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Exploring intercultural wonderment as a mediator for global perspective development in engineering students

John A. Schneider
Rowan University

EXPLORING INTERCULTURAL WONDERMENT AS A MEDIATOR FOR GLOBAL PERSPECTIVE DEVELOPMENT IN ENGINEERING STUDENTS

By
John A. Schneider

A Thesis

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Thesis Chair: Scott Streiner, Ph.D.

Acknowledgements

Abstract

John Schneider
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GLOBAL PERSPECTIVE DEVELOPMENT IN ENGINEERING STUDENTS
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Scott Streiner, Ph.D.
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The purpose of this study is to investigate the mediatory role intercultural wonderment plays in global learning during engineering students' international experiences. Engberg and colleagues have posited a connection between the programmatic components of an international experience (i.e., study abroad) and global learning, with international wonderment serving as a conduit for that connection. Qualitative and quantitative data were collected under an NSF multi-institutional grant that focused on identifying ways global preparedness can be developed in and out of formal curricula. Data included semi-structured, student interviews, student background data, and global perspective scores as measured by the Global Perspective Inventory (GPI) - a measurement scale of global and holistic student learning though their perceptions and experiences. The study resulted in an assessment and identification the opportunities for fostering intercultural wonderment and global learning within study abroad and recreational international experiences. The study found that opportunities for fostering intercultural wonderment in all areas exists between both types of international experiences. The study also found that there is recognized value that can come from recreational experiences. Finally, the study reaffirms the value of study abroad programs which is critical as effort is continued to be directed towards building these experiences for undergraduate engineering students.

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Contribution to Research

Background

There is a growing recognition in higher education to implement and engage students in purposeful environments (i.e. study abroad, recreational experiences) that would allow them to develop global perspectives and cross-cultural skills to help them effectively adapt to the diverse world market [1]–[4]. As our world becomes more globally driven as technology and markets expand and evolve, engineers need to be prepared to work and collaborate in the global economy. Engineers interact and communicate not only with various professional disciplines, but also across differing degrees of culture. Due to their skill sets and demand to problem solve, working with other cultures is becoming an inherent and daily task that engineering graduates will encounter. Thus, it is critical that engineering students develop the knowledge, skills, and attitudes necessary to work across cultural boundaries and to effectively adapt, integrate, and communicate in new environments. With this comes the need for educators to develop educational practices that help students cross these boundaries [5], [6]. Although participation in education abroad experiences it is growing in the engineering education sector, the critical mass of engineering students still lack international exposure. The most recent *Open Doors* report of the Institute of International Education found that between 2016 – 2017, only 5.3% of students who study abroad were engineers [7]. However, as engineering educators and program administrators are recognizing the importance for international experiences, there has been a large growth in this number from the 3.1% of students that were engineers and found be studying abroad ten years earlier.

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For engineering students to cross these cultural boundaries, they need to obtain greater skills and knowledge that will aid their global understandings. This individual development is often expressed as enhancing engineering students' global competency, or global perspective [8]–[10]. Curricular, co-curricular, and extra-curricular activities offer great opportunity for students to increase their global perspective [11], [12]. As a result, universities and their engineering programs are developing various educational opportunities that allow their engineering students to engage in such experiences that will aid in the development of their global perspective and better prepare them for the global workforce. Research and practice have shown that many types of international experiences exist (both academic and non-academic) for students to get international exposure (i.e., personal tourism and study abroad) and increase global awareness more broadly [8], [13]–[16]. To measure global perspectives and cross-cultural skills developed from international experiences, various instruments and scales have been created. The instrument and scales that are most common in assessing engineering students includes the Intercultural Development Inventory (IDI) [17], Miville Guzman Universality Diversity Scale (MGUD-S) [18],the Engineering Global Preparedness Index (EGPI) [19], and the Global Perspective Inventory (GPI) [20] Qualitative analysis can also be used to assess student development during international experiences.

Given the expansion of international experience types and engineering student participation [3], it's critical to determine the how different types of international experiences foster global learning and perspective development. These different international experiences vary in many aspects and provide different levels of engagements. Some experiences may provide students more surface level encounters and

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understandings, while others provide opportunities that are more immersive [21]. Having a better understanding of these international experiences and their respective learning outcomes can better help university study abroad administrators, faculty, and students to create and engage in meaningful international experiences. How can researchers begin to understand this differentiation between experience types to help students achieve greater levels of global learning?

The exploration of how *intercultural wonderment* is manifested through authentic, cultural engagements during these international experiences can help to understand what fosters global learning and perspective development. This idea of *intercultural wonderment* is a process that "encapsulates the underlying curiosity in individuals to seek out new and different experiences while studying abroad and involves a willingness and capacity to deal with discomfort and disequilibrium" [22]. This thesis examines how intercultural wonderment is manifested in recreational and study abroad experiences that undergraduate engineering students participated in.

Students, especially within engineering, are not likely to have an international experience. Therefore, it is important to understand the mechanisms that impact student learning. Overall, intercultural wonderment provides a framework to explore what experiences foster learning and the global learning outcomes that comes from them. Thus, this thesis aims to investigate the phenomenon of intercultural wonderment to better understand how intercultural wonderment is manifested and what role it plays in developing global perspectives in engineering students through the following research questions:

1. *How is intercultural wonderment manifested through international experiences?*

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a. *Which types of international experiences facilitate intercultural wonderment?*

2. *What is the role of intercultural wonderment in fostering global perspective development in engineering students?*

Purpose of Study

The purpose of this study is to investigate the mediatory role of intercultural wonderment during an engineering students' international experiences, as outlined by Engberg et al. (2016), which posits a connection between the programmatic components of an international experience and global learning outcomes [23]. The mediating factor between program design and global learning is intercultural wonderment (Figure 1), which is the focus of this thesis. This original study analyzed how different factors during study abroad trips fostered this idea intercultural wonderment. In turn, these were then found to have a relationship with global learning outcomes [22]. Intercultural wonderment may provide a key in understanding how to optimize student learning during international experiences.
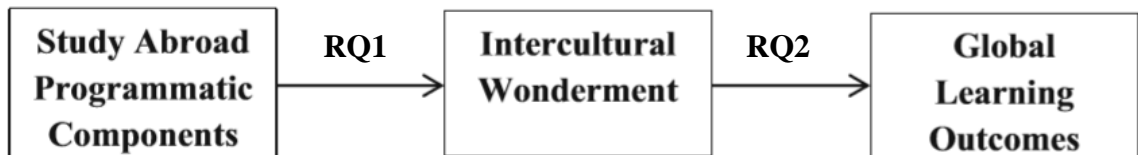
Figure 1. Framework of how intercultural wonderment acts as a mediator between global learning outcomes and how the thesis is broken down in relation to the framework.

Intercultural wonderment can be broken down into four categories: immersion, interaction, habits and behaviors, and comfort zone. The type of international experience is used as a corollary to programmatic components since it defines a certain aspect of the program for which the student is participating. Two different international experiences (recreational and study abroad) are explored to identify which categories of intercultural wonderment are fostered. For each type of experience, intercultural wonderment was examined to understand how global perspectives and learning outcomes were developed in the undergraduate engineering students. Overall, the thesis aims to better understand this mediating role of intercultural wonderment as it relates to study abroad and recreational experiences and global perspective development.

Study Design, Methods, and Outcomes

The framework for the thesis follows the general framework developed by Engberg and Jourian (2015) and is delineated for each study (Figure 2) [22]. Each study breaks down the components of the original framework to better understand the relationship that exists between programmactic components – in this case study abroad and recreational international experiences – and global learning outcomes expressed. Ultimately, these studies will help to better understand intercultural wonderment.

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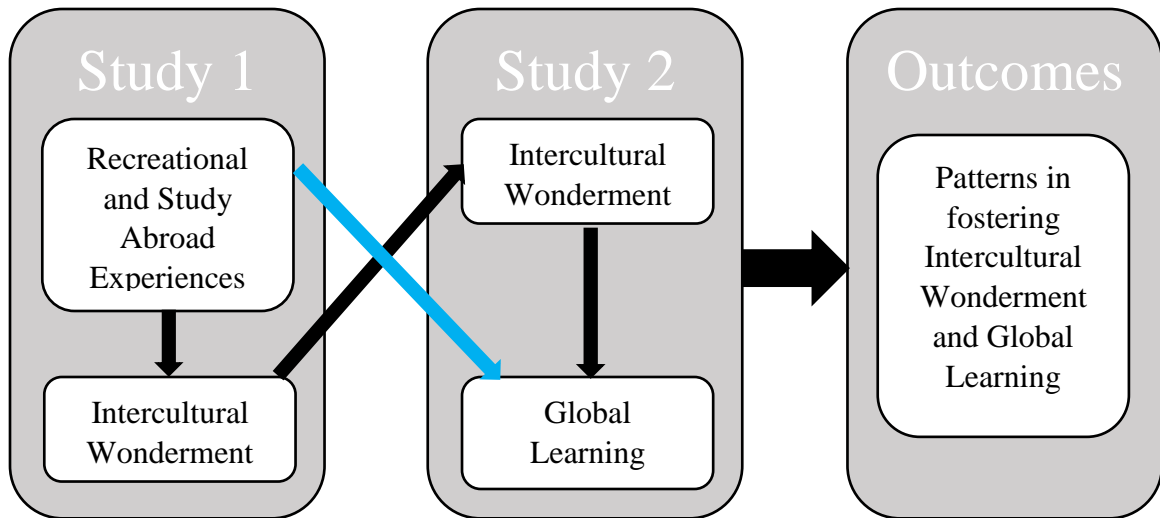
Figure 2. Thesis framework

Both studies drew upon qualitative and quantitative data in the form of interviews and demographic across multiple institutions. This data was used to identify the type of international experience, intercultural wonderment, and learning outcomes.

Study 1 focuses on the relationship between the programmatic component (or recreational and study abroad international experiences) and intercultural wonderment. This was examined by disseminating students into the two experience types and reviewing interviews to identify areas of intercultural wonderment. Each experience was reviewed to understand which experience type offers opportunity to foster each intercultural wonderment and how intercultural wonderment is fostered during these experiences. The outcome of the study first found that both international experience types that were identified all offer the opportunity for intercultural wonderment to be fostered. Intercultural wonderment was fostered through different mechanisms and is shown through qualitative evidence. In particular, both experiences offered great opportunity for intercultural wonderment through interaction.

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Study 2 assessed the relationship between intercultural wonderment and global learning. Intercultural wonderment was used to understand which global learning outcomes were developed. The GPI of students was analyzed along with assessing what were the engineering learning outcomes for global preparedness. The GPI is an instrument that rates students on their global learning within the areas of cognitive, interpersonal, and intrapersonal aptitudes and perceptions [20]. It was used because it closely aligns with global perspective constructs the study aims to measure. The GPI is also a validated instrument and widely used for a basis for comparison against non-engineers. Additionally, a number of studies have used the GPI to examine the impact of study abroad experiences with consistent results and strong statistical reliability and validity [20], [22], [24]. The global learning outcomes of the engineering students are defined through four areas that were found to be important knowledge and skillsets for globally prepared engineers through a Delphi study by Besterfield-Sacre et al. (2013) and via the Global Perspective Inventory (GPI) [20], [25]. The outcome of the second study found that cross-cultural communication skills and strategies had the emergence of the largest amount of global learning outcomes. Additionally, these were most commonly associated or connected to areas of intercultural wonderment that were identified. Within GPI scores, study abroad engineering students were also found to have statistically higher cognitive knowledge and cognitive scores that recreational engineering students.

Specifically, this thesis drew upon undergraduate engineering student interview data and quantitative measures of global perspective levels. The thesis utilizes this data to investigate global learning outcomes from each of the international experiences as well as

how intercultural wonderment acts as this mediating role to generate these learning outcomes.

Description of NSF Grant

The thesis was motivated through work done during a National Science Foundation (NSF) REE project called *Assessing the Spectrum of International Engineering Education Experiences* (EEC-1160404) [26]. The study grant was multi-institutional between the University of Pittsburgh, University of Southern California, Clemson University and Lehigh University. This grant was broken down into three separate studies that focused on how globally focused learning experiences impact student's global preparedness within engineering. Overall, the study focused on identifying how global preparedness is developed and how it could be enhanced with students under each identified way. The first study consisted of a Delphi study that led to the development of the construct of international education learning outcomes. The second study mapped the learning outcomes to educational practices, institutional characteristics, and student backgrounds. The final study analyzed the impacts of various international experiences across 14 engineering schools.

Data Collection

The data that was collected was under the aforementioned NSF grant. This grant utilizes two sets of data in the quantitative and qualitative form. The quantitative data that was collected derives from a grant-developed instrument that consists of 35 items from the Global Perspective Inventory (GPI). Additionally, demographic and international experience-related questions were asked. These questions were administered to freshmen through senior engineering students across the participating institutions from Spring 2016

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to Fall 2016. The demographic items included academic level (e.g., freshman or senior), gender (e.g., male or female), ethnicity (e.g., White, Asian, or underrepresented minority group), parents' educational background, type of location where the student was raised (e.g., urban, suburban, rural or small town), college GPA (if applicable) and second language fluency. The questionnaire would take approximately 7-9 minutes to complete but was dependent on the number of international experiences the student had. Students who agreed to participate in the study were given a $9.99 Amazon gift card.

Broader Impact

Enrollment and bachelor's degree attainment in engineering students is ever increasing by the year. Currently about 610,000 students enrolled within an engineering program, a 7% increase from the previous year, and approximately 99,000 students graduating with engineering degrees, a 6% increase from the previous year [27]. This growing population needs to develop not only the technical skills necessary for an engineer, but the knowledge and ability to utilize cross-cultural skills that will allow them to effectively work in diverse environments as career options are becoming increasingly internationalized. This thesis provides results into how intercultural wonderment is fostered through the different types of international experiences and how intercultural wonderment stimulates the potential for global learning outcomes. This study will provide university program administrators and faculty qualitative results which can aid in the development and implementation educational practices and experiences that can foster intercultural wonderment. Ultimately, the thesis aims to help university administration and faculty understand how international experiences can foster

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intercultural wonderment in order to increase student learning outcomes and methods that can be implored to facilitate intercultural wonderment in engineering students.

Organization of the Thesis

The organization of the thesis is as follows. Chapter 2 provides a literature background on all the critical ideas and areas that are discussed throughout the study. It includes four different sub-sections that are related to or pertaining to the importance of the global engineer, global perspectives, how intercultural wonderment was developed, and how intercultural wonderment is identified. Chapter 3 provides the methodology, analyses, and information regarding data reliability for the thesis. Chapters 4 and 5 provide the specific literature and background, implications, and results/discussion for the two main research questions. Chapter 6 summaries the research study and provides how this research contributes to literature. Lastly, Chapter 7 discusses the limitations that were present within the study and outlines potential future work.

<center>**Chapter 2**</center>

<center>**Literature Review**</center>

Importance of a Global Engineer

A global engineer has the ability to understand social, economic, political, and environmental conditions to create, adapt, and apply the appropriate solutions in a cultural context [28]. This demand of global engineers is becoming more prevalent as technology, economics, and world challenges continue to expand and grow. Creating global engineers not only helps create career competitive engineers, but engineers with greater abilities to tackle world challenges such as climate change, poverty, and global economics [28], [29]. Some important qualities found in a global engineer include: "(1) language and cultural skills, (2) teamwork and group dynamics skills, (3) knowledge of the business and engineering cultures of counterpart countries, and (4) knowledge of international variations in engineering education and practice" [30].

As our world is becoming more globally connected, there is a growing recognition by professionals and educational institutions that there is a need to develop engineers that have a global mindset [31]. From the professional sphere, the National Science Foundation, National Research Council, and National Academy of Engineering have urged engineering schools to enhance engineering curricula to better prepare engineers for the global workforce [1], [2], [4], [32]. Additionally, the Accreditation Board for Engineering and Technology (ABET) has instituted standards for engineering schools to incorporate a global element into the curriculum [2]. Under the new 2019-2020 ABET standards, institutions are required to demonstrate that their students can demonstrate "an ability to recognize ethical and professional responsibilities in

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engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts" [33]. Even though there exists the recognition and acceptance to create global engineers, there still exists a gap in practice in developing global engineers [34].

The world is constantly changing, and engineers need to be able to adapt and solve both reoccurring and unknown problems in these similar or new contexts. Taking action to develop the global engineer is especially important within the United States. English is the most wide-spread language on the globe [35], but this growing ability to communicate is impeded with the lack of geographical access and common interactions for many engineers. Through gaining exposure to other cultures and understanding the challenges the world is facing that US engineers can increase their "global perspectives" to becoming better global engineers.

What are Global Perspectives?

Terminologies, definitions, and frameworks. In order to create the global engineer, students need cross-cultural skills and global mindset development that allow them to successfully engage into a global work environment [29], [35], [36] researchers and educational institutions have used a variety of terminologies and definitions to characterize the concept of cross-cultural skills and global mindset development, including global competency [37], [38], intercultural competency [39]–[41], global preparedness [19], [42], [43], global perspective [20], and cultural intelligence [44], [45]. This differences often extend from the background of discipline, but overall, the necessary skills that would define the global engineer remain similar.

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These varying identifications relate to this global mindset and the development of global, international, and intercultural (GII) competencies [14]. Global competency requires an individual to have the knowledge, understanding, and communication skills to work in a global and multicultural environment [38]. Intercultural competency requires that an individual has the knowledge and skills necessary to be able to adapt and develop a cultural self-awareness and knowledge of other cultures [40]. Global preparedness is the "readiness to engage and effectively operate under uncertainty in different cultural contexts to address engineering problems" [19]. Cultural intelligence is the ability to understand and operate within culturally diverse settings within an emotional and cognitive level [45], [46]. All the definitions under this idea of GII focus on the individual developing the cognitive, emotional, and interpersonal demands to effectively engage and interact with other cultures.

Global perspectives deal with an individual developing a cognitive understanding about others, an identity and set of beliefs, and a sense of community with those that are culturally different [47]. It is the understanding and connection of one's life to the human condition that exists world-wide [48]. Increase efforts have been focused on international experiences, curricular, and co-curricular activities to improve student global perspective [20], [47], [48].

Universities are beginning more to focus on this importance of creating global engineers and instilling the global perspectives needed to act in diverse, cross-cultural settings. Although there is no definitive terminology in defining global perspectives and the cross-cultural skills, many professionals and university academics agree on the areas that are important for engineering work. Warnick's research (2011) found that employers

found global competency and skills are important qualities for engineers to have. Table 1 provides an overview of these key components that engineers were found to need to have to be successful in a global environment [49]. Jesiek et al. (2014) defined that technical coordination, understanding and negotiating engineering cultures, and a knowledge of the ethics, standards and regulations of different cultures were important areas of understanding for engineers in terms of global competence [9].

Table 1

Important global competency attributes that employers seek in engineers [49]

Global Competency Attributes
Exhibit a global mindset
Appreciate and understand different cultures
Demonstrate world and local knowledge
Communicate cross-culturally
Speak more than one language including English
Understand international business, law, and technical events
Live and work in a transnational engineering environment
Work in international teams

Another research study met with subject matter experts (SMEs) to determine what are the important areas for learning and how they are connected in order for engineering undergraduates to be successful in the workforce [19], [50] (Figure 3). For this thesis, the constructs within this semantic map are used and further discussed in Chapter 5. Overall, global perspectives and skills can benefit engineers to develop a different mindset to be more open to defining problems and solutions differently, and thereby helping them understand the values and perspectives of other cultures [8].

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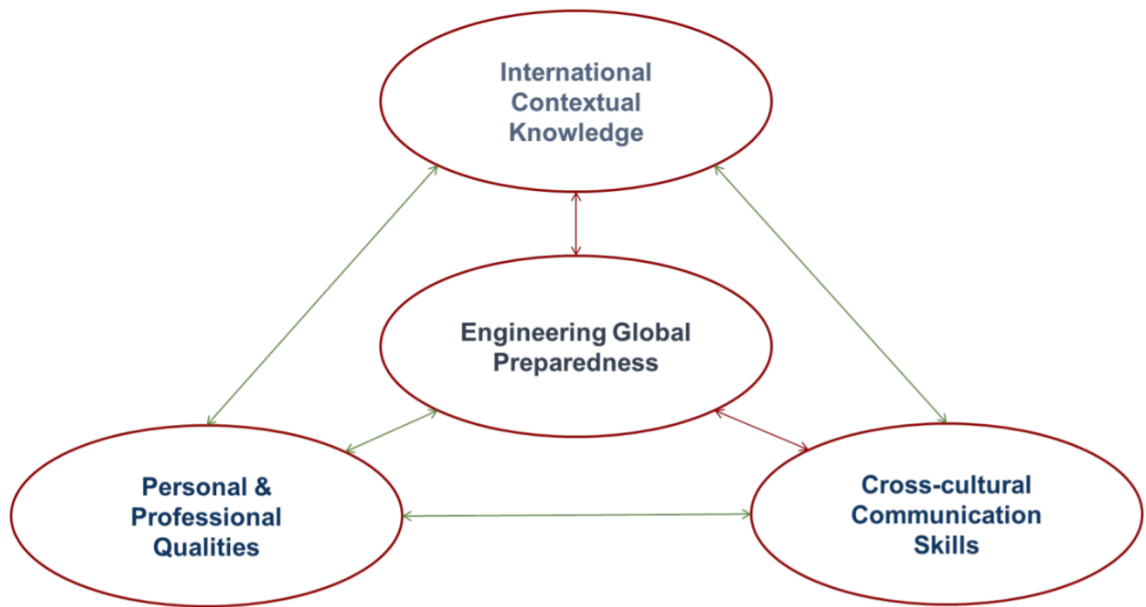
Figure 3. The global learning outcomes identified to be important for globally prepared engineers

Assessment and evaluation. One of the most common models to measure GII competency, and a basis for other cultural models, is Bennett's Development Model of Intercultural Sensitivity (DMIS), which generates a continuum that classifies individuals based on ethnocentric and ethnorelative perspectives [51]. Here, ethnocentric perspectives have an individual evaluate other cultures in relation to their own, whereas, ethnorelative the individual can see many values and behaviors as cultural rather than universal. There are six orientations on the spectrum that move from an ethnocentric to an enthnorelative perspective as the student were to gain intercultural competence: denial, defense/reversal, minimization, acceptance, adaption, and integration (Figure 4). The IDI was an instrument later developed to measure this continuum [17], [52].
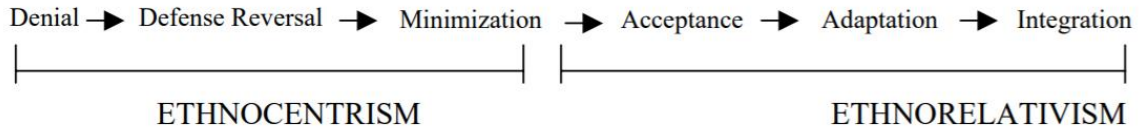
Figure 4. Development Model of Intercultural Sensitivity (DMIS)

Though the IDI is commonly seen, other alternatives that have been used to measure these global skills in engineers include the Miville-Guzman Universality-Diversity Scale (MGUD-S), Engineering Global Preparedness Index (EGPI), and Global Perspective Inventory (GPI) [18]–[20]. The MGUD-S has been used to determine an individual's level of awareness and acceptance for similarities and differences that exist between cultures [18]. The EGPI provides an index that analyzes how prepared students are for the global workforce and has previously been used within engineering [19]. The GPI measures global and holistic student learning and development through student experiences and perceptions of their campus environment [20].

There are many exist many definitions of global competency and the necessary skills and knowledge that are needed to create global engineers. For this study, the constructs on global perspective were used when discussing student development and will be further discussed in Chapter 5 [20].

What is Intercultural Wonderment?

Often, individual learning is generated from curiosity and meaningful experiences, which can shape personal development and perspectives. Particularly when students engage in an international experience, it is their underlying curiosity to seek out new experiences and ability to deal with the discomfort and disequilibrium where students may encounter the process of *intercultural wonderment*. Intercultural

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wonderment itself was based around the theories and literature of mindful wonderment [53], mindfulness [54], [55], cognitive disequilibrium spawned through encounters with difference [56], self-authorship and meaning making [57], and intercultural maturity [58]. Currently, there exists some literature on how the theories intercultural wonderment is based around may impact global perspective, but there exists little literature on the complete role of intercultural wonderment acting as the mediator in global perspective development.

Mindful wonderment. Mindful wonderment is the ability to see, hear and respond to new perspectives by remaining open and curious to new interactions and the ideas brought from them [53]. Through fostering mindful wonderment, an individual may be able to cultivate this curiosity about others and how to appropriately engage in another environment. Mindful wonderment then becomes a direct application within intercultural wonderment as an individual encounters cultures different than their own and develops some type of response to these engagements.

Research has shown that mindful wonderment can be used to better frame social justice within educational systems [53]. Here, mindful wonderment was used to develop the different levels of how social justice can be viewed in education. This skill can become translative across disciplines and is important for engineers. As engineering students enter their careers, the need for the development of mindful wonderment is crucial as they interact with individual who think, look, and act differently than themselves.

Mindfulness. Mindfulness is the process or state of being continuously aware where one may develop "novel distinctions" [55]. This is often achieved through

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awareness, openness and accepting new ideas in foreign contexts. Mindfulness promotes cognitive flexibility, concentration, and coping with high-stress environments, all important attributes for engineers [59]–[61]. Mindfulness was further found in engineering students to correlate with interpersonal skills in the form of confidence in business skills, another important characteristic for engineers [61].

Cognitive disequilibrium. Gurin et al. (2002) further discusses the importance disequilibrium during encounters with those who are different [56]. It allows individuals to have to understand the experience and potential challenges of the situation in relation with their own perspective leading to meaningful learning, interaction, and understanding of others who are racially or ethnically different. There has been literature that has shown that coursework that focuses on diversity promotes cognitive disequilibrium and that students have greater sense of well-being and orientations towards those that are different from themselves [62]. Through promoting cognitive disequilibrium, students can develop self-reflection that allows them to better accept and understand those that are different from themselves.

Self-authorship. Self-authorship is an individual's ability define themselves through their beliefs, relationships and identities that they have or create in their lives [57]. It was found to be contain three elements – trusting the internal voice, building an internal foundation, and securing internal commitments – where the student is taking ownership of themselves and creating and maintain these beliefs to create an identity unique to them [63], [64]. This is a critical component during a student's college career as they progress into adults [63], [64]. Students should be nurtured with experiences that foster self-authorship to draw out reflective experiences that better help them as adults

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[63], [64]. These experiences may exist in the form of international experiences, where students are encountering new opportunities and cultures different than their own. Outside engineering, there has been positive results through promotion and fostering self-authorship. When students in the liberal arts field were encouraged towards making internal connections and critical thinking, the students were found to have better self-authoring and positive life outcomes [63]. These concepts are translative across many disciplines and has the opportunity to positively affect engineering students.

In relation to intercultural wonderment, this becomes an important component because as individuals encounter the new experiences with other cultures, the outcomes from these engagements may cause the individual to develop different meanings about themselves. During engineering student's college careers, international experiences offer opportunities that stimulate self-reflection and self-authorship.

Intercultural maturity. Intercultural maturity is rooted in Bennett's intercultural sensitivity and Kegan's idea of self-authorship on how student's construct their lives from drawing on interpersonal, intrapersonal, and cognitive experiences [58]. It is "a multidimensional framework that describes how people become increasingly capable of understanding and acting in ways that are interculturally aware and appropriate"[58]. It focuses on how an individual progress in making meaning and utilizing intercultural skills when engaging with cultures that are different from their own [58], [65], [66].

During the growth of intercultural maturity, self-awareness and self-reflection are become important components. Students who often reflect on their interactions with other cultures move towards more complex levels of thinking in relation to their own ideas and how they view others as well as interact with other cultures [67]. Self-reflection allows

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for self-learning and when applied in a cultural setting generates greater level of cultural maturity; a construct important for engineers to have.

Identifying Intercultural Wonderment

   Areas of intercultural wonderment. During a longitudinal study, Engberg and Jourian (2015) assessed process-related variables, such as intercultural wonderment, on students who were studying abroad both pre- and post-departure. Reliability analysis and factor loadings were performed in relation to GPI for intercultural wonderment (α = .724) [22]. When identifying if intercultural wonderment is evident in students, the four questions were addressed:

1.   "How often does a student intentionally push themselves out of their comfort zone?"
2.   "How immersed is the student in the culture?"
3.   "Does the student attempt new habits and behaviors?"
4.   "Does the student engage with community individuals not from the classroom?"

   These questions relate to the four areas Engberg and Jourian (2015) define as intercultural wonderment: **comfort zone, immersion, habits and behaviors, and interaction** [22].

   Intercultural wonderment framework. There are many factors that come to impact a student's international experience. The students already have a pre-disposed identity, as well as the factors that are imposed on them by their home institution. When the student is an active participant in the international experience, curricular, co-curricular, and the community that is generated from the international experience are additionally major driving factors that impact this experience. These factors connect to fostering

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intercultural wonderment during an international experience, which in turn can lead to global outcomes. This adapted interpretation can be seen from Engberg and Jourian's (2015) conceptual framework (Figure 5) [22]. Understanding these experiences and how intercultural wonderment influences engineering students' global perspectives can assist in designing international experiences that foster high quality and meaningful interactions that foster strong cross-cultural skills.
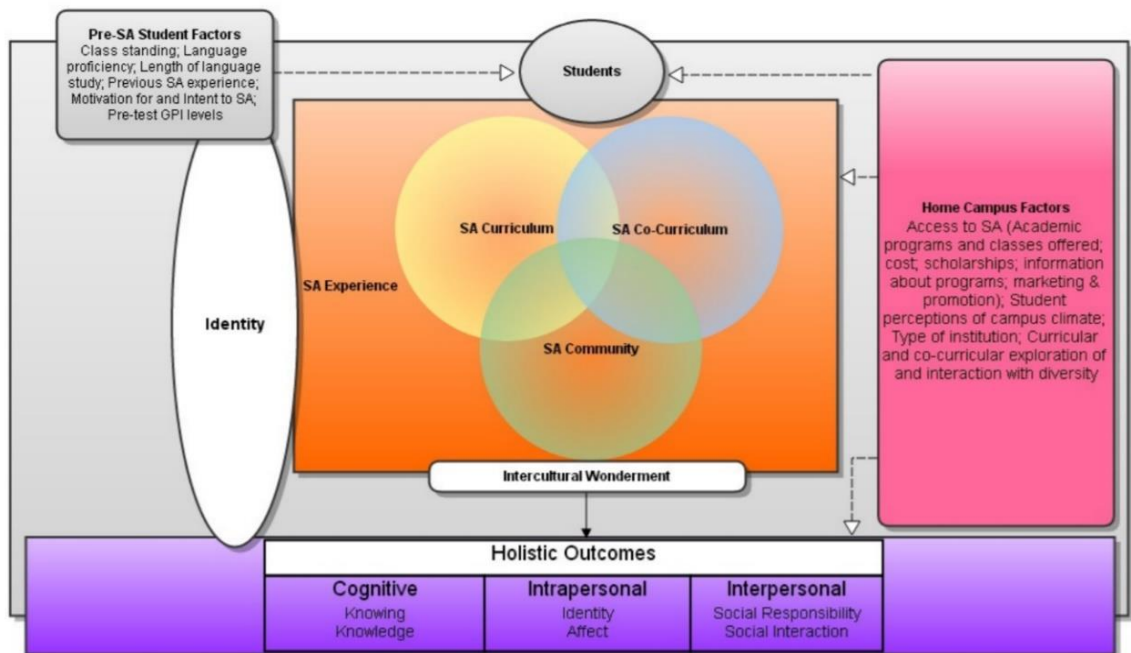
Figure 5. Conceptual framework from the Engberg and Jourian (2015) study [22]

Ultimately, Engberg, Jourian and Davidson (2016) describe intercultural wonderment to provide a crucial intermediary step in connecting an international experience's design and the global learning outcomes these experiences claim to address through their framework shown in Figure 6 [23].

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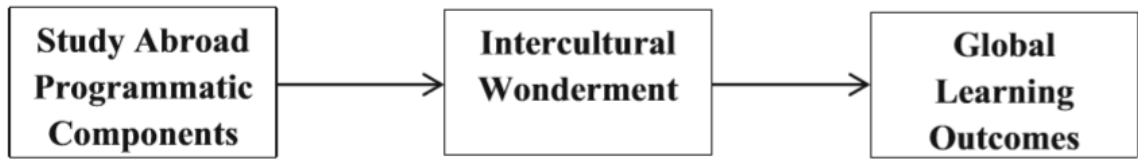
Figure 6. Conceptual framework conveying the intermediary role of intercultural wonderment [23]

A longitudinal study was conducted on 510 students who studied where the students were asked questions containing the GPI and pertaining to critical aspects of their study abroad experience. Among one of the critical aspect areas was intercultural wonderment whereas factor loading analysis was conducted. Table 2 provides the factor loadings and demonstrates intercultural wonderment is considered a factor during these experiences [22].

Table 2

Intercultural wonderment factor loadings

Intercultural Wonderment (α = 0.724)	Loading
How often did you intentionally push yourself out of your comfort zone?	0.747
How often did you feel immersed in the culture of the host country?	0.715
How often did you on your own explore new habits and behaviors while studying abroad?	0.713
How often did you interact with individuals from the host country outside of the classroom?	0.489

Intercultural wonderment was also found to have significant effects across all subdimensions of the GPI, indicating there may be a positive relationship between intercultural wonderment and it's impacts on a student's global perspective development

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[22], [23]. Previous studies have found international experiences to have this impact on global perspective development too [20]. Curricular, co-curricular, and community experiences were predictors of intercultural wonderment. These include developmental influence of faculty and staff, speaking host language inside/outside of the classroom, class assignments involving the community, classroom-based reflective activities, and sharing and discussing the international experiences with others [22]. By having educators and universities begin to understand how these programmatic components and influences, such as the international experience type, intercultural wonderment can be fostered in engineering students to improve their global perspectives and learning outcomes.

Chapter 3

Methods, Data Analysis, and Study Reliability

Data Collection and Participants

Data for the study collected from a partnership between four US universities (Mid-Atlantic, West Coast, Midwest, and Southeastern) that were collaborating on a National Science Foundation sponsored research initiative [19]. The data was collected both qualitatively and quantitatively through a Qualtrics survey sent out via email to engineering students who had at least one international experience and one-on-one interviews for students who indicated an interest for an interview. The survey prompted students to answer informative and demographic questions and the Global Perspective Inventory (GPI). The GPI was used when analyzing the connection between intercultural wonderment and global learning outcomes. Thus, details of the GPI and the analysis are described in Chapter 4. The informative and demographic questions were broken down into four areas: "profile characteristics (e.g., gender, age, class standing,), educational background (e.g., university, major, GPA), travel abroad/ international experiences (e.g., level of interest in international issues, foreign language proficiency), and characteristics of the international experiences (e.g., programmatic elements of experiences such as duration, amount of reflection, and comfort zone)." Follow-up emails were sent to the students requesting an interview.

A sample of 58 students responded to the email and were interviewed for the study. Table 3 provides demographics of the participants that were interviewed. The interviews were semi-structured and were conducted by trained researchers from each university on students who agreed to participate in the study and indicated they had

international experience. Supporting follow-up questions were added when further

student elaboration was necessary. The interviews aimed to identify and describe

emerging themes related to their international experience and global perspective

development not captured by the questionnaire.

Table 3

Descriptive Statistics - Demographic of engineering students interviewed

Gender	n
Male	20
Female	20
Ethnicity	**n**
White	22
Asian	9
Underrepresented minority	9
Academic Standing	**n**
Freshman	19
Mid-year	16
Senior	5
University Location	**n**
West-Coast	15
Mid-Atlantic	11
Southeastern	9
Midwest	5
International Experience Type	**N**
Recreational	23
Study Abroad	17

However, important interview questions asked are as follows:

1. Why did you choose to pursue your particular international experience?

2. During your [experience type], what aspects of it were most meaningful to you?

3. Can you describe a situation when you were in [location] when you met someone

   who had a very different cultural view than you?

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4. Did your [experience type] in [location] affect your thinking about the cultural relevance of engineering?

Data Analysis and Coding Protocol

Codebook development. A codebook was developed to help identify themes that exists between the experience types, intercultural wonderment, and learning outcomes. When generating the codebook, interviews were holistically reviewed with an *a priori coding* scheme from Besterfield-Sacre et al. (2013) around the following research questions [25]:

1. How is intercultural wonderment manifested through international experiences?

2. Which types of international experiences facilitate intercultural wonderment?

Training between two researcher coders was conducted on four interviews. An inductive, iterative coding protocol was employed on these four interviews to further refine coding definitions and allow additional themes to emerge not previously addressed within the codebook. One important emerging theme was "culture shock" and was added under intercultural wonderment. Often, students conveyed valuable experiences that were not thought to fall under any of the aforementioned areas of intercultural wonderment. There were many cases where students expressed disorientation by something they did or saw that caused some level of self-reflection. The descriptions of the situations were not addressed by the four areas previously defined. For this reason, and for the study to fully encapsulate all the meaningful experiences of the students, the area of *culture shock* was included by the authors under the concept of intercultural wonderment. Culture shock offer a complexity to cause disequilibrium within the student that causes them to challenge their identity and social understandings [22].

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Culture shock. Culture shock can be explained as the demand for adjustment by an individual to a new cultural setting caused by a new society's cultural values, beliefs, behaviors or norms [68], [69]. It stems from an intercultural encounter that causes confusion, surprise, or anxiety that can both occur within a society's own diverse culture or through traveling to another [70]–[72]. The outcomes from this contact can have either positive or negative impacts on the individual that results in changes to the individual's cognitive, interpersonal, or intrapersonal self [73], [74]. The experience of culture shock can be a very interactive and emotional experience for the individual.

Ultimately, the relationship between culture shock and the individual has the opportunity to lead to cultural learning [71], [73]. This idea of cultural learning is described by Ward et al. (2005, pg. 51) as "the process whereby sojourners acquire culturally relevant social knowledge and skills in order to survive and thrive in their new society" [73]. They individual begins to reflect on the situation within the foreign culture that allows for flexibility and an understanding of the new environment. It can lead to changes in how the individual communicates, views, and acts towards the culture.

Previous studies have shown that culture shock may make students feel anxious, nervous, or even excited [75], [76]. Whether the emotions or views are positive or negative, ultimately most students exhibited an adjustment through reflection and cultural understanding that led them to become acclimated and better understand the culture. However, with the adjustments, the students still maintained their own cultural norms.

Inter-rater reliability. The process of inter-rater reliability was assessed through two graduate researchers. Re-coding was initially performed on the training interviews during each iteration of the codebook to ensure this coding reliability and agreement. The

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codebook went through ten iterations before being finalized. The final codebook for this study contained the main categories of Intercultural Wonderment and Global Learning Outcomes. The subcategories for Intercultural Wonderment were defined as Immersion, Interaction, Comfort Zone, Habits and Behaviors, and Culture Shock. The subcategories for Global Learning Outcomes were defined as Cross-Cultural Communication Skills and Strategies (CCSS), Global Engineering Preparedness (GEP), International Contextual Knowledge (ICK), and Personal and Professional Development (PPD).

Cohen's kappa was initially used to measure the inter-rater reliability, but the researchers' goals of kappa levels indicating moderate or greater agreement were never reached. As a result, both graduate researchers coded all interviews using the final coding protocol and codebook for inter-rater purposes.

The researchers met twice a week to discuss the interviews that were coded in accordance to a schedule that was developed. Agreements and disagreements were both discussed to ensure the most relevant code was selected for the transcribed interview. Agreements required a review to ensure a double-check accuracy, and disagreements would require deliberation amongst the two researchers until a coding agreement could be reached. Faculty arbitration was implemented where necessary. These unresolved disputes would be moderated and finalized by the graduate advisor. The process had a total of 3 disputes that could not be agreed upon and were reviewed by the advisor. Walther's framework was additional implored to enhance data and process reliability.

Codebook. Table 4 provides the codebook that was used during the coding of all the interviews for "Intercultural wonderment." It was developed with an *a priori* scheme

based around the areas of intercultural wonderment from Engberg and Jourian (2016)

[23].

Table 4

Codebook for Intercultural Wonderment

Category	Sub-category	Definition
Intercultural Wonderment (During the international experience, the student expresses a curiosity and active mindset to engage and immerse themselves in another culture foreign from their own) (Engberg and Jourian, 2015; Engberg, 2016)	Immersion	The student indicated that they felt that they were actively engaged in the host country and culture.
	Habits and Behaviors	The student indicated that they tried or explored new habits and behaviors.
	Comfort Zone	The student conveyed that they pushed themselves or were pushed out of their comfort zone in some situation.
	Interaction	The student indicated they interacted with host members or community members
	Culture Shock	The student experience cognitive disequilibrium with the foreign culture but an active mindset to understand the situation.

Table 5 provides the codebook that was used during the coding of all the interviews for "Student Learning Outcomes." It was developed with an *a priori* scheme based around the areas of learning outcomes from Besterfield-Sacre et al. (2013) [25]. The codebook for "Intercultural Wonderment" was also used in conjunction to the intercultural wonderment codebook portion to develop the full codebook. For the development of the codebook, 11 iterations were utilized until its final development.

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Table 5

Codebook for global student learning outcomes

Category	Sub-category	Definition
	Cross-cultural communication skills and strategies (CCCSS)	The student indicated improvement in their ability to communicate or work with another culture. 1. Proficiency in using another language to interact with another culture 2. Ability to work as a member or leader in cross-cultural teams 3. Awareness and acceptance of diversity across cultures 4. Acknowledgement of difference of others 5. Ability to effectively adapt to and integrate into different cultural environments 6. Ability to interact with engineers and/or others from different cultures
Student Learning Outcomes [25], [42]	Global Engineering Preparedness (GEP)	Ability to define and solve engineering problems within another cultural context. 1. Knowledge of engineering and business practices 2. Understanding the importance of global collaboration in engineering 3. Awareness of the relationship between culture and engineering practice (i.e ethical or technical standards) 4. Ability to understand their career as impacted by global engineering practices

Table 5 (continued)

Codebook for global student learning outcomes

Category	Sub-category	Definition
	Personal and Professional Qualities (PPQ)	The student indicated improvements in personal or professional characteristics. 1. Self-efficacy/Can-do Attitude 2. Cultural Self-Awareness 3. Open, Positive Attitude 4. Flexibility, Adaptability 5. Creativity
Student Learning Outcomes [25], [42]	International Contextual Knowledge (ICK)	The student indicated a greater sense or improvement in cultural or global knowledge. 1. Increased awareness of global and/or cultural topics 2. Ability to see the bigger picture 3. Appreciation of service learning

Walther's Qualitative Research Analysis Framework. The qualitative research analysis framework provides research studies with a way to "develop and demonstrate overall research quality in the interpretive inquiry by shifting attention away from assessing the research quality of a final product" [77]. Table 6 provides the validation and reliability checks along with their descriptions incorporated under the framework.

Table 6

The constructs and descriptions for Walther's validation and reliability assessment for data

Construct	Description
Theoretical Validation	"the fit between the social reality under investigation and the theory generated"
Procedural validation	"features of the research design that inherently improve the fit between the reality studied and the theory generated"
Communicative Validation	"the integrity of the interlocking processes of social construction with the relevant communication communities"
Pragmatic Validation	"the compatibility of theoretical constructs with empirical reality"
Process Reliability	"the mitigation of random influences on the research process"

This framework was used whenever it could to ensure that the data collected was accurately and appropriately represented within the study design [77], [78]. Applications of the framework can be found in Table 7.

Table 7

Representation of how Walther's qualitative research analysis framework was utilized within the thesis

Description	Handling the Data
Theoretical Validation	• A codebook was created that aligned with current theories in intercultural wonderment and global learning • International experiences, intercultural wonderment and global learning/perspectives were studied to understand thesis outcomes
Procedural validation	• Two graduate researchers coded each interview and discussed all disagreements with the advisor solving any unresolved disputes • All revisions of the codebook along with interview codings were tracked
Communicative Validation	• Graduate researchers would meet in person to discuss each interview and codes • Each disagreement was resolved and agreed upon by the researchers
Pragmatic Validation	• Themes of fostering intercultural wonderment and as a mediator to global outcomes are investigated for engineering students
Process Reliability	• Each researcher kept all original coded materials with finals codings files created when the researchers met • All codes, coded materials, and changes to codes were discussed by all researchers and faculty advisor (when arbitration necessary) and tracked

Chapter 4

The Relationships Between International Experiences and Intercultural

Wonderment

The objective of this study was to analyze the relationship between programmatic components of international experiences and intercultural wonderment. Programmatic components can include factors such as program duration, cultural immersion opportunities, intercultural engagement and learning, and reflective practice [79]. The framework shown in Figure 7 from the Engberg and Jourian (2016) study was used to explore how engineering students engage with other cultures within recreational and study abroad international experiences and how these experiences can foster intercultural wonderment [23]. These experiences will be discussed in more detail in the section that follows.
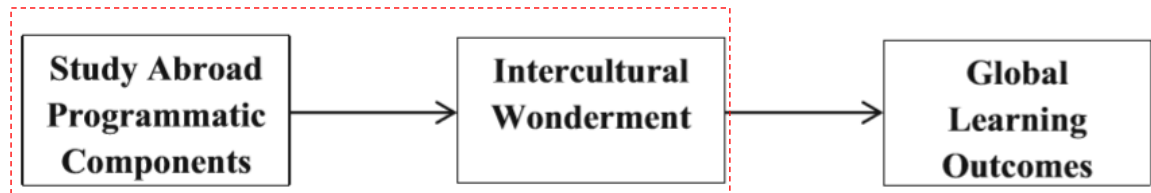
Figure 7. Conceptual framework conveying the intermediary role of intercultural wonderment and focus of the first study [23].

Data was gathered across a multi-institutional study where students provided background information through a survey and further discussed their international experiences though a follow-up semi-structured interview. Interviews were coded to identify instances of intercultural wonderment. Interview coding allowed connections and themes to be developed that demonstrated how intercultural wonderment was fostered

within each of the international experiences types to answer the following research questions:

1. How is intercultural wonderment manifested through international experiences?
2. Which types of international experiences facilitate intercultural wonderment?

Background Literature

Importance of International Experiences. There is a need for engineering students to develop their global perspective as the world is becoming more culturally diverse in the professional environment. International experiences (like study abroad) are common strategies that provide students with the opportunity to develop global perspectives. One opportunity for universities is to promote engineering students towards having some type of international experience. While study abroad has been the most common type of program for engineering students seeking international experiences, there are numerous other options (curricular and otherwise) for engineering students to develop global perspectives [8], [13]–[15]. Based on the current literature, two common international experiences of study abroad and recreational were identified. The experiences that the engineering students participated on did have variation, so there were groupings based on large similarities from literature to define the overall international experience. These groupings as well as their definitions are outlined in Table 8.

Table 8

Comparison of Recreational and Study Abroad Descriptions

Program Models [8], [13]–[15]	Description
Study Abroad Experience • Faculty led short term with course component – typically 10 to 14 days travel • Faculty led short term – typically 10 to 14 days • Short term study abroad – typically 1 to 3 months • Long term study abroad – typically 3 months to a year	Participation in a study abroad or academic exchange through a university or some other generic study abroad program.
Recreational Experience • Vacation • Summer camp or activity • School activity	Participation abroad that comes from vacation, living, or general travel to other countries.

Study abroad. As the demand to increase student accessibility to having an international experience increases, the number of study abroad opportunities has also been increasing. There are academic year long trips, semester long trips (6- to 12-week programs), short term study trips (7- to 28-days) [8], [21], [80], [81]. There are many features that can define short-term programs. They can exist in the form of an integrated class experiences where students have a component of the class taken at the home university in addition to a travel component, studies during summer of winter breaks, and can involve homestays during the experience [82]. These programs can be arranged either through the home university and their partnerships or through external programs [80]. Ultimately, the key component being used to identify study abroad programs are a conjunction of a classroom and international travel components that a student is participating in.

Recreational. Personal travel offers students an opportunity to travel abroad individually or with friends and family [16]. Students who often go through this experience type mainly enter this experience with the intention of having fun and engaging with a new culture; however, new knowledge is often learned about the foreign culture during this experience abroad [16]. During these experiences, the students are traveling to these countries for personal reasons. They may be going on vacation, hiking, or attending religious camps that are not a part of affiliated with the university. Most of these personal experiences abroad typically take place either before the student attends the college or following their university experience [16].

Intercultural wonderment in international experiences. International experiences provide students with an opportunity that may allow them to reflect on their own culture as well as on another culture. There exists research that focuses on how international experiences should be intentionally designed for students to achieve the greatest level of global learning [8], [9], [15]. However, outside of the international curricular and activity implementation, there exists opportunities for students to learn through intercultural wonderment. This process "encapsulates a number of 'provocative moments' in which students are intentionally moving outside their comfort zones and exploring new relationships, contexts, values, and perspectives that concomitantly stimulate growth and development" [22].

Ultimately, intercultural wonderment is derived from student curiosity and the meaningful engagement that can occur during international experiences either intentionally or serendipitously. Research from Engberg and Jourian (2015) has shown the following areas may have an impact on fostering intercultural wonderment:

Immersion, Interaction, Comfort Zone, Habits and Behaviors, and Culture Shock [22], [23]. These ask the questions of how immersed the student feels in a culture, how often do they interact with the culture, how often do they push themselves out of their comfort zone, and how often does the student engage in a new habit or behavior. When assessing intercultural wonderment, Engberg and Jourian (2015) found that there were significant increases in GPI scores [22].

Therefore, intercultural wonderment may provide a crucial intermediary step in connecting an international experience's design and the global learning outcomes these experiences claim to address through their framework shown in Figure 7 [22]. Engineering educators should understand how different international program types (and their design) foster intercultural wonderment. Ultimately, this should be used to help international program administrators and faculty to design international experiences in a manner that leverages the opportunities for intercultural wonderment.

Results and Discussion

Figure 8 and 9 provide the frequency of student intercultural wonderment within each experience type and the normalized values of intercultural wonderment per student that occurred within each international experience. This normalized value was used to be able to compare intercultural wonderment frequencies between experience types since not all experience types had the same number of students. This value was found by dividing the total number of intercultural wonderment occurrences by the number of students in each experience type. The results show that all intercultural wonderment can be found on recreational and study abroad experiences. The two experiences allow the students to engage daily with a foreign culture where they are "able to look back and reflect upon the

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country they left, experiencing it from a different place and point of view" [83]. When looking at their frequencies, it was found that the intercultural wonderment was found to be present the most and similar in in ratio magnitude under interaction, but that students who had recreational experiences were often less likely to expressed intercultural wonderment as culture shock or comfort zone, but more likely in the form of immersion (Figure 9).
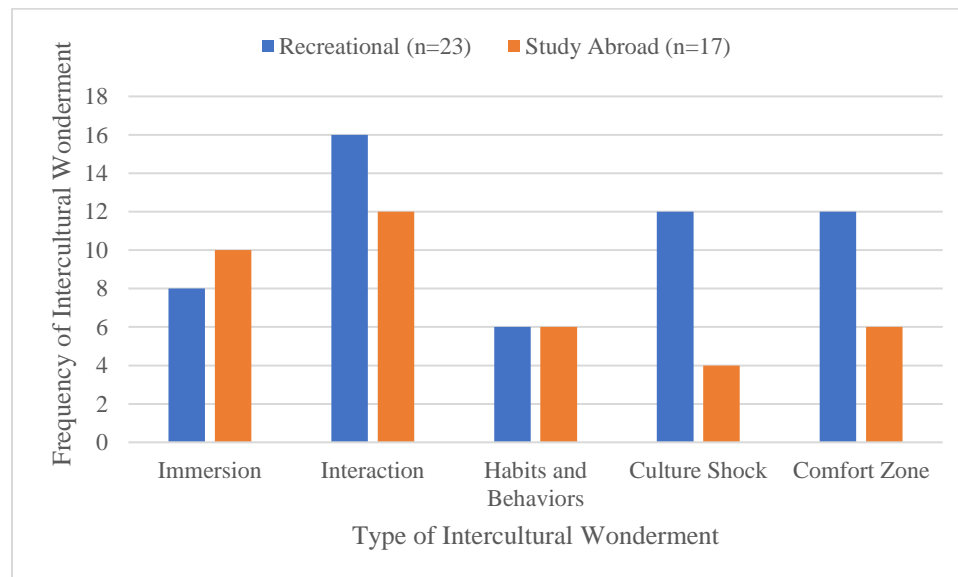
Figure 8. Frequencies of intercultural wonderment for each experience type
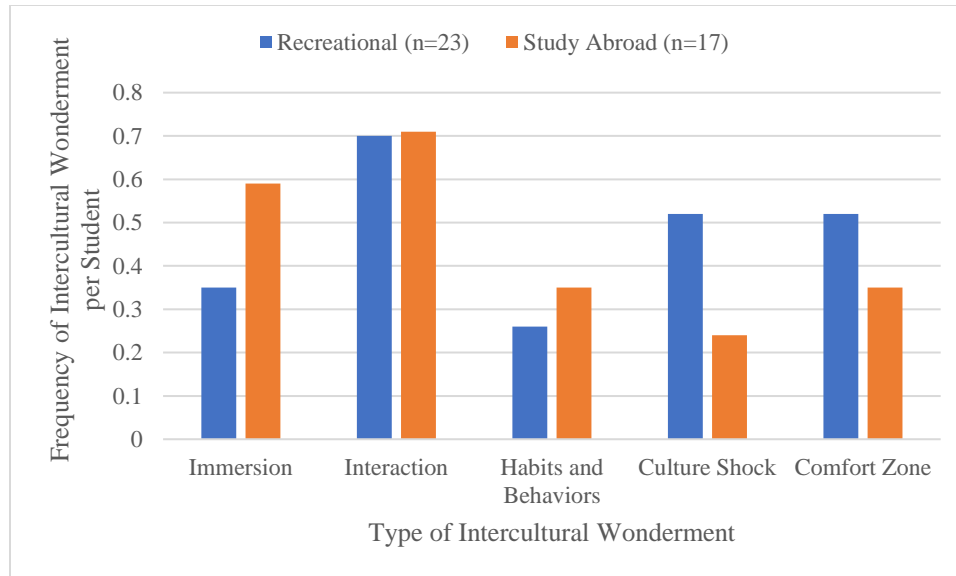
Figure 9. Frequencies of intercultural wonderment per student for each experience type

Recreational. Recreational experiences are found to provide an opportunity for diverse engagements with another culture. Due to the nature of recreational experiences, the students will have the ability to interact with another culture, be pushed out of their comfort zone, witness something that may surprise them, try something new, or even have a feeling of being immersed.

It can be seen that recreational experiences allow for opportunity in all intercultural wonderment areas, but the greatest potential for intercultural wonderment to occur may be through interactions with the other culture. As highlighted, more than 50% of the students expressed intercultural wonderment as an interaction (Table 9) with some students demonstrating more than one interaction (Table 10). Student 22 provided context that they had two meaningful interactions that led to intercultural wonderment (Table 10).

Table 9

Truth table for intercultural wonderment during recreational experiences

Student	Interaction	Culture Shock	Comfort Zone	Immersion	Habits and Behaviors
3	Yes	No	No	No	Yes
4	Yes	No	No	No	No
5	No	Yes	No	No	No
6	Yes	No	No	No	No
7	No	Yes	No	Yes	Yes
8	No	No	No	Yes	No
9	No	Yes	No	No	No
10	No	No	No	No	No
11	Yes	Yes	No	Yes	No
12	Yes	No	Yes	Yes	Yes
13	Yes	No	Yes	No	No
14	Yes	Yes	Yes	Yes	Yes
15	Yes	No	Yes	No	No
16	No	Yes	No	No	No
17	No	No	Yes	No	No
18	No	No	No	No	No
19	No	No	Yes	No	No
20	Yes	No	No	Yes	No
21	Yes	No	Yes	No	No
22	Yes	Yes	Yes	No	Yes
23	Yes	Yes	No	Yes	No
24	No	No	No	No	No
25	No	No	Yes	No	No
Total	12/23 (52%)	8/23 (35%)	9/23 (39%)	7/23 (30%)	5/23 (22%)

Table 10

Counts of intercultural wonderment for each student on recreational experiences

Student	Interaction	Culture Shock	Comfort Zone	Immersion	Habits and Behaviors	Total
3	1	0	0	0	1	2
4	1	0	0	0	0	1
5	0	2	0	0	0	2
6	1	0	0	0	0	1
7	0	2	1	1	2	6
8	0	0	0	1	0	1
9	0	1	0	0	0	1
10	0	0	0	0	0	0
11	1	2	0	1	0	4
12	1	0	1	1	1	4
13	1	0	1	0	0	2
14	1	1	1	2	1	6
15	3	0	2	0	0	5
16	0	1	0	0	0	1
17	0	0	1	0	0	1
18	0	0	0	0	0	0
19	0	0	1	0	0	1
20	1	0	0	1	0	2
21	2	0	2	0	0	4
22	2	1	2	0	1	6
23	1	1	0	1	0	3
24	0	0	0	0	0	0
25	0	0	1	0	0	1
Total	16	12	12	8	6	54

Student 22 went on a four-week trip to Egypt with their family. When asked about a meaningful interaction they remembered, they responded,

I remember like being in a car and somebody like wiped the window with a really dirty rag and it made the window dirtier. I like didn't really have any, it's just like custom that you're supposed to give some money and so I didn't really have anything except for like a large bill and so I had to give it. He was very, very thankful and kept saying, just like repeating like thanks and like there's like a phrase that means "the sun will shine on you" or something like that. So it was just like a good interaction. It was very just like surprising. I didn't expect it you know.

-Student 22

They discussed how small interactions like these, gave them a better understanding of other cultures' lifestyles and a comfortability to interact with others, regardless of how they may look.

Additionally, when compared against study abroad, students demonstrated intercultural wonderment more often in the area of culture shock (Figure 9). Student 7 went on a trip to visit family in Columbia over the holidays. They found it very interesting how family-driven the culture was as opposed to the culture in the United States. The student remarked,

I was surprised that they put so much emphasis on tradition and family life… So it just really amazes me how everything is centered on tradition and family there.

-Student 7

The student is assimilated to the United States family culture, where simple interactions together are less common, such as sitting down for family meals [84]. The

student consistently discussed how they were surprised by the religious aspect of life in Columbia and how much that play a role in the importance of family interactions and tradition. These ideas are often more prevalent in Hispanic cultures [85], [86], so the student remarked these to be interesting engagements.

Comfort zone was also an area of intercultural wonderment that was often more present in recreational experiences. Student 21 describes how an experience helped them grow personally and understand a country's current circumstance. During their time in Greece, the country was in political distress. They described a time where they were taking a train with their grandparents and got separated in Athens following political demonstrations. Student 21 explained the situation:

And I turned and I was all alone and I'm like on the train… And I was just—I was—I'm in shock, right? I'm what? How old was I? Maybe 17? 16? 16 years-old, and I'm on Greek train by myself in an area that's having political distress, so I was kind of freaking out.

-Student 21

Anecdotally, recreational experiences are conventionally thought to have little value in developing global perspectives as compared to academic programs. But, within these student cases, the students showed growth and understanding. Although less formal in education structure, recreational experiences can stimulate a journey of self-discovery and reflection through the experiences that the individual has [87], [88]. The greater informality in the opportunity allows the individual to structure, tailor, and understand their international experience in a way that is meaningful to them through their engagements with the foreign culture.

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The current study found that recreational experiences offer students many opportunities to engage with another culture. There exists potential for intercultural wonderment to be fostered through interaction, immersion, culture shock, comfort zone, and habits and behaviors. There is an indication that the greatest potential for intercultural wonderment may be through interactions that are created during the experience. A profile of student experiences abroad indicated that students who would recreationally travel abroad described their increase in cultural aptitude to be through the interactions that they had during their experiences [16].

Study abroad. Study abroad experiences provided engineering students to experience the culture while having an educational component. These programs to study abroad vary in duration and can be structured to run between 2 weeks or even for a full academic year [21]. However, there are increased efforts towards short-term programs in engineering because of their ability to accommodate the barriers of study abroad for engineering students [15], [81], [89]. Many of the students from this study took part in short-term study abroad experiences lasting a few weeks.

The results from the study show that study abroad experiences can greatly vary in the opportunities that exist during the experience and offer the opportunity for students to encounter intercultural wonderment in any intercultural wonderment area. The results from the study abroad experiences indicate that there exists the greatest opportunity for fostering intercultural wonderment was interaction, immersion, and habits and behaviors (Table 11). Overall, only three students did not experience intercultural in one of the areas. Additionally, 10 of the 17 students experienced intercultural wonderment more than once (Table 12).

Table 11

Counts of intercultural wonderment for each student on study abroad experiences

Student	Interaction	Culture Shock	Comfort Zone	Immersion	Habits and Behaviors
31	1	0	0	0	0
32	0	0	0	0	0
33	2	1	0	1	0
34	1	0	0	0	0
35	0	0	0	0	1
36	2	0	1	0	1
37	3	1	0	1	1
38	2	0	0	0	0
39	0	0	0	0	0
40	0	1	1	2	0
41	1	0	0	2	0
42	0	0	0	0	0
43	0	0	0	1	1
44	0	0	2	2	0
45	0	0	0	1	1
46	0	0	2	0	1
47	0	1	0	0	0
Total	12	4	6	10	6

Table 12

Truth table for intercultural wonderment during study abroad experiences

Student	Interaction	Culture Shock	Comfort Zone	Immersion	Habits and Behaviors
31	Yes	No	No	No	No
32	No	No	No	No	No
33	Yes	Yes	No	Yes	No
34	Yes	No	No	No	No
35	No	No	No	No	Yes
36	Yes	No	Yes	No	Yes
37	Yes	Yes	No	Yes	Yes
38	Yes	No	No	No	No
39	No	No	No	No	No
40	No	Yes	Yes	Yes	No
41	Yes	No	No	Yes	No
42	No	No	No	No	No
43	No	No	No	Yes	Yes
44	No	No	Yes	Yes	No
45	No	No	No	Yes	Yes
46	No	No	Yes	No	Yes
47	No	Yes	No	No	No
Total	7/17 (41%)	4/17 (24%)	4/17 (24%)	7/17 (41%)	6/17 (35%)

During Student 33's study abroad experience, their group trip balanced the time between tours of manufacturing plants or office and lessons at the Vietnamese school. The student remarked on how the university had students enrolled there take them around during the times they were free to see the city and experience life in Vietnam. They commented,

The students kind of made the trip for me. They – on the very first night, all these students that went to the university, they took us out on their motorbikes and they took us, toured all around the city, and that's pretty much how the trip went for two weeks… But that – I mean, that's really what made the experience for me was to be able to meet those kids, and for them to show me their style of life.

-Student 33

The student remarked how these interactions helped them to interact with all peers coming back to their institution and allowed them to engage in many aspects to the Vietnamese culture that would not have been as likely without these personal interactions.

Additionally, immersion was noticed to be another area of intercultural wonderment that can more often be seen to occur in study abroad than recreational. Student 40 described how during their time studying abroad in Korean, they felt at one point they were living as their fellow Korean students were. This allowed to reflect and gain a better understanding and interact with the culture. They stated,

They took us out to dinner every night. Food is a huge part of Korean culture, I learned. Here you make a business deal over golf. There, you make it over dinner. The sharing

culture was very interesting where you're constantly passing bowls back and forth. This was a moment where I felt like we were doing it exactly as the Korean students were and we felt like we were a part of the culture. Also, the guy at the convenience store next door loved us because we went every morning to get coffee and water, so we got to know him really well by the end of two weeks of staying at the hotel next door to him.

<div align="center">

-Student 40

</div>

This was a common theme that foreign institutions would often provide students to engage with the American students. These opportunities seem to provide great value and often stimulated some form of intercultural wonderment.

For the students of the habits and the behaviors intercultural wonderment, the students generally discussed two areas: language and sustainability. These topics are related to the areas of social and academic – two areas that were found to be the largest motivators for students to study abroad [90], [91]. Students discussed either how they felt there was an importance to continue a new language. Generally, this was the language inherent to the culture of the country they had their experience. The other students discussed how the experiences impacted their views towards the concept of sustainability. The engineering students often expressed initiatives of continuing sustainability efforts when they would return to the United States.

Most of these students visited countries in the European union. Typically, these countries are more culturally more invested in sustainable research and energy conscious efforts than the United States [92]. During some of the engineering student's study abroad experiences, this was often noticeable for them. The culture influenced them to be

more conscious about waste and the amount of energy that they use daily. Particularly, Student 35 reflected,

I was constantly being reminded to turn off the lights and I was really bad about that, and I think it stuck with me. They'd occasionally say 'turn off the light' and whatever and there's 'turn off turn off turn off' and 'if you're not using it,' 'Turn it off' which makes perfect sense and I think that stuck with me.

- Student 35

Additionally, Student 46 became more aware of how riding your bike everyday can help reduce carbon emissions for a more sustainable planet. In Europe, the student noticed this was a very common form of transportation and had a self-reflection that caused them to build this activity into their own life as a more common form of travel. The student describes their change in lifestyle in the following comments:

But I think it's the little things that really were different… You know, I ride my bike to class nowadays instead of driving my car, because when I was in Germany everybody rode their bike to school. It's really just very subtle differences I think which kind of come together.

- Student 46

Ultimately, the results from the study abroad experiences indicate that this experience provide students with many different opportunities within a culture that can lead to intercultural wonderment. Study abroad/short-term programs can provide students "exposure to the values, beliefs, and behaviors of people in the host country" where there can be the facilitation by trip advisors to generate meaningful contacts [81]. This can be through interactions with the host culture, introducing new and unique cultural

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experiences, or through challenging them to understand the other culture in situations that may or may not be stressful or uncomfortable [93], [94]. Overall, as study abroad experiences are becoming more utilized in engineering education, the results demonstrate great opportunity in fostering intercultural wonderment.

Implications and Conclusion

The study provides insights on recreational and study abroad experiences and intercultural wonderment. There are benefits and opportunities that exist within recreational and study abroad experiences. Both experiences offer the opportunity for intercultural wonderment to be fostered in all five areas of intercultural wonderment.

The study found that both recreational and study abroad offer the most opportunity for fostering intercultural wonderment in the area of interaction. During recreational experiences, the students often described how they had to engage and interact with the host culture daily as they and their families progressed through their trip. Whereas, during study abroad experiences, the students did have similar opportunities to interact, but the structured format of the study abroad experiences had the students express interactions through excursions that may have stemmed from the program structure (i.e. student guides).

When comparing the two international experiences, the study suggests that recreational experiences may offer more value in fostering comfort zone and culture shock. This may be due to the decreased level of formality that stems from tourism as opposed to the more structured formats of study abroad. On the other hand, study abroad may offer more value in fostering intercultural wonderment in the form of habits and behaviors and immersion. Additionally, there is evidence to support that recreational

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experiences may offer value in fostering intercultural wonderment. These findings

oppose some previous anecdotal conjectures that they provide little value towards global

learning.

Chapter 5

Intercultural Wonderment and Learning Outcomes

Introduction

The objective of this study was to analyze the relationship between intercultural wonderment and the global learning outcomes expressed by the students as well as through Braskamp's Global Perspective Inventory (GPI) [20]. As aforementioned, intercultural wonderment is an individual's underlying curiosity to seek out new experiences and ability to deal with the discomfort and disequilibrium. Global learning was measured qualitatively through the interviews with an *a priori* coding schema based on the global preparedness model developed by Besterfield-Sacre et al. (2013) [25]. Theses outcomes are: Cross-Cultural Communication Skills and Strategies, Global Engineering Preparedness, International Contextual Knowledge, and Personal and Professional Skills. Global perspectives were measured using the GPI which measures holistic and global learning development through student perspectives and experiences. It includes the three main scales of cognitive, intrapersonal and interpersonal. A non-parametric analysis was run using a Whitney-Mann U-test to assess statistical significance between experience type and GPI scores.

Data was collected across a multi-institutional study where students provided background information through a survey and further discuss their international experiences through an interview. Interviews were coded to identify student intercultural wonderment and the global engineer learning outcomes obtained. Interview coding allowed connections and themes to be developed that related the five different types of

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intercultural wonderment to the global learning outcomes in order to answer the following research question:

1. What is the role of intercultural wonderment in fostering global perspective development in engineering students?

Figure 10 provides a representation of the study focus in relation to Engberg et al.'s framework on the intermediary role of intercultural wonderment [23].
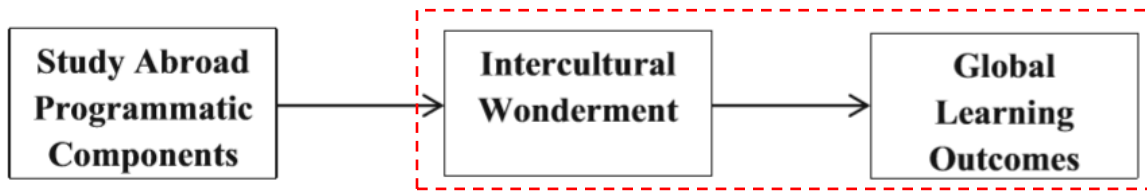
Figure 10. Conceptual framework conveying the intermediary role of intercultural wonderment and focus of the second study

Background Literature

  The global learning outcomes. The global learning outcomes that were decided to be used incorporate all areas that reflect important areas for engineering undergraduates as a global engineer. The main categories used were used from a previous study by Besterfield-Sacre et al. (2013) [25]. They are defined as Cross-Cultural Communication Skills and Strategies, Global Engineering Preparedness, International Contextual Knowledge, and Personal and Professional Skills from a Delphi study that was conducted. The Delphi method that was implored utilized engineering education experts from the field in a four-phase methodology. In the first portion, subject-matter experts (SMEs) were asked to identify main attributes of a global engineer and the necessary learning experiences. This was then used to create a questionnaire for the

SMEs to better identify similar and opposing ideas. The SMEs were then asked to provide additional input over the course of a two-day summit where the experts consult and decide how the factors developed overlapped. This was first done individually, and then as a group. This was summit was facilitated by Dr. Darla Deardorff and resulted in a model demonstrating the interrelationships between all the learning outcomes as shown in Figure 11.
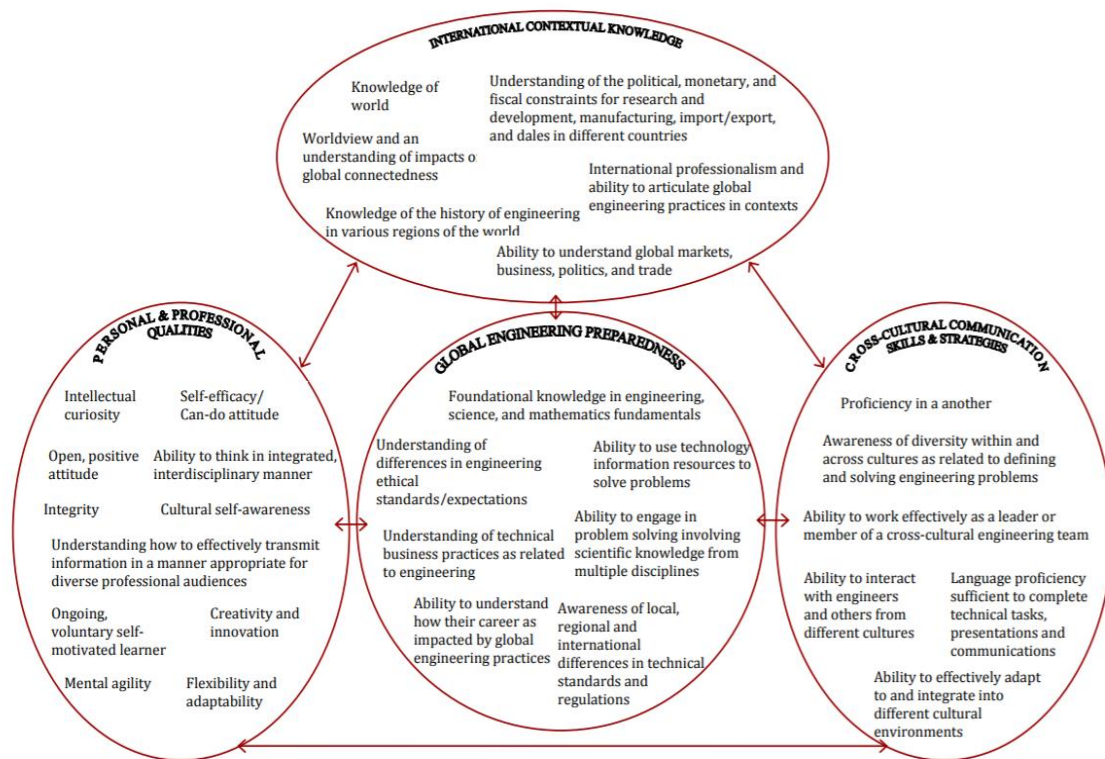
Figure 11. Framework of global learning outcomes and associated traits for each outcome

Developing global learning skills. As there is an increase in globalization, the increase in demand for engineers to develop the skills and abilities to understand and handle varying cultural situations is becoming ever more important. Individual perception

and attitude, knowledge and behavioral outcomes are some of the areas that are identified to be important areas of global learning [95]. Engineers will need to be able to develop intercultural awareness, empathy, self-awareness, and the social skills demanded to better communicate and solve problems [96]. There exist many methods that can help the engineering students develop these skills and are often through in class modules, experiential learning in the classroom or via international travel and individual reflection [95], [97], [98]. International travel provides students with a great opportunity. Table 13, from Falk et al. (2012), highlights key conceptualizations that Aristotle poses to how traveling contributes to learning [99].

Table 13 [99]

The conceptualizations of how travel can impact the learning of the traveler

	Passive	Active
Practical skills (*techne*)	Incidental development of generic skills and technique (e.g. communication, problem solving)	Active quest for control and mastery of physical or cognitive skills
Knowledge (*episteme*)	Serendipitous and spontaneous acquisition of knowledge (e.g. incidental learning about sites, settings and species)	Deliberate search for knowledge and understanding
Practical wisdom (*phronesis*)	Accumulating 'life experience' through exposure to varied situations and settings (e.g. self-awareness, and social and cultural awareness)	Active pursuit of a good and virtuous life

Global Perspective Inventory. The GPI was created with the intentionality that any individual would be able to utilize the instrument. It adopts a 5-point Likert-scale that rates the individuals in the areas of interpersonal, intrapersonal, and cognitive, seeking to answer how individuals "think, feel and relate to others" [20]. Therefore the scale often addresses the questions of "How do I relate?," "Who am I?," and "What do I know?" (Figure 12).
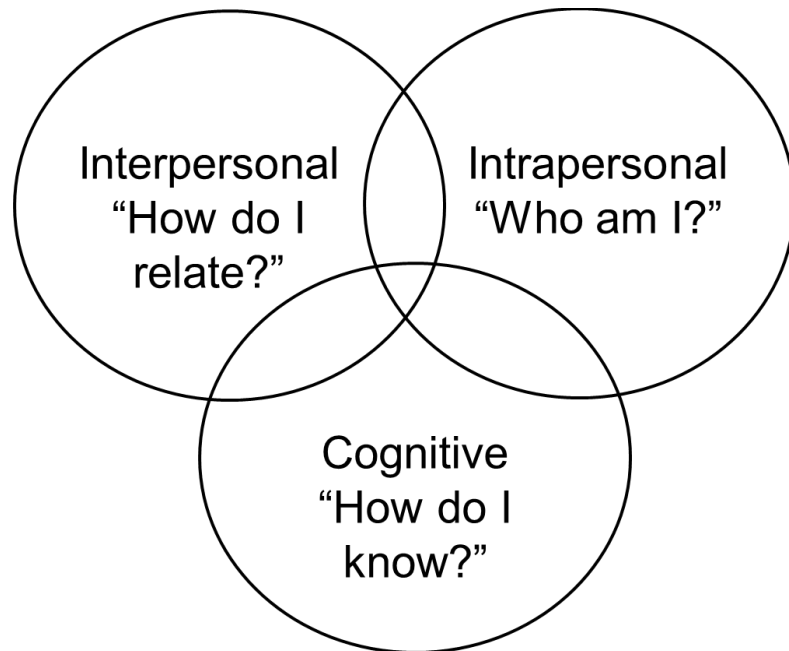
Figure 12. Conceptual depiction and composition of the GPI

Each dimension is further broken down into two subscales to better analyze individual learning and perception. These three dimensions, their respective subscales and descriptions can be seen in Table 14.

Table 14

GPI categories and subscales [20]

Interpersonal	
Social responsibility (α = 0.73)	The level of interdependence and social concern for others
Social Interaction (α = 0.70)	The degree of engagement with others who are different from oneself and degree of cultural sensitivity when living in pluralistic settings
Intrapersonal	
Identity (α = 0.74)	Combination of the level of awareness of one's unique identity and degree of acceptance of one's ethnic, racial, and gender dimensions of that identity
Affect (α = 0.73)	The level of respect for and acceptance of cultural perspective different from one's and degree of emotional confidence when living in complex situations
Cognitive	
Knowing (α = 0.66)	Degree of complexity of one's view of the importance of cultural context in judging what to know and value
Knowledge (α = 0.77)	Degree of understanding and awareness of various cultures and their impact on global society

Cronbach's alpha (α) is an estimate of the reliability of a test's scores and score interpretation[100]

There have been numerous studies that have utilized the GPI as a scale to assess global perspectives of students both in an out of engineering [5], [15], [19], [36], [53], [73]. Additionally, there has been previous research around intercultural wonderment and its relationship to global perspectives represented through the GPI [22], [23].

Results and Discussion

The results for the study describe learning outcomes in terms of their GPI scores following their international experience and the learning outcomes categories that were described in the interviews. Each GPI dimensions will be discussed, while the learning

outcome categories are discussed in relation to the type of international experience. Opportunities where the students experienced intercultural wonderment will be used to demonstrate the higher levels of the learning outcomes.

Global learning outcomes. Table 15 represents the total learning outcomes for experience type. However, since there were different amounts of students that went on each experience, a sample average of learning outcomes per student was taken to normalize the data (Table 16). This was additional done on each of the four areas that were identified to be important learning outcomes for the global engineer. Overall, the results showed study abroad to have more learning outcomes per student. The results indicate that study abroad offers more learning outcomes per student in Personal and Professional Development (PPD), Cross-cultural Communication Skills and Strategies (CCCSS), and Global Engineering Preparedness (GEP), whereas recreational offers more in International Contextual Knowledge (ICK). There does not exists a large variation between the two experience types though. Each experience offers learning benefits to the students. Cushner (2007) [83] in his assessment of student teaching abroad demonstrates this when he stated,

> *The experience abroad, regardless of the level at which it takes place, offers the individual a unique opportunity for intercultural development as it involves both physical and psychological transitions that engage the cognitive, affective, and behavioral domains.*

The following sections further analyze each of the global learning outcomes by looking at each experience type that demonstrated the highest learning outcome averages.

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Table 15

Frequency of learning outcomes for each international experience

Experience	Learning Outcomes	Cross-Cultural Communication Skills and Strategies	Global Engineering Preparedness	International Contextual Knowledge	Personal and Professional Development
Recreational (n=23)	227	68	51	70	38
Study Abroad (n=17)	215	66	59	51	39
Totals (n=40)	**648**	**222**	**151**	**159**	**116**

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Table 16

Frequency of learning outcomes per student for each international experience

Experience	Learning Outcomes	Cross-Cultural Communication Skills and Strategies	Global Engineering Preparedness	International Contextual Knowledge	Personal and Professional Development
Recreational (n=23)	9.87	2.96	2.22	3.04	1.65
Study Abroad (n=17)	12.65	3.88	3.47	3.00	2.29

Cross-cultural communication skills and strategies. When comparing study abroad and recreational experiences, students who went on study abroad experiences typically exhibited more learning outcome under CCCSS (Tables 15 and 16). Often, recreational visits by tourists are not provided or understand how cultural interaction differ, which may lead to difficulties in interaction or engaging in opportunities for improvement in cultural communication [103]. Students in study abroad programs, especially short-term programs, are often given some educational cultural background in interacting and communicating with the foreign culture [8], [9]. However, there existed a great ability to develop learning within both experiences. In both experiences, students demonstrated a more noticeable ability to develop a learning outcome in the form of being able to interact with other cultures, being aware and accepting other cultures, and acknowledging the differences in others (Tables 17 and 18).

Study abroad experiences have found to aid students to help with language improvement, an ability to interact with culturally different individuals, and an increased recognition of another culture's differences [104]–[106]. For example, student 47 from study abroad discussed how the experience improved their ability to interact with the host culture changed from the beginning to the end. It originated from perpetual people asking to take pictures with them and their group of friends. The student commented,

I got more used to people coming up to you and asking to take pictures with you. And I got more used to… everyone in China is trying to haggle you to buy stuff, and I got more used to dealing with that, with people, and stuff like that, so.

-Student 47

Table 17

CCCSS coding frequencies for study abroad experiences

Student	Ability to interact with engineers and(or) others from different cultures	Awareness and acceptance of diversity across cultures	Acknowledgement of difference of others	Ability to work as a member or leader in cross-cultural teams	Proficiency in using another language to interact with another culture	Ability to effectively adapt to and integrate into different cultural environments
31	1	0	1	0	1	1
32	0	0	0	0	0	0
33	0	0	2	0	0	0
34	1	1	0	0	0	0
35	0	0	0	0	0	1
36	1	2	0	0	2	0
37	0	0	0	1	0	1
38	1	2	0	0	0	0
39	2	1	3	0	1	0
40	2	1	0	1	0	0
41	1	0	1	0	1	0
42	1	0	0	0	0	0
43	1	0	2	0	0	0
44	3	4	1	3	0	0
45	0	0	2	0	1	0
46	5	1	2	1	1	1
47	3	0	0	1	0	0
Total	22	12	14	7	7	4

Additionally, recreational experiences have noted that individuals increased in learning in CCCSS. Individuals have been found to have improvement in their sociability with different people, language improvement and an understanding and awareness of different people, cultures, and perspectives [107], [108]. Within recreational, student 19 discusses how their overall experiences in Costa Rica lead to reflection made her more aware of the circumstances of others and that people should accept people based on their beliefs. The student reflected,

I think just to be interested in the way other people were brought up and just kind of what their beliefs and traditions and just all that gives you more of a well-rounded outlook on the world and an understanding for how things change as you move, you know, around the globe. Whether it's in, you know, northeast Maine, or whatever, Africa, everything changes. So it's just made me more aware of kind of every—the way people live isn't similar. You know, it's different than the way I grew up and I live.

-Student 19

Table 18

CCCSS coding frequencies for recreational experiences

Student	Ability to interact with engineers and(or) others from different cultures	Awareness and acceptance of diversity across cultures	Acknowledgement of difference of others	Ability to work as a member or leader in cross-cultural teams	Proficiency in using another language to interact with another culture	Ability to effectively adapt to and integrate into different cultural environments
3	1	0	1	0	0	0
4	0	1	0	0	0	0
5	1	1	0	1	0	0
6	0	0	0	0	0	0
7	1	2	0	0	2	0
8	0	1	0	1	0	0
9	1	1	0	1	0	0
10	2	0	0	0	1	0
11	1	1	0	0	0	0
12	1	1	1	2	0	0
13	1	0	0	0	0	0
14	2	2	1	0	0	0
15	1	0	0	0	0	0
16	1	0	0	0	1	0
17	1	2	0	1	0	1
18	0	0	1	0	0	0
19	2	2	2	0	0	0
20	1	0	1	0	0	0
21	1	1	1	0	0	0

Table 18 (continued)

CCCSS coding frequencies for recreational experiences

Student	Ability to interact with engineers and(or) others from different cultures	Awareness and acceptance of diversity across cultures	Acknowledgement of difference of others	Ability to work as a member or leader in cross-cultural teams	Proficiency in using another language to interact with another culture	Ability to effectively adapt to and integrate into different cultural environments
22	2	1	1	0	1	0
23	2	1	0	0	1	0
24	2	0	1	0	1	0
25	2	1	0	0	0	0
Total	26	18	10	6	7	1

Global engineering preparedness. Global engineering preparedness (GEP) demonstrated the greatest opportunity for student learning outcomes in the study abroad. This is not extremely surprising given that the majority of the engineering students are engaged in some program or course that is focused on engineering. Taking these courses allows the students to better relate and understand how engineering values and approaches vary from culture to culture. All students demonstrated at least one of the learning outcomes, while three students demonstrated a high or seven or eight learning outcomes during their study abroad experience (Table 19). However, study abroad programs do not seem to demonstrate to students the importance of global collaboration. Only 5 of the 16 students demonstrated this learning outcome. It seems this experience more impacts how students view themselves and their increased level on engineering knowledge in relation to cultural, not global, efforts.

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Table 19

GEP coding frequencies for study abroad experiences

Student	Awareness of the relationship between culture and engineering practice	Understanding the importance of global collaboration in engineering	Ability to understand their career as impacted by global engineering practices	Knowledge of engineering and business practices
31	1	0	1	0
32	4	0	2	1
33	2	0	0	1
34	0	0	1	1
35	1	0	1	0
36	3	0	3	2
37	1	0	0	1
38	1	0	0	0
39	1	1	1	0
40	2	2	0	1
41	1	1	0	1
42	2	0	1	1
43	0	0	3	0
44	1	1	1	1
45	1	0	1	0
46	2	1	1	3
47	0	0	1	0
Total	23	6	17	13

Student 32 placed a higher value on the cultural and engineering awareness knowledge of GEP that they gained from their study abroad experience. They discussed how their short-term three-week trip in Germany had both travel and education components, where the education had "an engineering portion and a cultural awareness portion" at German colleges. German culture and engineering are very focused on sustainable efforts [109], [110]. During their experience, they were able to connect this cultural and engineering knowledge they gained during one of the trips that they took. They remarked:

I think they—like the general ethos of the culture is you do what's good for the culture

itself, and they—Germany is not as individualistic as the U.S., so they realize like the

need for public transportation versus each individual has a car—and there are better

examples… Germany has a combination of being more public-minded, and—actually, a

really good example of this is their recycling system. They have—so we have like a

recycling bin or maybe plastic cups. They have like seven different recycling bins, and I

think pretty much every house has this, and they're all different color-coded, so the

individual sorts the recycling and then puts them into the bins, and then—so it

streamlines the whole process, because instead of having to go a plant and then being

sorted, the individual sorts their own, and then you can put the plastic directly with the

plastic and so on. So the citizen takes on the responsibility of doing that recycling,

whereas here that's—you kind of throw it all away. And people don't even recycle here

most of the time, so having—yeah, everybody seems to care more about like the outcome

of how the direction and size of the society is going, I think. And that translates into an

engineering practice…

-Student 32

Throughout their interview, the student discusses how the German culture values

sustainable efforts in areas such as transportation, recycling, and energy. The student

further compares and recognizes this cultural difference from Americans from this study

abroad experience.

Student 46 demonstrated GEP learning outcomes in all areas with the greatest

focus on knowledge on engineering and business practices that were learned from their

international experience. They conveyed their experience in Germany further helped

them to become an engineer, since all engineering, regardless of the culture, uses mathematics. They also discussed how their classes taught about wind turbines and its economics. Additionally, when describing their current research on smart grid systems, they said, "my background, at least from Germany, has helped me understand the basic principles."

Overall, recreational experiences demonstrated much lower GEP learning outcomes when compared with study abroad. Although the students in recreational struggled more with identifying these global learning outcomes, it did provide many students (18 out of 23) with an awareness of the relationship between culture and engineering (Table 20). This was often seen from their travels and seeing that other cultures may have different needs and constraints to solve a problem. Student 16 highlights this idea when they commented,

I guess it allowed me to see different cultures in ways that other people think, isn't necessarily the way Americans think so it put a perspective on things. Which is really important if you're doing engineering because you are looking to ways to solve problems for everybody and not just specific people and so seeing different cultures and different ways of thinking helped me broaden the way I think about approaching a problem in engineering and thinking in how to apply it to people in general not in a specific group.

-Student 16

These students are not receiving any formal instruction, outside the possible tours the student participates in. The interviews convey that typically the main avenue for engineering learning outcomes is typically through observation.

Table 20

GEP coding frequencies for recreational experiences

Student	Awareness of the relationship between culture and engineering practice (i.e ethical or technical standards)	Understanding the importance of global collaboration in engineering	Ability to understand their career as impacted by global engineering practices	Knowledge of engineering and business practices
3	1	0	1	0
4	0	0	0	0
5	2	0	0	0
6	1	0	0	0
7	2	0	1	0
8	3	1	0	0
9	2	0	2	0
10	2	1	0	0
11	1	2	0	0
12	2	0	1	2
13	1	0	0	0
14	0	0	1	0
15	1	0	0	0
16	4	0	0	0
17	3	2	0	1
18	0	0	0	0
19	1	0	0	0
20	2	1	1	0
21	1	1	0	0
22	2	0	0	0
23	0	0	0	0
24	1	0	0	0
25	0	1	0	0
Total	32	9	7	3

International contextual knowledge. Although very close in frequencies per student, the results had recreational experiences demonstrating more opportunity for international contextual knowledge (ICK) learning outcomes (Tables 15 and 16). Both study abroad and recreational experiences also do offer a high opportunity in the learning outcome of ability to see the bigger picture, but often do lack in the appreciation of service learning (Tables 21 and 22). Recreational experiences may have this slightly increase average due to the fact that while these students are engaging in recreational experiences, they are often on agendas that are considered more "fun activities" where they are visiting museums and enjoying the daily life of the foreign culture [111]. The students within recreational most commonly indicated growth in "increased awareness of global and/or cultural topics" (Table 21). Literature does show though that students from study abroad do gain learning in cultural and global topics relating to the visiting country [112].

Table 21

ICK coding frequencies for recreational experiences

Student	Increased awareness of global and (or) cultural topics	Ability to see the bigger picture	Appreciation of service learning
3	3	2	0
4	0	1	0
5	2	1	2
6	3	0	0
7	3	2	1
8	0	1	1
9	3	2	1
10	7	1	0
11	0	1	0
12	3	0	0
13	2	2	0
14	0	0	0
16	1	0	0
17	1	1	0
18	0	1	0
19	0	2	0
20	1	0	0
21	0	1	1
22	1	1	0
23	2	1	0
24	1	0	0
15	3	1	0
25	3	2	2
Total	39	23	8

Table 22

ICK coding frequencies for recreational experiences

Student	Increased awareness of global and (or) cultural topics	Ability to see the bigger picture	Appreciation of service learning
31	1	0	0
32	1	1	1
33	1	3	0
34	2	1	0
35	1	1	0
36	1	1	0
37	3	2	0
38	1	1	0
39	0	2	0
40	4	1	0
41	1	1	0
42	2	2	0
43	0	3	0
44	0	0	0
45	3	0	0
46	1	4	0
47	3	2	0
Total	25	25	1

From these engagements where the recreational students are attending tours or museums, many times they learned about the history or political situation of the country. Student 10 provided an example of this when they stated,

We did go to this house visit where he was talking about the emperor and everything,

about World War II and everything, and it kind of changed my perspective on that,

because they don't view the emperor during World War II as like a villain or anything,

like, you know, we were taught in history class. He was just sort of a side player, because

they viewed the generals as the people who were charge of that, all the war and stuff

-Student 10

Overall, the students in both experiences further reflected a high learning in the ability to see interconnectivity of differing communities and culture. From the student discussions, this learning outcome seem to stem from exposure to foreign cultures during their travels. For example, study abroad student 43 explained,

I guess in a way like if you can—you can think about it in way, like that everyone's connected as a whole, and that there's always like the trade goods coming in. That also like you're connected as human beings, because you're all out there trying to make a living and everything. But you also didn't really know about that until like you really think about it. So I guess I wasn't forced to really see this perspective when I traveled.

-Student 43

Personal and professional development. It is not unknown that international experiences have been found to improve the qualities of an individual. Study abroad has been found to help with student confidence, adaptability, and cultural self-awareness [113], [114]. Literature has also shown that recreational experiences to have a positive effect on individuals in the areas of adaptability/flexibility, cultural self-awareness, problem-solving, and self-confidence [107], [108], [115].

The results from the study further confirmed what has been found throughout literature. When comparing the two experiences, personal and Professional Development (PPD) demonstrated the greatest opportunity in student learning outcomes in study abroad. The two experiences offered similar learning development in personal and professional qualities though apart from creativity (Table 23 and 24). The results had no indication of creativity as a learning outcome within recreational experiences. These

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results suggest that recreational experiences may not provide as great of an opportunity for students to develop their creativity as study abroad experiences which have students engage in academic coursework/programs where their creativity may be challenged or further developed. Overall, within both experiences, students expressed the largest amount of learning through the development of a more open or positive attitude (Table 23 and 24).

Table 23

PPQ coding frequencies for study abroad

Student	Open, Positive Attitude	Self-efficacy or Can-do Attitude	Cultural Self-Awareness	Flexibility, Adaptability	Creativity
31	0	2	1	0	0
32	0	0	1	1	1
33	0	1	0	2	0
34	0	1	0	0	0
35	1	0	1	1	0
36	1	1	0	0	0
37	1	0	0	0	0
38	1	0	0	0	0
39	0	1	2	0	0
40	2	0	0	0	0
41	0	3	0	0	0
42	1	0	0	0	0
43	3	0	2	0	0
44	0	0	1	1	1
45	1	1	0	1	0
46	1	0	0	1	0
47	0	0	0	0	0
Total	12	10	8	7	2

During study abroad experiences, students often expressed how they became more open from their interactions with others. Student 46's study abroad experience they discussed how they developed a more open and positive attitude. They spoke of how they tried to travel to other countries every weekend they had free and met a woman on the train who told them all about their own travels and the people she met. From this, the student commented,

I tried not to be so closed minded. I think certainly there's a stereotype that Americans are very set in their ways and they believe their way is the right way. So I tried to combat

that and being open, I tried to listen to people, I tried to—certainly I wasn't trying to

force any belief but being more engaging and sharing perspectives and not being so

adamant that my way of doing things is the way of doing things.

-Student 46

Table 24

PPQ coding frequencies for recreational

Student	Open, Positive Attitude	Self-efficacy or Can-do Attitude	Cultural Self-Awareness	Flexibility, Adaptability	Creativity
3	1	0	0	0	0
4	0	0	2	0	0
5	2	0	0	0	0
6	0	0	0	0	0
7	1	1	2	1	0
8	0	0	0	0	0
9	1	0	0	1	0
10	2	1	0	0	0
11	0	0	1	0	0
12	0	0	2	0	0
13	0	0	0	0	0
14	2	0	1	0	0
15	0	2	1	0	0
16	0	1	0	0	0
17	3	0	1	1	0
18	1	0	0	0	0
19	1	0	0	0	0
20	0	0	0	0	0
21	1	0	0	1	0
22	0	1	0	0	0
23	1	0	1	0	0
24	0	0	0	0	0
25	1	0	0	0	0
Total	17	6	11	4	0

During the recreational experiences, students often conveyed their development to a more open and positive attitude through observation. Student 17 discussed during their trip to Israel and how US news often places a negative connotation about the area. However, when the student visit the country they developed a different perspective. They reflected,

I tried not to be so closed minded. I think certainly there's a stereotype that Americans are very set in their ways and they believe their way is the right way. So I tried to combat that and being open, I tried to listen to people, I tried to—certainly I wasn't trying to force any belief but being more engaging and sharing perspectives and not being so adamant that my way of doing things is the way of doing things.

-Student 17

Study abroad and global learning. The quantitative descriptive results suggest overall that the quantity of cultural encounters and duration engaging in another culture may aid in developing global learning outcomes. However, it is commonly thought that engineering students rarely have the opportunity to live for extended periods of time abroad or multiple international experiences. It is becoming more common for engineering students to take part in short-term study abroad programs [9]. These opportunities stem from short-term study abroad experiences often being more affordable and better aligning with the curricular constraints [9], [116]. Many of these students from the study abroad experience type were a part of short-term study abroad programs. In addition to the previous trends, the results from this study suggest that there exists a large opportunity for students to develop global learning outcomes within study abroad programs. Previous research has indicated that students who study abroad can develop

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global skills that impact their openness to others, intellectual capabilities, and personal development [117], [118]. Within the study, study abroad experiences had the second highest average of learning outcomes per student and averaged more than two outcomes for each of the global learning outcome categories.

Global Perspective Inventory. Figures 13 and 14 provides the averages and standard deviations for the three GPI dimensions and six subscales for all the students, recreational, and study abroad experiences.
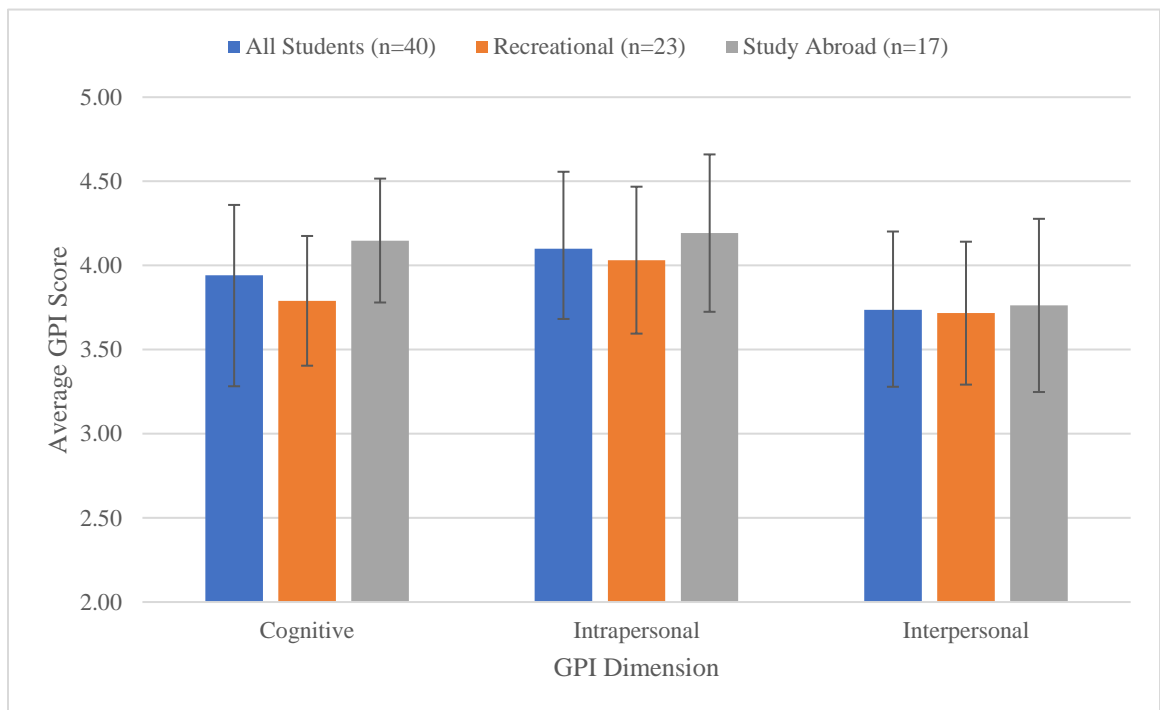

Figure 13. Average scores for the GPI domains within each international experience
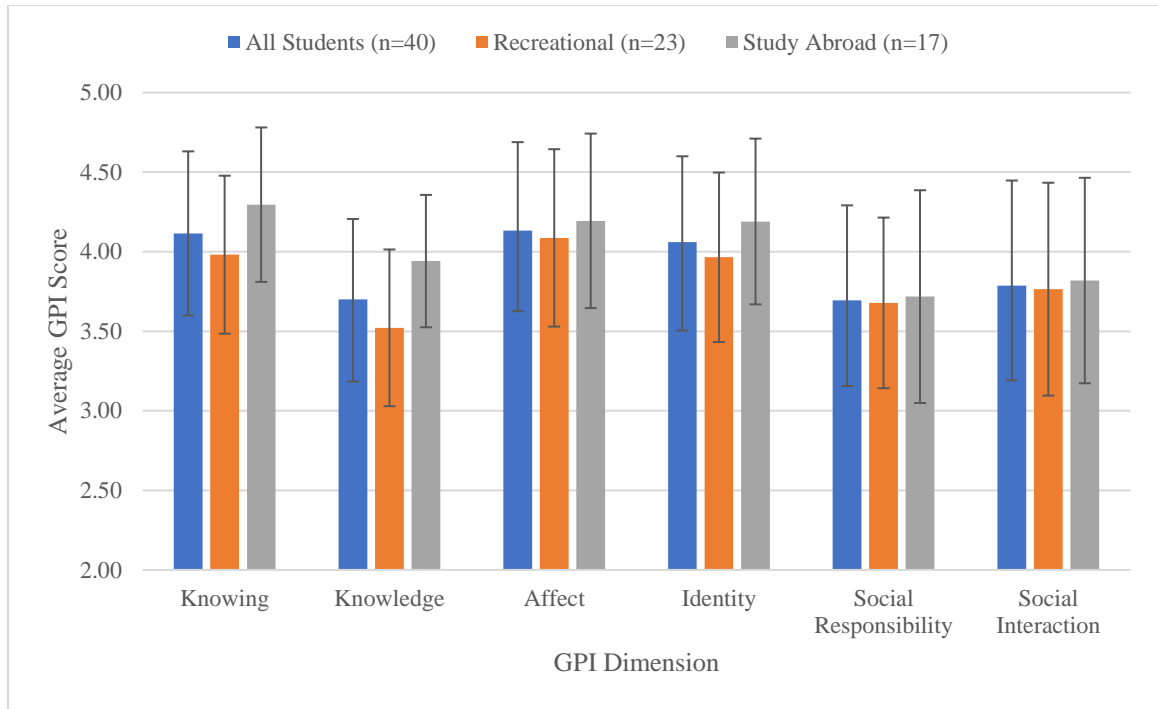
Figure 14. Average scores for the GPI subscales within each international experience

Tables 25 and 26 show the results from the Mann-Whitney U test for the GPI dimensions and their subscales. There was a statistical difference found between recreational and study abroad global perspectives in the cognitive dimension and the subscale of knowledge. Study abroad students reflected higher scores in these areas and are shown through their mean ranks in Table 27. Additionally, these results from the non-parametric test indicate that recreational experiences can provide similar value to undergraduate engineering students in Intrapersonal and Interpersonal global perspective development.

Table 25

Non-parametric Mann-Whitney U-test results for GPI dimensions between study abroad and recreational experiences where study abroad students were statistically higher

Dimension	U-value	p-value
Cognitive	101.50*	0.01*
Intrapersonal	164.00	0.388
Interpersonal	197.00	0.967

* p ≤ 0.05 confidence level

Table 26

Non-parametric Mann-Whitney U-test results for GPI sub-dimensions between study abroad and recreational experiences where study abroad students were statistically higher

Subscale	U-value	p-value
Knowing	125.00	0.53
Knowledge	102.50*	0.01*
Affect	184.50	0.763
Identity	150.50	0.216
Social Responsibility	190.50	0.891
Social Interaction	200.50	0.891

* p ≤ 0.05 confidence level

Table 27

Mean rank values for cognitive and cognitive knowledge between study abroad and recreational

Dimension or Subscale	Recreational Mean Rank	Study Abroad Mean Rank
Cognitive	16.41	26.03
Knowledge	17.43	24.65

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Cognitive development from study abroad. When comparing the average GPI scores, study abroad students demonstrated a statistically significant higher score in the Knowledge subscale, as well as within the Cognitive dimension. This subscale pertains to what students understand in regard to cultural knowledge and issues in relation society [20]. The results indicate that perhaps the educational component of study abroad experiences provide the engineering students with more opportunities and exposure to this area which make these results to be statistically higher [101], [119], [120].

Intercultural wonderment and global learning. The results from the study demonstrate that intercultural wonderment does play a part in global learning. The descriptive quantitative results suggest that there is a trend between frequency of intercultural wonderment and learning outcomes. When reflecting about their experiences, students further provided insight into how these moments of intercultural wonderment brought about global learning outcomes. Overall, most of intercultural wonderment occurred following some type of contact, both directly or indirectly, with another culture. With this, students often demonstrated intercultural wonderment and would mostly commonly express learning outcomes associated with cross-cultural and communication skills. Other areas of global learning were typically expressed following observation, academic engagements, or personal reflection about their own skills regarding a particular moment during their international experience.

Student 45 discussed how during his study abroad experience they had stayed with a host family. They mentioned that the family would have him participate in everything they did and provided a very immersive environment. Following this, they recognized they increased their ability to acknowledge the differences of others stating,

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I think it came down to an appreciation of the culture. And just an understanding that there are lots of other people out there with very different experiences and who grew up in very different worlds. And that's just something I kind of always need to be aware of.

-Student 45

Another student discussed their experience of being out of their comfort zone. Student 51 was talked about how when they were in Honduras, they were at one point packed into a very same bus; people were sitting on each other and the bus was packed as full as it could be. They even mentioned that it would not have surprised they if the bus had livestock on it. This experience though had the student convey that they felt better from this in being able to effectively adapt to and integrate into another cultural environment. They stated,

But just being able to hop right into that culture and knowing how to interact with the people definitely increased … not overwhelmed by the differences but just kind of like becoming so much a part of the culture…

-Student 51

Although these results suggest that intercultural wonderment typically develops learning outcomes focused in cross-cultural and communication skills, this does not mean that intercultural has not and cannot develop other global learning outcomes.

Chapter 6

Summary and Contributions

Chapter Summaries

The thesis provided a qualitative and quantitative analysis of intercultural wonderment as a mediating role between international experience programmatic components and global learning outcomes within engineering students. The design of the thesis followed the framework demonstrated in Figure 15.
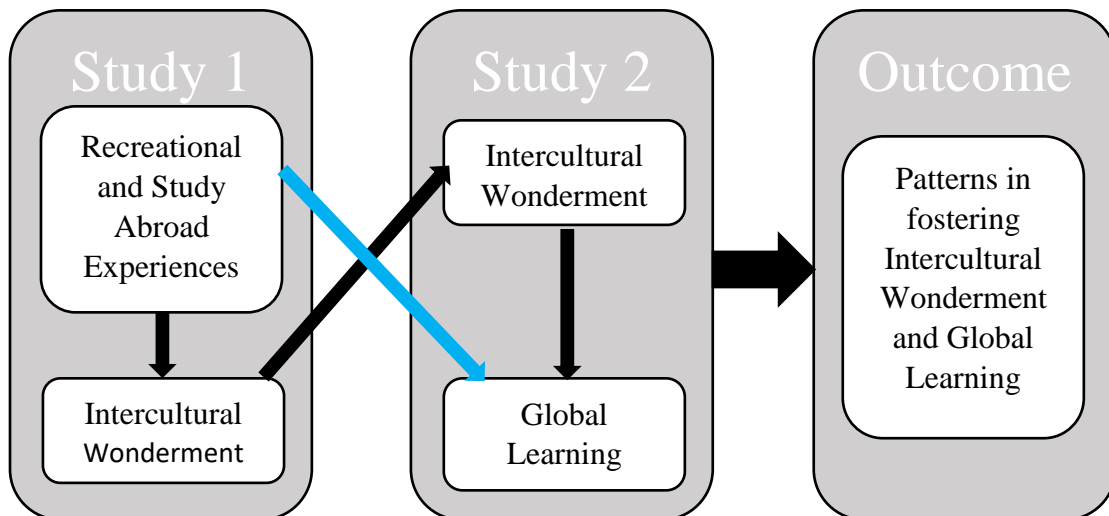
Figure 15. Thesis framework

Contribution of the type of study. The role of intercultural wonderment in international experiences has been studied within students that have participated in study abroad programs [22], [23]. The study analyzed predisposing factors that facilitate intercultural wonderment and its impact on global perspectives in terms of GPI. While this study has provided value in understanding intercultural wonderment and its value in study abroad programs, there can be more research to understand the importance of

intercultural wonderment. These previous studies were limited to just study abroad programs. It also only used the GPI as a basis to determine development of global perspectives during these international experiences. It was done solely quantitatively and did not look at more specific intangible outcomes that may result from these experiences. This research approaches intercultural wonderment on a on broader in multiple spectrums.

First, the study investigated intercultural wonderment through both a quantitative and qualitative lens and was specifically done in the engineering population. The initial study on intercultural wonderment was only conducted quantitatively and was not exclusive to one population. In addition to the GPI data that was collected, intercultural wonderment was identified through student interviews as opposed to a Likert-scale. Further, this study analyzed how intercultural wonderment is foster in two common types of international experiences – study abroad and recreational travel. Finally, the study looked at other global learning outcomes that can be fostered from each international experience and through intercultural wonderment, aside from just global perspective. The research here presented is the first study to look at how intercultural wonderment is manifested and the results that are derived from it through multiple lenses.

Empirical contribution.

Study 1. Chapter 4, or study 1, focused on the relationship between the type of international experience and intercultural wonderment. The study utilized qualitative interview data and quantitative frequency data rates to determine how intercultural wonderment is fostered within an international experience. The study found that overall intercultural wonderment can be fostered in all areas within both international

experiences. The results further indicate that recreational experiences may provide greater value than anecdotal pre-notion, which can be seen in how intercultural wonderment is fostered during these international experiences. Additionally, intercultural wonderment occurs most often in the form of interaction and can be seen to be fostered in slightly different fashions.

Study 2. Chapter 5, or study 2, focused on the relationship between intercultural wonderment and global learning outcomes, where global learning outcomes are defined by GPI scores and learning outcomes for engineering global preparedness were adapted from Besterfield-Sacre et al. (2013) [25]. Overall, the study identified the learning outcomes that were often developed or not developed within each experience. Interviews indicated that intercultural wonderment within these experiences often produced greater quantities of global learning. Most commonly, students developed cross-cultural and communication skills and strategies. All global learning outcomes were present though in some form with both international experiences.

The study results from the Mann-Whitney test found a statistically significant difference between recreational and study abroad students in the cognitive knowledge sub-dimension and cognitive GPI dimension. This may be attributed to the academic structure of the study abroad programs. The study presents evidence that reactional and study abroad programs offer great opportunity for engineering students to engage in global learning.

Intercultural wonderment as a mediator. During the interviews, the students would recount engagements during their international experiences that were typically the most significant to them. These engagements were situations where the students often

went through a reconciliation and reflective process that ultimately led to them developing global learning. This process was intercultural wonderment.

The thesis found there does exist a mediating step that is critical in students for them to develop global learning outcomes. The results suggest that intercultural wonderment mainly fosters cross-cultural and communication strategies though. Other learning outcomes often came from other settings that were not necessarily attached to intercultural wonderment. It was through analyzing the independent relationships between intercultural wonderment and the programmatic component of international experience type and global learning outcomes that this was achieved. Overall, the qualitative and quantitative data that was utilized found that intercultural wonderment was present and a key mediator to global learning outcomes.

Chapter 7

Limitations and Future Work

Limitations

There are several limitations to the study. The two studies were focused on interviews where intercultural wonderment was determined based around the students own self-report. The interviews were not necessarily conducted directly following the international experience either. Some of the students had international experiences during high school, so interviews may have been conducted years later. So, it may not be possible to know the full extent of intercultural wonderment during the international experience. It is often hard for engineering students to participate in an international experience during college, and the experiences that students recalled from previous years still provide meaningful engagements for the students upon reflection. It does provide a broad sample and understanding of intercultural wonderment within engineering undergraduates, but still does prevent any casual conclusions to be drawn regarding the overall population.

Also, for both studies, the two international experience types did not have a very large quantitative sample representation. For this reason, the non-parametric test was run. While the interviews and numerical data sets did provide insight into each international experience, a larger sample for the international experiences that are lacking in size may provide a greater depth of understanding into how intercultural wonderment is fostered and the global learning outcomes that are achieved. This increase may also provide a better cross-experience type comparison. The second area of the thesis additionally relied on one instrument to measure global perspective and one framework to measure global

learning. This is not uncommon within the international engineering education field due to the complex nature of understanding and assessing global perspective and learning.

Finally, the interviews that were used within the study had an interviewing protocol proposed around an NSF grant on global learning experiences and global preparedness. The initial NSF study did not inquire students on topics relating to intercultural wonderment. Neglect of potential questions relating to intercultural wonderment may have reduced the quantity of data that was obtained pertaining to how intercultural wonderment is fostered in each international experience and the direct correlation between intercultural wonderment and global learning outcomes.

Future Work

There exists great potential in additional qualitative and quantitative research around how intercultural wonderment is fostered during an international experience and the impacts on global learning outcomes. Additionally, studies should be conducted in both research realms to increase the understanding of intercultural wonderment in engineering education contexts. Short-term faculty trips are becoming more prevalent in engineering education, and results from the current research suggest there is a large opportunity for fostering intercultural wonderment in study abroad experiences. Further research focusing on intercultural wonderment on these excursions may provide great value and insight into how short-term, faculty led trips can be improved to increase student learning. Domestic opportunities provide students with the ability to engage in global learning without needing to travel abroad. Analysis should be conducted that analyses internationally focused programs that aim to develop global learning domestically. There is a need to increase the opportunities that foster intercultural

wonderment and identifying program structures that may cause intercultural wonderment offers the potential to enhance the global learning experience for engineering students in a domestic context. The findings from studies 1 and 2 both provide these implications for future research.

To improve the current findings found within both studies, steps to further develop and refine of the interview protocol will be done to gain a more comprehensive qualitative data set of how intercultural wonderment is fostered. With the new interview protocol, more students will be interviewed to gain a larger sample of each international experience type and a more comprehensive understanding of the mediating role of intercultural wonderment. Additionally, a refined interviewing protocol may allow the emergence of additional learning outcomes to emerge from student interviews.

The type of international experience is one form of an international experience programmatic component. Future research studies should look to assess the mediating role of intercultural wonderment in relation to other international experience programmatic components. Collection of this data can be obtained through the addition of more survey questions that are preliminarily sent to students and interview probes. Continuation in examining, refining, and adding to these findings is important to better understand the mediating role of intercultural wonderment and its impact on developing global learning in engineering undergraduates.

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