn from education abroad programs.<sup>23</sup> By analyzing reflective papers of 18 students who returned from experiences overseas, they found that while experiences abroad have an impact on students' cognitive, affective, and behavioral skills, they do not necessarily develop deeper levels of intercultural understanding. This reinforces the notion that immersion into another culture alone may not increase global preparedness, and that more guidance and knowledge about the nature of global preparedness development will not only better help students to analyze their own experience, but help educators assess this development in turn.

### *The mechanisms of international experiences and meaning-making*

Research indicates that educational interventions play a critical role in helping students increase their knowledge of other cultures, their global preparedness, and their capacities for cross cultural communication. However, the research community needs to more closely examine the mechanisms of intercultural education and how these changes occur. Qualitative research is well suited to investigating the process and the quality of intercultural learning.<sup>1</sup> King and colleagues analyzed college students' international experiences to better understand how students learn to be globally prepared. They identified characteristics and key features of students' international experiences for insights about the nature of the development of this educational outcome. Using in-depth interviews conducted with students attending six colleges and universities, the authors gleaned insights into the nature of college experiences relevant to how students develop global preparedness, resulting in three major themes. These themes are:

1. Encountering Others' Experiences During Intercultural Learning- exposure to others' experiences was often a powerful element of a learning experience. Many students acknowledged that differences in perspectives were rooted in people's life experiences and social backgrounds. Students were exposed to other's culturally based experiences as they built rapport and developed a sense of trust within their relationships, normally in the context of immersion trips, service learning projects, or field trips.
2. A Sense of Safety as a Mediator to Exploring Intercultural Differences – students' emotional reactions within a particular educational context played a critical role in shaping their perceptions of international experiences, and how they choose to engage in such experiences with others. Regardless of how the experience was structured, whether or not students felt safe during an experience or had an adequate degree of support played a central role in determining their emotional responses as well as their willingness to engage with and learn from the experience.
3. Approaches to Participating in Intercultural Experiences – once a student decided to willingly participate in intercultural experiences, five distinct approaches were frequently used engage with the culture around them, displaying varying degrees of complexity. The highlighted approaches are (a) listen and observe, (b) compare and contrast ideas, (c) engage in personal reflection, (d) explore personal identity as it relates to global understanding, and (e) empathize with others.

The research presented in this paper draws upon the prior research and extends it to the engineering discipline building on prior research by the authors. The research presented in this paper does not limit the definition of international experiences to study abroad experiences alone. Rather, it considers the spectrum of international and global experiential opportunities available to students (both in and out of formal educational contexts) (e.g., personal tourism, rooming with a foreign national, second language course, service learning programs such as Engineers Without Borders, a course with a global focus). It also outlines the beginnings of a qualitative analysis process by which engineering educators may more closely examine the mechanisms of the international experiences that undergraduate engineering students participate in, how meaningful and effective experiences occur, and how it relates to engineering global preparedness.

## **Methodology**

This paper draws on interview data collected during the second phase of a project that is investigating how international and globally focused learning experiences impact engineering students' global preparedness. Specifically, this paper reports an analysis of freshman and senior student interview data collected among three collaborating universities as part of a mixed-method study conducted in Spring 2014. Following a questionnaire that collected extensive data on students' demographics, prior international experiences, and global preparedness (as measured by the GPI and EGPI), a sub-population of students were invited to be interviewed to explore how their motivation to travel, reflectiveness, and social risk-taking contributed to their responses to the instruments and to identify the most meaningful aspects of international experiences as perceived by the students.

### *Instrumentation*

The Global Perspective Inventory (GPI). The GPI, developed by Braskamp, Braskamp, and Merrill, is anchored by two theoretical perspectives grounded in holistic human development: intercultural maturity (e.g. trying to make sense of their journeys through life) and intercultural communication (e.g. the thinking, feeling, and relating domains).<sup>24</sup> It identifies three major domains of human development: cognitive, intrapersonal, and interpersonal.<sup>25</sup>

The Engineering Global Preparedness Index (EGPI). The EGPI is aligned to both ABET's more difficult to measure professional skills and the NAE's, Engineering of 2020. The EGPI directly measures how prepared students are for the global workforce. It utilizes four subscales including Global Engineering Ethics and Humanitarian Values, Global Engineering Efficacy, Engineering Global-centrism, and Global Engineering Community Connectedness and 18 individual items, each of which have been extensively tested psychometrically using Wilson's four building blocks of item response theory which include: construct map, a measurement model, extensive item design iteration and robust review of outcome space in which extensive validity testing and reliability (using Cronbach's alpha) determination is embedded. Moreover, three rounds of confirmatory factor analyses were conducted with the instrument.<sup>7,17,26</sup>



## Study Sample

Interview participants were selected using a cross-case matching methodology based on their global preparedness measure score for both instruments (i.e., high vs low scorers). Specifically, we interviewed students who “scored” high on one or more of the instruments to further tease out the underlying reasons for students’ global preparedness. In addition, we interviewed a few “low” scorers to verify that there was a range of student responses. In coding for emergent themes, “low” scorers were not included in the analysis. From the three collaborating institutions, a university in the Mid-Atlantic, West Coast, and central United States, completed surveys were analyzed and both the EGPI and GPI were scored. Once EGPI and GPI scores were calculated, the students were ranked in order of decreasing scores. The two scoring lists were then compared, cross-matching students down the lists. The top and bottom 25% were investigated on both instruments. Both “high” and “low” scoring students with varying amounts of international experience (both curricular and co-curricular) who had identified themselves in the survey as interested in completing an interview, were then invited to complete a follow-up interview. For this part of the study, twenty-five undergraduate engineering students, representing the three collaborating institutions, were invited and interviewed. Nine interviews were conducted at the university in the Mid-Atlantic University, 10 from the West Coast University, and 6 from the central US University. A summary of some important demographic characteristics of the study sample across institutions can be seen in Table 2.

**Table 2.** Demographic Characteristics of Study Sample (N=25)

<b>Gender</b>	<b>Sample Size</b>	<b>Percentage</b>
Male	18	72
Female	7	28
<b>Academic Standing</b>		
Freshman	8	32
Senior	17	68
<b>Global Preparedness Score (EGPI/GPI)</b>		
High/High	10	40
Low/Low	10	40
High/Low	5	20

## Data Collection and Interview Procedure

One-on-one semi-structured interviews were conducted by graduate students and post-doctoral students at each university, either in person or via the phone. Each interview lasted approximately 20-30 minutes, was audio recorded, and transcribed verbatim. The semi-structured nature of the interviews provided the students freedom to expound on the most personally relevant aspects of their international experience, yet guided them to discuss varied domains of their experience that were deemed to foster global preparedness development based on previous work by the authors. Each student participant received monetary compensation for each interview. This study was met with IRB approval at all collaborating institutions.

By drawing on the results from previous work, and the expertise of multiple investigators on the research team, an interview protocol (Appendix A) was developed and employed for each

interview. The following overarching questions framed the interviews: “Why did you choose to study abroad and/or pursue an international experience?”, “Did these experience change the way you think about engineering?”, and “Did these experiences affect your thinking about the cultural relevance of engineering?” In addition, the Engineering Global Preparedness conceptual model (developed in previous work by the authors, see Appendix C) was used as a prompt to identify attributes and outcomes of international experiences that resonated with the students.

### *Data Analysis Procedures and Coding Protocol*

After comprehensive training of the graduate and post-doctoral students, interviews were holistically reviewed with a priori coding schema focused on the study’s objectives. An inductive coding protocol was utilized to further refine the coding definitions while allowing for additional analytical themes to emerge. The preliminary codes consisted of international experiences’ types and structures, motivations, openness to experience, degree of reflection. The transcripts were then coded according to the final coding schema by multiple research team members for inter-rater reliability purposes, and arbitrated where necessary. All coding disagreements were arbitrated among the two raters (per interview) for rater calibration; and if conflict could not be arbitrated, a PI resolved the final coding. The final codes with corresponding definitions, which are grounded in literature and previous work, include:

1. **Learning Outcomes and Attributes of those Outcomes** – the outcomes including skills, knowledge, and awareness attributes that resonated as a result of inspecting the Engineering Global Preparedness conceptual model. Additionally, the research team coded for both “purposeful” learning outcomes (outcomes as a result of the design and mission of the international experience) and “serendipitous” learning outcomes (outcomes that were not expected or occurred by accident). The learning outcomes emerged without solicitation, or offered by the interviewee without prompt.
2. **Experiences and Structures** – the types, pedagogical approaches, and programmatic elements of international learning experiences (curricular, as well as co-curricular and extracurricular) that were the most impactful in the development of globally prepared engineers. In addition to the tangible elements of the experience (types and programmatic elements of experience), the type and amount of meaningful interaction with host culture and populace as a result were coded in this category.
3. **Motivations** –motivation was defined in the context of the student’s international experience to include both intrinsic and extrinsic motivations. This involved looking for the internal and external factors that drove students to pursue international experiences. The short term and long term goals that students pursued as a result of their international learning experience were noted. Additionally, the interviews were coded for: (1) the inherent reason for pursuing an international experience, (2) reason for choosing a particular program or type of experience, and (3) if their experience influenced future career choices or motivated them to pursue other international experiences (desire for similar or dissimilar experiences). Beyond these aspects of motivation, the graduate and post-doctoral students looked at the factors that influenced the interviewee’s experience; for example, was it a class the student had to take (extrinsic motivation) or was the experience something the interviewee sought after (intrinsic motivation)?

4. **Social Risk Taking** – From a historical context, social risk taking involves situations in which a student’s esteem in the eyes of others is at stake. The focus of this category in the context of this study was on situations when a student was pushed (involuntary), or sought opportunities to be pushed (voluntary) beyond their comfort zone. Because there was no general risk-taking disposition, what constituted “social risk taking” varied from student to student. Therefore, student interviews were analyzed for both perceived risk-taking tendencies (from the student’s perspective), and actual risk-taking behavior as perceived by the coder (i.e. described risk taking versus inferred risk taking). This category also included factors that caused the students to go beyond their comfort zone, which included controllable and uncontrollable factors (locus of control).
5. **Reflection** – reflection is a mental activity aimed at investigating an individual’s own actions in a certain situation and can be described as a process, which involves looking into one’s own experiences, connecting with one’s own feelings, and attending to one’s own theories in use.<sup>27</sup> For this study, reflection took place in the context of the student’s international experience. This involved a mental review of the international experience, an analysis of causes and effects, and the drawing of conclusions for further actions. Reflection on experience was framed as an intentional and dialectical thinking process where a student revisited features of an experience and used one or more lenses in order to assign meaning(s) to the experience that guided future action.<sup>28</sup> From this standpoint, reflection the students had before, during, and after the international experience were analyzed. Reflection that occurred during the interview itself did not qualify as ‘Reflection’, as the nature of the interview was to engage the students to reflect on their experiences. Thus coding this way would have been unnecessary and uninformative.
6. **Inductive** – refers to codes that emerged from out of the interview data, not included in the predetermined codes above. Often, the codes in this category spanned multiple categories.

Four members of the research team were randomly assigned to code and analyze a set of interviews, resulting in six unique dyad pairs, with each pair assigned 5-6 transcribed interviews. A multi-step approach was used for interview coding and interpretation; these steps are described in Appendix B. Student profiles were thus created for each interviewed student. Each profile consisted of 1) background information, 2) global preparedness scores, 3) prior international and global experiences, 4) frequency distribution of unique ideas in each category with representative quotes, 5) brief narratives outlining the major talking points of the interview and resulting themes and, 6) quality of reflection score. The coding team reviewed all profiles holistically to see patterns in the data, and identified exemplar themes that were common among interviews. To answer the research question regarding how different cognitive, behavior, and affective factors of an engineering student’s international experience contribute to global preparedness, the researchers began by analyzing the distribution of the discussed codes (outlined above) for all of the interviews, with emergent themes and exemplary quotes for each category. Lastly, a detailed discussion of three example emergent themes related to meaningful international experiences for engineers is presented. The chosen themes cut across many of the codes, and are directly related to the development of engineering global preparedness.

## **Thematic Findings and Discussion**

*What do students talk about during interviews of their international experience(s)?*

A table of total frequencies for each category across all interviews, seen in Table 3 below, was constructed from the frequencies of each coding category calculated on each student profile sheet. While we won't go in depth into each theme that emerged from each category, the provided list and table are intended to highlight the type of themes that were distilled from the interviews, and representative quotes that highlight them.

**Table 3.** Summation of Frequencies Across Student Profiles

Category	Frequency	Representative Quotes
Learning Outcomes	224 (30.7%)	"... interacting with people and learning how to manage the people aspect of a job is equally important as the actual engineering work that you're doing"
Experiences/ Structures	171 (23.4%)	"...my host parents were also very talkative, and had been used to hosting foreign kids before. So they were really good at helping bring me into the culture, spending a lot of time talking to me and getting me to practice the language."
Motivation	78 (10.7%)	"...before entering college, I just knew that I wanted to study abroad. That was definitely one of my criteria when I was looking into universities."  "I've always wanted to do engineering projects in developing countries."
Social Risk Taking	30 (4.1%)	"I feel like a lot of engineers kind of stick with their engineering friends and they don't really branch out and meet new people."
Reflection	210 (28.8%)	" People are different no matter where you go but I feel like where you grow up and kind of like the culture you accustomed with kind of shapes you in that way."  "...learning another language thing...the process of like learning it, where you're like struggling to communicate constantly, I feel like it taught me a lot about patience and communication."
Inductive	17 (2.3%)	"That's actually been one of my biggest regrets—that I don't know that many international students"
<b>Total</b>	<b>730 (100%)</b>	

It is evident that students discussed Learning Outcomes, Reflections, and Experiences/Structures the most (in that order), while talking much less about Motivation or Social Risk Taking. A more thorough description of the accounts of the research participants' international experience interviews and the resultant emergent themes are discussed below.

## *Emergent Themes*

Many themes emerged from the interviews and the resulting narratives. However, three themes were selected for further detailed discussion due to the prevalence throughout all of the student interviews, as well as perceived insightfulness and novelty to the international engineering education research body:

- The Role of Student Expectations
- The Mechanisms for Meaningful International Experiences
  - Solo immersion
  - Duration
  - Interaction with the local culture
  - Authenticity, and
  - Contribution to others and service learning
- The Impact of ‘Engineering’ on Engineering Experiences Abroad

Each theme is presented with examples and exemplary quotes from the interviews.

### ***The Role of Student Expectations***

Data from the interviews provided evidence that the significant majority of the high scoring interviewees emphasized the role of their expectations and motivations prior to an international experience. The emergent theme helps address the first research question: How do students’ motivation to travel, reflectiveness, and social-risk taking during international experiences contribute to engineering global preparedness? Students emphasized what they hoped to gain from an experience and how it related to what they ultimately reported that they brought back from the experience. What a student learned from an international experience was driven by his or her expectations prior to the experience. A student’s biggest takeaway and how that student created meaning were dependent on what the student wished to gain from the experience. Many student responses highlighted this, as one student remarked,

I would just say that I guess the reason [my international experience] focused so much on the personal qualities is because when I was going over there, that’s more what I was looking for....So that’s probably why I got so much of the personal side out of it, is because that’s like one of the main reasons I wanted to go over. I guess I was a little less interested in the, like the engineering aspect of it and more in just the cultural and working with another country.

Another senior student described her experience in Panama, indicating that her reason for studying abroad was anthropologically based, stating:

I really like to try and understand people and know a little bit more about different lifestyles; to take me out of a limited perspective, because people with limited experiences have limited perspectives.

This student’s biggest learning outcome was that it reinforced her desire to work in developing countries, saying “I want to help people who spend most of their time just meeting their basic subsistence needs.”

Students brought their own expectations and desires into an international experience, often shaped by their prior experiences and/or upbringing. International experiences did not necessarily alter a student's expectations or worldview, but rather, the international experience confirmed it: "I think my travel experiences just confirmed my worldview". One student explained how he brought his family values and career goals into his international experience, and what meaning he made from it:

The whole environmental aspect that's been something my family's naturally kind of fond of. So, I don't want to do anything that takes away from the world. I want to be better. I want to be more environmentally friendly. So whatever industry I went in, I would want to work in an industry or company that had that same mindset not just like completely wrecking the world. So these experiences probably didn't change that, but just the fact of seeing like the Great Barrier Reef shrinking reinforced my desire and drive to do a more environmentally friendly job or career.

Some interviewed students oriented their careers for international work, and brought these expectations and desires into their international experience: "I already came to college knowing that I wanted to do things like [study abroad], and I have oriented my career towards those kinds of goals." Most high scoring students indicated prior expectations and desires as a key driver of a meaningful international experience. The low scorers let their experience dictate what should and should not be meaningful. Therefore, educators should encourage students to seek opportunities that allow their *own* expectations to manifest through proper international engineering offerings. Additionally, many of the high scorers seemed to reference that their families valued international experience. Students who were born to immigrant parents or married to non-U.S. spouses were better able to articulate and express meaningful global preparedness reflection, regardless of any prior formal international experiences: "...my mom is from Laos and my dad is from Bangladesh ... You know they always recount their experiences to my brother and I, and that has definitely shaped how I approach problems." This aligns with the work of McLeod and Wainwright who found that expectancies, both met and unmet, were significantly related to how students judged their international experiences.<sup>29</sup>

The effects of student expectations on instructional practice and learning outcomes have been well documented.<sup>30-33</sup> In international education, it is often a goal to match student expectations and desires with program learning objectives. Regardless of the student's background, an engineering student will get the most meaningful experience if the student can clearly identify their expectations, and be able to make sense of relationship between these expectations and the international environment in which they are asked to participate.

### ***The Mechanisms for Meaningful International Experiences***

The second main theme that emerged from the interviews related to what elements of an international experience were the most important for an engineering student and their ability to develop into a more globally prepared engineer. The type and structure of an international experience is critical for encouraging the development of global preparedness among undergraduate engineering students. While it is necessary to acknowledge that there is no "one size fits all" style of international experience, the high scorers from this study were in agreement about the mechanisms for a meaningful international experience for engineers. Solo immersion,

duration, interaction with the local culture, authenticity, and contributing to others are keys to meaningful international experiences. These elements of an experience are unpacked and described below.

### Solo immersion, Duration, Interaction with Local Culture and Authenticity

Students often focused the structure of the international experiences that they had rather than its content. The highest scoring students in particular pointed to solo immersion and duration as key programmatic components of meaningful international experiences. One high scoring student remarked, “I think the most meaningful aspect was the fact that I did do it by myself,” while others elaborate on this point, “... if you reach out of your comfort zone and try to explore things with independence then you can be able to understand things at a deeper level.” Many of the high scoring students interviewed in this study felt prepared for and embraced immersive international experiences. One student who had a solo immersion experience in France stated,

Going off to France just throws caution to the wind, that kind of mentality kind of just stuck with me and everything I did from there was a little bit less conservative. I kind of thought I was a book worm before that but after I just took on any challenge that I met because I was excited and I really wanted to go ahead and push myself and see how far I can go despite not knowing what I was doing or where I was going.

Duration, specifically longer (semester to year long) international experience was also indicated by many high scoring students as being vital to a meaningful international experience, “... when I was in Iceland, the length of the stay was essential because we traveled around so much to see different areas, different energy plants.” The handful of students who mentioned duration spoke passionately about its direct and indirect contributions towards meaningful international experiences. Duration may be an essential conduit of a meaningful international experience because it can provide more time for cultural engagement, development of greater independence, and adjustment to “culture shock”. It also offers the student with opportunities to explore surrounding cultures.

Engaging with the local culture was a common theme noted in most high scoring student interviews. Some of the students remarked on their ability to willingly participate in an unfamiliar culture as a point of pride, and emerged as a learning outcome from their experience:

My friends and I got lost literally outside of where our map was. That really tested our skills with independence and cultural abilities because there were no buses that came out to where we were and we had to figure out how to get someone to take us back to the city. So that was a big experience for me personally, just because the ones that really test my abilities in other culture, those are the ones that are most important to me.

One student with an extensive international experience background best exemplified this:

... sometimes that need for authenticity, puts you in some awkward and culturally inappropriate situations. But there is something to be said about trying to just not be a tourist, and I think the experiences that I’ve had [were more authentic]. And when you’ve lived in a place for six months, you’re not just a tourist anymore.

Other students underscored the lack of local interaction that their peers had while on the same international experience. For example, a high scoring student said,

I know people that have done programs where they go the group of Americans, and they kind of just stay with the Americans and they don't really make friends with the other international people, either because they don't have the opportunity or because it's too easy for them to just stay with the people that they're with.

Importantly, when students were challenged to take risks by being in a non-American based immersive program they often got more meaning out of their experiences and were able to better articulate and reflect on the influences the experience has had on their global preparedness development. Many scholars argue that simply being immersed into a new culture is insufficient for development of global preparedness. Many students fail to thrive in the “sink-or-swim” environment of solo immersion study abroad programs, often fleeing as quickly as possible to avoid further unpleasant and threatening exposure to the new and unfamiliar<sup>31</sup>. Research posits that comprehensive support before, during, and after an immersion experience is required for global preparedness development.

### Contributing to Others and Service Learning

International engineering experiences in which a student has the opportunity to contribute to others was extremely meaningful and valuable in the development of global preparedness. Some students spoke about something they helped “engineer,” such as:

I know that a lot of times engineers ... design something because it makes sense to them and ... in a developed world context, but they don't consider the end user ... This experience showed that I'm capable of bridging that ignorance and using materials that the people are familiar with and making things modular so that they can conceptualize how it's made, what it does, and how they might make it themselves.

However, most participants discussed helping the foreign communities through non-engineering means, becoming more aware of the constraints and obstacles that are required to make a difference, and realizing there is more to international development and service than engineering. A high scoring student recognized that, “When I design things, I should be aware of the social consequences. Not that I should design things to alleviate social ills.” Another student reflects, “[my experience] just reinforced the ideas that I had. Engineering can change lives.” A particularly high scoring student shared insightful reflections on international development, and the role engineers have in the process:

[paraphrased] In most cases, you have to be really careful with international development. There's a lot more to it than, “we're going to help this other culture.” Because this culture and society probably has different ways of meeting those needs and maybe it's not necessarily engineering to your proper standards. But what they don't need you to do is go engineer it for them. It's not a lack of engineering knowledge; usually it's more a lack of capital and strong communities. So fixing it for them isn't going to create sustainable change. I feel like I have that perspective on international development, and that I at least have an understanding that it's not nearly as simple as you could make it out to be.



Service is a natural extension of engineering, and it follows that more meaningful experiences for high scoring students involved contributing to others and making the world a better place. Experiences that integrate service in some capacity allow students to have meaningful interactions with the host culture and local populace, and are long enough that the student can be immersed in authenticity.

### ***The Impact of ‘Engineering’ on Engineering Experiences Abroad***

Students were somewhat specific about the events of an experience that were the most meaningful, or the stereotypes that were broken down from an increased amount of cultural exposure. However, one topic that was surprisingly absent from the study data was engineering. The majority of high and low scoring students did not connect engineering with deeper values and cultural assumptions. The students’ “meaningful” experiences often did not directly reference engineering aspects of the trip, but focused more on its socio-cultural aspects. In many cases, the students preferred to have their international experience not focus on technical engineering aspects. Some students reflected and learned more about how to work in engineering groups and how to communicate more effectively, as opposed to the engineering work itself. Interestingly, the highest scoring student has had 5+ international experiences, only one of which was directly related to engineering.

There was limited emphasis on technical engineering skills in the student interview responses. The research team presented a conceptual map of engineering global preparedness (see Appendix C) to each student and had them reflect on which parts of the map resonated with them in regards to their international experience. There was a general mix of cross-cultural communication skills and strategies, personal and professional qualities, and international contextual knowledge (entirely dependent on the type of experience). Engineering global preparedness, the centerpiece of the model, was consistently regarded as “unimportant”, “least relevant”, or just ignored entirely. One student proclaimed, “... Foundational knowledge of engineering ... was the least relevant to me.” Another student echoed this, “This experience benefits me greatly but primarily in soft skills rather than concrete engineering understanding.”

The focus of many of the interviews was on the cultural relevance of engineering or how the other aspects contribute to becoming a better engineer and person. The emergent theme of the importance of student expectations is connected here. Most students didn’t set expectations related to their technical major, but rather for personal growth. One student stated:

Going abroad really expanded my view, it made me realize that math and science are great starting point but if you really want to do anything you really have to have a global view and you really have to understand all these different cultures and all these situations that these people are in. And once you do that you can notice all the little similarities between cultures.

Another student commented on how engineering is more about understanding the people than the product. He went on to say that the most successful companies that he interacted with abroad were the ones that paid the most attention to cultural details. Accordingly, the common theme emerged that there isn’t just one way to solve a problem: “I guess travel definitely teaches [you] that there’s never only one way to make something better, and that one way that you think is better is not always better to the person that you’re imposing your thoughts on.” Most students

were content that their international experience was not technically centric. One stated: “I would say that like my knowledge of my like engineering skills were what I expanded the least while I was there, and I’m almost happy about that.” One student mentioned how he didn’t want to spend his trip hunched over engineering books and went on to say “I could take engineering classes anywhere. And you know I could practically learn the stuff just on the internet. So that part of it actually wasn’t that exciting...It was way more interesting to see how their universities work... make friends there...see what it’s like to live in the city there and find an apartment and learn another language and see, just what daily life was like.”. A very high scoring student remarked that:

[paraphrased]...My international experience changed my perspective of the culture of engineers, this superiority complex that insists that engineering is the way to solve problems. And that’s just completely not true. Most of the problems in the world are not going to be solved by engineering, necessarily. And I think getting out of the US, getting out of the little engineering school bubble and seeing another culture, and living in another place...traditional engineering has caused a lot of issues and problems in the world, rather than a solution to it. My experience influenced the perspective that I had.

While the technical aspects of engineering may certainly be a vital part of an international engineering experience, a significant takeaway from our student data doesn’t appear to be the technical aspects of engineering. Students preferred to focus on the socio-cultural aspects of engineering, deferring to their technically focused home studies for a more concrete engineering experience.

### **Limitations and Future Work**

There are several limitations to this study. Some of the student participants in the study spoke of international experiences that were solely for personal purposes, like vacations, rather than structured educational experiences (e.g. study abroad or internships). These experiences (personal tourism, 2<sup>nd</sup> language courses at home campus, etc.) generally did not provide fruitful reflections or examples of how the experiences influence their engineering global preparedness. While these interviews provided a side of the story of experiences that might not be as effective in the development of engineering global preparedness, low scoring participants may not be interviewed in future work, thus allowing the research team to focus more on experiences that better globally prepare students. This study does also not map the number and types of experiences with the resulting learning outcomes category. More insight can be gained if the connection between experiential factors and learning outcomes is explored, as well as investigate how this connection relates back to the conceptual model of engineering global preparedness developed in previous work.

In the future, the interview protocol will be adjusted to provide the student with more prompts in order to obtain richer reflections and experiential anecdotes from the students. Another round of interviews will be occurring where a larger population of EGPI and GPI high scores is targeted in order to refine and inform the adjustment the instrumentation for future studies. Once the instruments are refined, they can be distributed to a more diverse and comprehensive population of engineering students from across the country. From this larger study population, it is the goal of the research team to provide recommendations on which experiences and their attributes will

provide a set of students with an optimal global experience that prepared them for global workforces that the US and the world need.

Additional research and design steps will be taken to develop a refined and robust interview protocol that engineering educators may follow when discussing the impact of international experiences with undergraduate engineering students. The research team is working on generating a “Quality of Reflection” rubric that would accompany the interview protocol. These artifacts would provide the research community with a mechanism for both interviewing students about their international and global experiences as well as assessing the quality of the interview in a systematic way.

## Conclusions

This paper presented the results from a pilot study that focused on the international education experiences of undergraduate engineering students. Three themes emerged from this qualitative study of student interviews. In order for students to gain preparedness from their experience, their expectations must align with the experience. This reminds us that not all programs or experiences are suitable for every person, and international and engineering educators must help students choose the experience that fits their personal and career goals for their time abroad. The mechanisms for a meaningful international experience for engineers were identified to include solo immersion during the experience, having authentic cultural interaction, and contributing to others. While these are not the only mechanisms, being able to understand these mechanisms will help us direct students to experiences where they will thrive. Lastly, many international experiences discussed lacked engineering components. Many of the students who study abroad focus on socio-cultural aspects and rarely embrace the technical side of engineering classes. Those that were able to noted that engineering classes taken abroad were no different than what they would get in the US and that they would prefer to learn about the engineering cultural differences or see engineering practices in use to get a better understanding of the challenges they face when working in a global market.

## Acknowledgements

This research is being funded by the National Science Foundation (EEC-116040) entitled *Collaborative Research: Assessing the Spectrum of International Undergraduate Engineering Educational Experiences*. We would also like to acknowledge Dr. Shaobo Huang and Sydnie Cunningham for their assistance in interviewing students.

## References

1. King, P. M., Perez, R. J. & Shim, W. How college students experience intercultural learning: Key features and approaches. *J. Divers. High. Educ.* **6**, 69–83 (2013).
2. Levonisova, S. *et al.* Moving Towards a Research Informed Conceptual Model of Engineering Global Preparedness. in *2014 ASEE Annual Conference and Exposition, Indianapolis, IN* 1–17 (2014).

3. Hunter, B., White, G. & Godbey, G. What Does It Mean to Be Globally Competent? *J. Stud. Int. Educ.* **10**, 267–285 (2006).
4. AG, C. *In Search of Global Engineering Excellence: Educating the Next Generation of Engineers for the Global Workplace.* (2006).
5. Streiner, S. *et al.* Exploring Engineering Education in Broader Context : A Framework of Engineering Global Preparedness. in *2014 ASEE Annual Conference and Exposition, Indianapolis, IN* 1–12 (2014).
6. Grandin, J. M. & Hirleman, D. E. Educating Engineers as Global Citizens : A Call for Action / A Report of the National Summit Meeting on the Globalization of Engineering Education. *Online J. Glob. Eng. Educ.* **4**, (2009).
7. Ragusa, G. Engineering Global Preparedness : Parallel Pedagogies , Experientially Focused Instructional Practices. *Int. J. Eng. Educ.* **30**, 400–411 (2014).
8. Salisbury, M. H. The effect of study abroad on intercultural competence among undergraduate college students. *Dissertation* 1–133 (2011).
9. Galloway, P. D. in *ASCE Press* 46–51 (2007).
10. Warnick, G. M. Global Competence : Determination of its Importance for Engineers Working in a Global Environment. *Dissertation* 1–292 (2010).
11. Generation Study Abroad Initiative. *Institute of International Education* (2014). at <<http://www.iie.org/Programs/Generation-Study-Abroad/About/Why-Study-Abroad>>
12. Deardorff, D. K. Identification and Assessment of Intercultural Competence as a Student Outcome of Internationalization. *J. Stud. Int. Educ.* **10**, 241–266 (2006).
13. Jesiek, B. K., Thompson, J. & Mazzurco, A. Global Engineering Competency in Context : Situations and Behaviors Global. *Online J. Glob. Eng. Educ.* **8**, (2014).
14. Parkinson, A. The Rationale for Developing Global Competence Competence. *Online J. Glob. Eng. Educ.* **4**, (2009).
15. Passow, H. J. WHAT COMPETENCIES SHOULD ENGINEERING PROGRAMS EMPHASIZE ? A META-ANALYSIS OF PRACTITIONERS ' OPINIONS INFORMS CURRICULAR DESIGN. in *3rd International CDIO Conference* (2007).
16. Fantini, A. E. in *The Sage Handbook of Intercultural Competence* 456–476 (2009).
17. Ragusa, G. Preparing Engineers for Global Workforce: A Research University's Response. in *American Society of Engineering Education Conference Proceedings*. Session AC 2009-2186. Austin, TX (2009).
18. Ragusa, G. Engineering preparedness for global workforces: Curricular connections and experiential impacts. in *ASEE Annual Conference and Exposition* (2011).
19. Downey, G. *et al.* The Globally Competent Engineer : Working Effectively with People Who Define Problems Differently. *J. Eng. Educ.* (2006).

20. Parkinson, A. Engineering Study Abroad Programs : Formats , Challenges , Best Practices. *Online J. Glob. Eng. Educ.* **2**, (2007).
21. Engle, L. & Engle, J. Study Abroad Levels : Toward a Classification of Program Types. *Front. Interdiscip. J. Study Abroad* **9**, 1–20 (2003).
22. Vande Berg, M. INTERVENING IN STUDENT LEARNING ABROAD : A Research Based Inquiry. *Intercult. Educ.* **20**, 15–27 (2009).
23. Root, E. & Ngampornchai, a. ‘I Came Back as a New Human Being’: Student Descriptions of Intercultural Competence Acquired Through Education Abroad Experiences. *J. Stud. Int. Educ.* **17**, 513–532 (2012).
24. Braskamp, L. A. & Engberg, M. E. *Guidelines for judging the effectivness of assessing student learning.* (2014).
25. Braskamp, L. A. & Engberg, M. E. How Colleges Can Influence the Development of a Global Perspective. *Lib. Educ.* **97**, (2011).
26. Wilson, M. R. *Constructing Measures.* New Jersey: Lawrence Erlbaum. 28-142 (2011).
27. Schon, D. A. *The reflective practitioner: How professionals think in action.* (Basic books, 1983).
28. Turns, J. A., Sattler, B., Yasuhara, K., Borgford-Parnell, J. L. & Atman, C. J. Integrating Reflection into Engineering Education. in *2014 ASEE Annual Conference and Exposition, Indianapolis, IN* 1–16 (2014).
29. McLeod, M. & Wainwright, P. Researching the Study Abroad Experience. *J. Stud. Int. Educ.* **13**, 66–71 (2008).
30. Engle, L. & Engle, J. Assessing Language Acquisition and Intercultural Sensitivity Development in Relation to Study Abroad Program Design. *Front. Interdiscip. J. Study Abroad* **10**, 219–236 (2004).
31. Vande Berg, M., Paige, R. M. & Lou, K. H. in *1* 3–58 (2012).
32. Stroud, a. H. Who Plans (Not) to Study Abroad? An Examination of U.S. Student Intent. *J. Stud. Int. Educ.* **14**, 491–507 (2010).
33. Salisbury, M. H., Umbach, P. D., Paulsen, M. B. & Pascarella, E. T. Going Global: Understanding the Choice Process of the Intent to Study Abroad. *Res. High. Educ.* **50**, 119–143 (2008).

**Appendix A – Interview Protocol**

*Each interview should take around 30 minutes*

<b>Warm-up Questions</b>	<b>Prompts (if needed)</b>
<ol style="list-style-type: none"> <li>1. Why did you choose to study abroad and/or pursue an international experience?</li> <li>2. When did you pursue your international experience?</li> <li>3. Where did you pursue your international experience?</li> <li>4. How long was your international experience?</li> </ol>	

<b>Experiences</b>	
<ol style="list-style-type: none"> <li>1. Please describe one or two experiences that were especially meaningful to you during your study abroad experiences. These experiences could be either personal or related to your academics. Examples could be a trip that you took while abroad, a project you worked on, a class you took, etc.</li> </ol>	<p>What aspects of these experiences were meaningful?            What did you learn through these experiences?            Without these experiences, what would your international experience have lacked?</p>
<ol style="list-style-type: none"> <li>2. Did these experiences change the way you think about engineering?</li> </ol>	<p>In what ways?            How have this changes affected how you pursued your major once back to your home campus?            How have these experiences changed how you plan to utilize your major in the future?</p>
<ol style="list-style-type: none"> <li>3. Can you describe a situation abroad when you met someone who had a different cultural view than you?</li> </ol>	<p>Why was their perspective different from yours?            What was the most surprising?            How did this affect the way you interacted?            Did their perspective change yours on an issue/topic?</p>
<ol style="list-style-type: none"> <li>4. Did these experiences affect your thinking about the cultural relevance of engineering?</li> </ol>	<p>If yes, in what ways?</p>
<ol style="list-style-type: none"> <li>5. Have you done anything different since you returned from studying abroad?</li> </ol>	<p>If no, why do you think that is?</p>

<b>Outcomes</b>	
<ol style="list-style-type: none"> <li>1. Now that you’ve provided us with information about your experiences, we would like to learn a little more about how these experiences have helped to improve certain learning outcomes. We are providing you with a conceptual map for engineering global preparedness.                On the map there are four areas or circles that encompass engineering global preparedness (announce each of the four circles). Within each area are attributes that help to describe the area. Please take a minute to review the map and reflect on your experience in light of the four areas on the map (give students a minute to review).</li> </ol>	
<ol style="list-style-type: none"> <li>2. Is there anything further you would like to share about your experiences or learning related to global preparedness?</li> </ol>	

## Appendix B – Summary of Coding Protocol Steps

Steps	Explanation
1. Holistically read transcripts	Seek evidence of themes aligned with 5 categories; further refine coding definitions
2. Create brief narrative and give quality score	Each coder writes a brief narrative of each interview with evidence of themes  Rates interview on quality of reflection, 1 being absence of meaningful reflection and 3 being presence of meaningful reflection
3. Color code transcripts	After consensus is reach on narratives, each coder color codes his/her assigned transcripts using the final six qualitative categories  While analyzing, each coder will identify “ideas”, and not code for words specifically
4. Arbitration of color categorization	Each dyad pair will review and identify areas of disagreement  PI reviews the results and arbitrates where needed
5. Frequency distribution table	Create a table of the number of unique ideas that appeared in the transcript for each category
6. Complete Student Profiles	Load frequencies to each profile with each student’s data from the questionnaire
7. Review all profiles to distill emergent themes and patterns	Team reviews all transcripts/ profiles pairs holistically

Appendix C – Engineering Global Preparedness Semantic Map

SYNTHESIZED SEMANTIC MAP  
 Delphi Summit: June 26, 2013  
 Version 5.0-October 16, 2013

