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**EXAMINING GLOBAL PERSPECTIVES OF ENGINEERING STUDENTS:
DETERMINING EDUCATIONAL IMPACT**

by

Brian R. Moore

A Thesis

Submitted to the
Department of Experiential Engineering Education
College of Engineering

In partial fulfillment of the requirement

For the degree of
Master of Science in Engineering

at

Rowan University

May 15, 2020

Thesis Chair: Scott Streiner, Ph.D.

Acknowledgments

Foremost, I would like to thank Dr. Scott Streiner for his guidance, encouragement, and assistance during this research and my experience as a graduate student. He consistently provided me with helpful feedback that drove my research to be as thorough and successful as possible. This research and my experience would not have reached their full potential without his guidance and effort.

I would also like to acknowledge Rowan University for funding this research and the furtherment of my education in the engineering space. It is an opportunity I am grateful and lucky to have had. Lastly, special thanks to Dr. Cheryl Bodnar, Dr. Brent Jesiek, and the ExEEd graduate research team for all their constant support and thoughtful feedback.

Abstract

Brian Moore
EXAMINING GLOBAL PERSPECTIVES OF ENGINEERING STUDENTS:
DETERMINING EDUCATIONAL IMPACT
2019-2020
Scott Streiner, Ph.D.
Master of Science in Engineering

Globalization is causing higher education to adapt their approaches to student learning, especially those in the engineering disciplines as the nature and impact of their work becomes more cross-cultural and diverse. The efforts of programmatic change have led universities to emphasize new or different student experiences and educational practices to better prepare graduates for this societal change. Given this trend, research on which educational practices have the most impact on preparing engineering graduates to enter a global workforce is needed. Research has shown that international experiences like study abroad have a positive impact on students' *global perspectives*, especially when they engage in international programs and opportunities throughout college. Unfortunately, engineering students have been underrepresented among study abroad participants (less than 10%) historically, due to a variety of reasons (e.g., lack of preparation, structured curricula, lack of integration). Thus, this thesis examines how global perspectives can develop throughout college separate from study abroad experiences and investigates which educational opportunities (i.e., courses, co-curricular experiences) have the largest impact on the development of these global perspectives, as well as their interest in pursuing international experiences in general.

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Chapter 1

Introduction

Background

Due to constant advancements in the technologies of communication and transportation, organizations of business and engineering are becoming more interconnected and interdependent worldwide. In response to such a change, institutions of higher engineering education continue to increasingly emphasize the importance of having global aspects within many of their educational programs. Engineering researchers and employers alike believe that engineers need to embrace a broader version of their professional role and have a three-dimensional perspective. They are also recognizing the importance of preparing current and future generations of engineers to be effective and successful in the global economy [1-7]. Engineers are becoming increasingly expected to combat the world's most dynamic and complex challenges [8]. Organizations such as the National Academy of Engineering, (NAE), the National Science Foundation (NSF), the National Research Council (NRC), and even the Accreditation Board of Engineering and Technology (ABET) all challenge universities to graduate students who are globally prepared or have a global perspective [9-12]. For institutions to take focus in bettering the global perspectives of engineering students, it is important to define what makes an engineer globally competent.

Simply put, engineering global competency can be defined as the ability to work effectively with people who define problems differently [13]. Jesiek et al went as far as defining three main contextual dimensions of global engineering competency, which

include technical coordination, engineering cultures, and ethics, standards, and regulations [14]. These definitions have been extremely useful in understanding the skills that go into being a global engineer and designing programs that produce engineers with a complete and well-rounded education. However, these definitions do not offer a method of assessing engineers in a manner that quantifies their global competency, or perspectives. Luckily, Braskamp, Braskamp, and Engberg developed an instrument called the Global Perspectives Inventory (GPI), which does precisely that [15].

The GPI is a survey instrument designed so that any person of any age, or specific cultural group can take the set of items and gain quantifiable insight on how they think, feel, and relate to others. The instrument divides global perspectives into three domains with each domain having two scales, thus having six scales of global perspectives. The cognitive domain is centered on one's knowledge and understanding of what is true and important to know and contains the *knowing* and *knowledge* scales. The intrapersonal domain focuses on one becoming more aware of and integrating one's personal values and self-identity into one's personhood and contains the *identity and affect* scales. The third and final domain is the interpersonal domain, which is centered on one's willingness to interact with and accept people that have different social norms and cultural backgrounds. This domain contains the *social responsibility* and *social interaction* scales. Completion of the GPI instrument results in a quantity for each of the six GPI scales between zero and five for each participant, which can then be combined to achieve an average value for the depth of one's global perspectives on a scale of zero to five [15].

The measurement of global perspectives is essential not only in assessing the global outcomes of students, but in assessing the effectiveness of programs that are meant

to prepare students for success in a multicultural engineering settings. Though various efforts are being made by engineering institutions across the country to offer programs that are beneficial to the global perspectives and abilities of their students, the success of these programs is heavily understudied thus far by engineering researchers. Study abroad is currently the most common way institutions choose to expand global skills in students [13,14]. However, engineering students are drastically underrepresented amongst the students that study abroad each year. Though increasing, engineering students only made up about 5% of the population of U.S. students studying abroad in the 2017-2018 school year according to the Institute of International Education's (IIE) 2019 *Open Doors* report [16].

Study abroad is a difficult experience for engineers to participate in during their four years of college for many reasons. Grandin and Hirlemann identified sixteen obstacles that engineering students face in the path of achieving a more complete education [7]. Atop this list were curricular rigidity, lack of tradition, lack of support for engineers from study abroad professionals, and cost. Students often do not see room for an international experience in their already tough to manage academic schedules. International experiences have also only recently become associated with engineering curricula and hold more tradition in the humanity fields meaning not many engineering specific programs are offered causing students to have to fit these experiences into times when they are not taking courses, or add time onto their degree. For students to have equitable access to such experiences, efforts must also be made to lower the cost of these experiences for the universities and students alike. Though study abroad is currently the most common form of global education for engineering students, a study Pedersen

conducted supports that simply sending students to a location abroad for academic study is not sufficient toward facilitating the larger goal of creating effective global citizenship [17]. The goal of getting more engineering students to study abroad will also be no simple task and one that will take time to achieve.

In the meantime, it is important for engineering educators to pursue local means of globally preparing engineering students in addition to approaches with an international component. In a related effort, Liberal Education and America's Promise (LEAP), a national initiative launched by the Association of American Colleges and Universities (AAC&U) to align the goals for college learning with the needs of the new global century developed four student learning outcomes that are regarded as essential to student success in the interconnected world [18]. The initiative is especially concerned with students who have been historically underserved in higher education. George Kuh, a member of the Liberal Education and America's Promise (LEAP) National Leadership Council (NLC), then developed ten high impact educational practices that have been widely tested and shown to be beneficial for college students of many backgrounds. Educational research suggests that these practices increase rates of student retention and student engagement. They include first-year seminars, common intellectual experiences, learning communities, writing-intensive courses, collaborative assignments and projects, undergraduate research, diversity/global learning, service/community based learning, internships, and capstone courses and projects. Kuh suggests that institutions implement at least two of these practices into their students' college experience to create a more complete education and prepare them for the globalized workforce. This thesis aims to investigate the effect that these high impact educational practices and other courses and

co-curricular activities mentioned in the GPI instrument have on the global perspectives of college students and their interests in certain experiences through the following research questions:

1. How do precollege courses and co-curricular activities effect the global perspectives of first-year engineering students?
2. How do the courses, co-curricular activities, and high impact educational practices engineering students participate in during college effect their global perspectives?
 - i. How does participating in courses and co-curricular activities before college compare to during college in terms of effect on global perspectives?
3. How do precollege educational courses and co-curricular activities effect the interests of first-year engineering students in participating in an international experience or any of Kuh's high impact educational practices?
 - i. What are the reasons that students lack interest in having an international experience and how do they relate to the courses and co-curricular activities participated in before college?

Purpose of Study

The purpose of this study is to explore the role of certain courses, co-curricular activities, and high impact educational practices in the broadening of global perspectives in engineering students. Many institutions have begun to incorporate global components into their engineering programs, but not much study has been done into the effectiveness

of these components, or when it is best to implement them. This research aims to examine these important factors as well as explore what reasons students have for not wanting to participate in an international experience and which programmatic components may influence them to feel otherwise. The components examined include the courses and co-curricular activities included in the GPI survey instrument as well as the high impact educational practices developed by George Kuh [15,18]. Exploring the effectiveness of these components in enhancing global perspectives in students offers the engineering education community insight on which experiences to emphasize as part of their curriculum. Examining the effect that participating in these components has on future interest in global educational practices offers the engineering education community insight on which experiences may lead students into desiring an international experience or pursuing global learning that they did not see as valuable in the past. Engineering education is currently evolving to respond to the call for more globally minded and skilled engineers and, to be effective in doing so, it is important to understand the global perspectives of students and how their experiences may alter them.

Study Design, Methods, and Outcomes

The framework of this thesis research, as shown in Figure 1, is centralized on the work done by Braskamp, Braskamp, and Engberg (2014) and George Kuh (2008). Braskamp, Braskamp, and Engberg's GPI instrument was used to gain insight on the courses and co-curricular activities that each participant was involved in and how frequently they were involved during high school (first-year students), or in college (graduating students). It also provided a quantitative description of the global perspectives of each student so that the roles that certain experiences played in their

development could be analyzed. George Kuh's work in developing ten high impact educational practices provided the study with a group of student experiences to be analyzed that are proven to be effective in enhancing global mindsets in students (Kuh, 2008). The combination of these analyses will provide engineering educators with better insight on how to design their programs to ensure they graduate students with global preparedness.

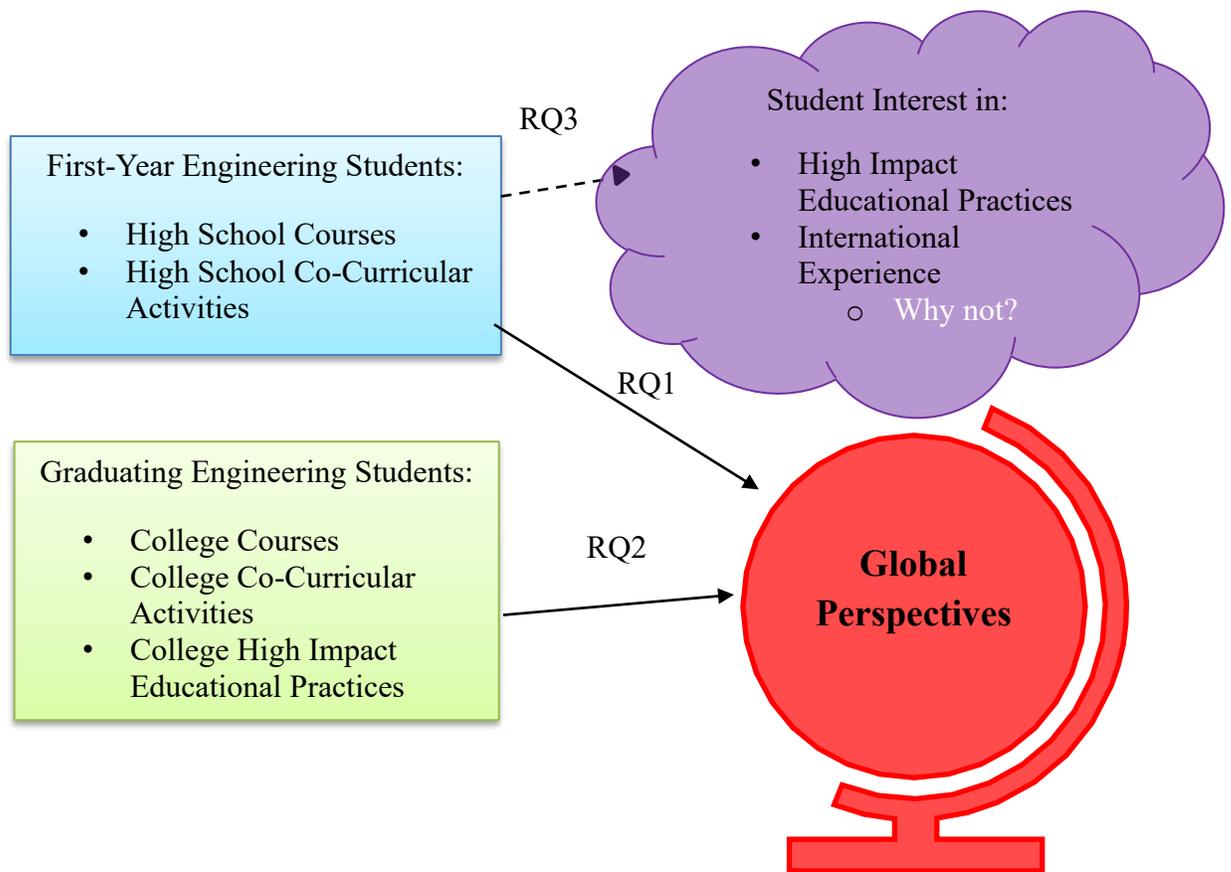


Figure 1A. Thesis Framework

This research is based on the analysis of data collected from two samples. One sample includes students entering the first year of their engineering program and the other includes students in the final semester of their program that are graduating. The first-year engineering students were asked about the frequency of their high school participation in courses and co-curriculars that are mentioned in the GPI instrument as well as their interests in having an international experience or any of the high impact educational practices developed by George Kuh that their university offers. If students responded with a lack of interest in having an international experience they were also

asked why they responded that way and given the opportunity to write an open-ended response explaining their motive(s).

The frequency of participation in courses and co-curriculars that these students displayed during high school was tested for effectiveness in each of the six scales of GPI. These courses and co-curriculars were also tested for effectiveness in producing interest in students pursuing an international experience or any of the high impact educational practices developed by Kuh. The open-ended responses students provided that stated their reason for not pursuing an international experience were categorized based on commonalities between the responses to examine the frequencies of each. These categories were also used to compare these reasons with the courses and co-curriculars they participated in during high school to determine if there is any evidence of a relationship between the two. This provides insight on which courses and co-curriculars may incline student interest in an international experience and which may decline that interest.

Graduating seniors were asked about their participation in the courses and co-curricular activities mentioned in the GPI instrument during college as well as their participation in the high impact educational practices developed by Kuh. This was used to again test the effectiveness of the courses and co-curricular activities mentioned in the GPI as well as the effectiveness of participating in any of Kuh's high impact educational practices in terms of global perspectives. The effect that course and co-curricular participation had on global perspectives while in college was analyzed and compared to the effect that they had on students who participated in them during high school. The effectiveness of the high impact educational practices on broadening global perspectives

is useful information for engineering educators trying to design programs for better globally preparing engineering students while trying to limit the number of extra courses and/or experiences they will have to include in their curriculum. Braskamp, Braskamp, and Engberg tested their GPI instrument on students of all majors from 100 universities across the country and they consider the results of this study to be the “national norms” of global perspectives. The average global perspective results of the students from this study were also compared to these “national norms” to see how their institution’s student population compares to those across the country in global perspectives.

These analyses produced many interesting results. Amongst the first-year engineering students, multi-cultural courses, courses with opportunity for dialogue with students of different backgrounds, interacting with students from a different country and race, discussing current events, and following international crisis during high school displayed the strongest effect on global perspectives. The co-curricular activities that students participated in also had higher general effect on global perspectives than courses did. Of the reasons that students gave for not wanting to study abroad, the most frequently stated reasons included not caring about international education/experience, being unwilling to leave the United States, cost, not knowing much about the options available, and expecting engineering to be too difficult to manage the experience.

Amongst the graduating engineering students, multi-cultural courses, service-learning courses, global issues courses, following international crisis, discussing current events, reading the newspaper, and leadership programs participated in during college displayed the strongest effects on students’ global perspectives. The graduating engineering students also experienced stronger effect from the co-curricular activities

than they did courses and experienced stronger effects in both courses and co-curriculars than the first-year students did. As for the high impact educational practices that graduating senior students participated in during college, engineering professional societies, undergraduate research, and internships/co-ops displayed the largest effects on the six scales of global perspectives. Another interesting finding is that study abroad did not display any effect on the six subscales of global perspectives as a whole. This highlights the fact that there needs to be more effort made in focusing on local means of improving global perspectives in students.

Data Collection

In collecting the data for this study a survey instrument was administered to 480 first-year engineering students and 55 graduating senior engineering students at Rowan University. The survey was distributed to students through their engineering clinic courses, a hands-on course that Rowan University engineering students take each semester. All engineering students take this course and were asked to complete the survey voluntarily. The survey instruments were slightly different for each sample. The first-year students were asked to report which of the courses and co-curriculars from the GPI instrument that they participated in during high school and how frequently they did so. They were also asked whether, or not they are interested in having an international experience along with the chance to respond in an open-ended fashion as to why they may have responded “no,” or “maybe.” Lastly, they were asked whether they would like to participate in twelve examples of George Kuh’s high impact educational practices that are offered by Rowan University while in college. In addition to questions about their

prior and future experiences, the survey included the 35-item instrument that is used to determine the numerical values describing each students' global perspectives.

Similarly, graduating engineering students were asked about the courses and co-curricular activities that they participated in while in college and the frequencies of each. They were also asked which of Kuh's high impact educational practices that they participated in while in college. The senior survey also included the 35-item instrument used for quantifying their global perspectives into each of the six scales. Lastly, both surveys included questions regarding each student's personal background such as gender, racial identity, citizenship, parents' education level.

Broader Impact

Engineering employers across the country are calling for students to graduate with skills that will benefit them in the global society. Engineering students are increasingly seeking out these opportunities and educational institutions are rapidly attempting to adopt their program structures to fit such a need. The research presented in this study greatly benefits these researchers and educators by informing them of some specific courses, co-curricular activities, and educational practices that are especially beneficial in enhancing student global perspectives. It even provides insight on exactly which courses and co-curriculars benefit which of the GPI scales most so that educators can adjust their programs based on their students' prior knowledge.

One issue with globally educating engineering students is that not many of them see it as important or seek it out under their own volition. This research gives detailed analysis of why some students do not choose to seek out an international experience and what aspects of their prior education and experiences may have led them to feeling that

way. With this information researchers may use certain beneficial and effective practices to ignite student interest while also broadening their global perspectives, in some cases, unbeknownst to the students themselves.

Organization of Thesis

The organization of this thesis is as follows. Chapter 2 provides a literature background on all the ideas and prior research critical to understanding the organization and driving forces behind my study. It includes subsections detailing the importance of global engineering, what defines a globally prepared engineer, the concept of global perspectives, the landscape of international experiences, important alternatives to study abroad, and specifically the benefits of George Kuh's high impact educational practices. Chapter 3 goes into detail about the data involved in this study, how it was analyzed, and its implementation in answering this study's research questions. Chapters 4 and 5 present all of the results and accompanied discussion of this research in relation to findings of prior research and personal inferences. Chapter 4 details the effects that participation in certain courses and co-curricular activities had on both first-year and graduating engineering students. It also explores the effects of high impact educational practices being implemented with college students. The chapter culminates by comparing the courses and co-curriculars that the first-year and graduating students had in common to analyze the difference in effect of implementing these activities before and during college. Chapter 5 takes a deep dive into the opinions of first-year engineering students and precisely why they either lack interest in having an international experience or do not see it as feasible within their four-year experience at Rowan University. Chapters 6 and 7

conclude the thesis by summarizing the main objectives of this research and building a plan for its involvement in future studies.

Chapter 2

Literature Review

Importance of Global Engineering

Constant advancements in the technologies of communication and transportation have caused the world to become more interconnected and interdependent. This change has especially been felt in the fields of business and engineering. Many companies now have multiple international locations that employees must commonly travel amongst, communicate with, and interact with. In addition to multinational companies, engineers are becoming increasingly expected to combat the world's most dynamic and complex challenges [8]. Two examples of organizations doing this type of work are the Peace Corps. and the National Guard. The need for institutions of higher engineering education to produce engineering graduates that are prepared for a globalized workforce is evident and increasing.

This need has been highlighted by both the professional and educational engineering communities in conferences, national reports, and publications. The National Academy of Engineering (NAE), the National Science Foundation (NSF), and the National Research Council (NRC) have each challenged universities to graduate students who are globally prepared [9-11]. Additionally, ABET requires engineering programs to demonstrate that their graduates have “the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context [12].” Engineering educators and higher education leadership believe

those students who are able to work effectively with colleagues across national, cultural, and ethical boundaries will be more prepared and successful post-graduation [4, 6, 13].

Defining a Globally Prepared Engineer

It is first essential to define what makes an engineering student globally prepared. Global competency is a common term used to describe this attribute but has been defined in many ways amongst researchers. Downey et al simply define engineering global competency as “the ability to work effectively with people who define problems differently than oneself, including both engineers and non-engineers [13].” Lohmann et al highlight the importance of globally preparing engineers, while also defining three new skills required of future engineers [6]. These three skills include 1) broader multidisciplinary base of knowledge, 2) more defined and diverse interpersonal skills, and 3) the ability to live and work comfortably in a transnational engineering environment. A study by Chan and Fishbein later developed five key attributes of a global engineer from research throughout Canada and the world. These attributes include 1) superior communication skills, 2) a facility for multidisciplinary and interdisciplinary teamwork, 3) a well-developed sense of social responsibility and ethics, 4) being entrepreneurial, and 5) an ability to deal with complexity and systems thinking [8]. These definitions and attributes offer valuable insight on the evolution of the industry and the need for change in engineering preparation.

More recently, Jesiek et al performed a study including data from employers and members of the engineering industry as well as case studies and other literature developed on the topic of global engineering. From this study they developed three specific contextual dimensions of global engineering competency. The first being

technical coordination, defined as working with and influencing other people so they conscientiously perform necessary work in accordance with a mutually agreed schedule. The second dimension is understanding and negotiating engineering cultures, which involves the ability to understand and negotiate situations where multi-national differences in technical works practices exist. The final dimension of engineering global competency is navigating ethics, standards, and regulations, which requires awareness of local expectations and the ability to deal with ethical issues arising from cultural, or national differences [14]. Defining engineering global competency continues to gain complexity through the increase in research and popularity of the topic.

In succession to defining the topic come efforts of assessing it, which, if deemed successful, hold a lot of value in educational research. Thus far, multiple instruments have developed and gained popularity with this goal in mind. The Miville-Guzman Universality-Diversity Scale (MGUDS) is one example. It measures diversity contact, relativistic appreciation, and comfort, awareness, and acceptance of other's and their differences [19]. Another is Hammer and Bennet's Intercultural Development Inventory (IDI), which was constructed to measure people's orientations toward cultural differences [20]. In 2010, Ragusa developed an engineering specific instrument called the Engineering Global Preparedness Index (EGPI). It was designed to measure engineering students' preparedness for global workforces. These instruments have all been useful in assessing engineers and non-engineers and quantifying global preparedness and mindsets. Most recently, an instrument was developed by Braskamp, Braksamp, and Engberg called the Global Perspectives Inventory (GPI) [15]. This instrument not only measures participants' global perspectives, but also draws upon certain global and educational

experiences in order to assess what influences may be impacting someone's results. Another global assessment tool has been validated since after this thesis data was collected called the Global Engineering Competency Scale (GECS) [36].

Global Perspectives Inventory

Braskamp, Braskamp, and Engberg state that we live in a global world in which multiple perspectives about knowing, sense of identity, and relationships with others are distinct and serve as powerful influences in our society. They take a view of holistic human development encompassing two theoretical perspectives: intercultural maturity and intercultural communication [22,23]. From these perspectives come the three domains and six scales that Braskamp et al developed to define and describe global perspectives. The first domain is the cognitive domain, which is centered on one's knowledge and understanding of what is true and important to know. This domain contains the scales of knowledge and knowing. The second domain is the intrapersonal domain, which focuses on one becoming more aware of and integrating their personal values and self-identity into their personhood. This domain contains the identity and affect scales. The final domain is the interpersonal domain, which centered on one's willingness to interact with and accept people whom have different social norms and cultural backgrounds. Within the interpersonal domain are the social responsibility and social interaction scales. The relationship between the domains and scales can be exemplified through the figure below.

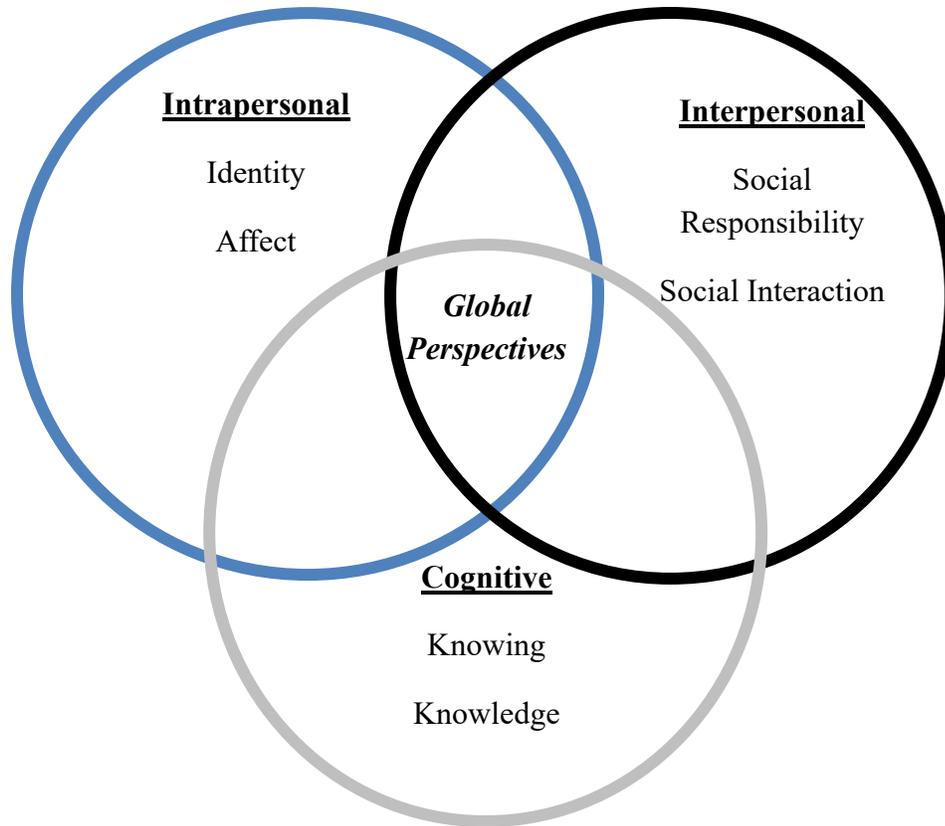


Figure 2. The six scales of global perspectives and their corresponding domains

Table 1

The descriptions of the six scales of global perspectives

Dimension	Scale	Alpha	Description
Cognitive	Knowing	0.66	Degree of complexity of one's view of the importance of cultural context in judging what is important to know and value
	Knowledge	0.77	Degree of understanding and awareness of various cultures and their impact on our global society and level of proficiency in more than one language
Intrapersonal	Identity	0.74	Level of awareness of one's unique identity and degree of acceptance of one's ethnic, racial, and gender dimensions of one's identity
	Affect	0.73	Level of respect for and acceptance of cultural perspectives different from one's own and degree of emotional confidence when living in complex situations, which reflects an "emotional intelligence" that is important in one's processing encounters with other cultures
Interpersonal	Social Responsibility	0.73	Level of interdependence and social concern for others
	Social Interaction	0.70	Degree of engagement with others who are different from oneself and degree of cultural sensitivity in living in pluralistic settings

Researchers and employers alike feel engineering students need to embrace a broader vision of their professional role and have a three-dimensional perspective that encompasses technical, professional, and global attributes [1]. The GPI instrument is designed and constructed so that any person of any age, or specific cultural group can take the set of items and gain quantifiable insight on how they think, feel, and relate to others [15]. It has a variety of uses in research and has accompanied the completion of many studies thus far within engineering and non-engineering disciplines. For example, Engberg & Fox used an early version of the instrument to explore the relationship between undergraduate service-learning experiences and global perspectives. The results demonstrated significant associations between service-learning and aspects of each of the three domains of global perspectives suggesting service-learning to be a valuable tool in the effort to globally prepare students [24]. Additionally, in seeking effect of student motivation to study abroad on intercultural development, Anderson, Hubbard, & Lawton completed a study using the GPI instrument. This study discovered that students who studied abroad in locations considered to be entertainment destinations showed lower GPI results than those who went to more culturally challenging destinations. The study abroad experiences also showed no significant effect on students GPI results [25].

Another example of the GPI being used in research is one that preempts this thesis. Engberg & Davidson studied student pre-college engagement and its effect on the development of a global perspective. The study included over 3,000 participants from institutions across the country that were all entering their first year of college. The results displayed significant relationships between precollege engagement and the knowledge, affect, and social responsibility scales of global perspectives. In particular, the results

linked precollege involvement in curricular and co-curricular opportunities focused on learning about difference, global issues, and leadership and service opportunities in development of all domains of global perspective from the GPI [26]. Results in this study were a motivating factor in the exploration of the first-year students pre-college experiences in this thesis and takes the exploration a step further by analyzing the same experiences being completed in college and comparing the two.

The GPI is a very valuable instrument in the field of global engineering education and this thesis research due to the way it quantifies students' global perspectives. Measuring global perspectives and analyzing their change in students enables engineering educators to test the effectiveness of certain programs, courses, projects, and more in their ability to globally prepare students. Current research shows that international experiences, like study abroad, are the most commonly mentioned strategy in globally preparing students and broadening their perspectives [30, 31]. Alan Parkinson highlights the need for more involvement in these experiences from engineering students while explaining the current formats, best practices, and challenges surrounding study abroad programs for engineers. [9].

Study Abroad for Engineers

Parkinson reviewed many study abroad programs across the country and identified nine main program formats that are used within engineering education. The nine main program formats and their descriptions are as follows.

Table 2

Engineering Study Abroad Program Formats

Program Format	Description
Dual Degree	Students obtain two degrees – one from the home university and one from the abroad university.
Exchange	Students from home and abroad university are exchanged and take regular courses in the abroad language.
Extended Field Trip	1-3 week tour involving visits to numerous countries, companies, and/or universities
Extension	Home university operates a pseudo-extension campus in the abroad country
Internship/Co-op	Students work abroad at a foreign company or at an international branch of a U.S. company.
Mentored Travel	Under the guidance of a faculty member, students travel to abroad country and study and/or tour for 4+ weeks
Partner Sub-contract	Home university partners with an abroad university and contracts courses to be taught to the home university's students
Project-based Learning/Service Learning	Students travel abroad and are immersed in another culture via a project that connects technology with the abroad society
Research Abroad	International experiences for students which involve research

A result of research from P.J. Pederson supported evidence that simply sending students to a location abroad for academic study is not sufficient toward facilitating the larger goal of creating effective global citizenship [17]. With this in mind, a particular program format that is currently growing in popularity is the mentored travel. These types of programs are being practiced in shorter length and often referred to as short-term

faculty led experiences. A study completed by Celeste Gaia utilized the GPI as a pre-post test instrument to test the effectiveness of faculty-led study abroad experiences lasting three weeks, or less. This study found these experiences to be effective in enhancing participants' understanding and awareness of other cultures and languages, appreciation of the impact of other cultures on the world, and awareness of their own identity. However, these programs may need to address the value of living in complex situations, respect and acceptance of varying cultural perspectives, and a greater sense of responsibility of others more fully [27].

Regardless of the format type, engineering students remain underrepresented amongst the population of students studying abroad. Though increasing, engineers only make up about 5% of the students studying abroad each year as of 2017 according to the Open Doors Report from the Institute of International Education [16]. This is due to many perceived barriers specific to engineering students. With study abroad being the main way that students broaden their global perspectives, the majority of students are not getting the exposure to global learning needed in preparing them for the modern workforce. Grandin and Hirleman identified sixteen obstacles and hurdles that engineering students face in the path of achieving a more global engineering education. High on this list is the lack of international education as tradition in engineering curricula and its more common association with fields in the humanities. Another important disincentive on this list is the rigidity of the very demanding and lockstep engineering curriculum, making it difficult to leave campus, difficult to transfer credits back from a foreign institution, even difficult to take preparatory courses, such as language classes, in anticipation of time spent abroad. The academic rewards system also tends to focus on

teaching, research, and competing for research dollars, which discourages faculty from investing time in the development of international programs. There are no promotion and tenure rewards for sending students abroad or for arranging exchange programs or other special international academic opportunities. In addition to all of these obstacles, another difficult and popular hurdle that students and their families face is cost [7]. Scholarship and financial aid are often scarce or extremely competitive for study abroad experiences which are very costly to both the student and university.

Eliminating these barriers completely may not be an achievable goal and the process of doing so will be a lengthy and difficult one. In the meantime, it is important that universities are preparing their students for the globalized workforce whether they choose to study abroad, or not. To do so universities must look into local means of globally preparing their students. Downey et al. are among the scholars who realize the role of this programmatic change as “an at home effort to initiate students on the path to global competency in ways that fit their standard curricula [13].” Though research has shown international experiences, such as study abroad, to be the most common way of increasing global preparedness, certain local means have shown promise in doing so as well. In addition to study abroad and personal tourism abroad, Levonisova et al. found service learning and courses with a global focus to have positive correlations with learning outcomes related to global preparedness. The combination of the four was found to be significantly related to students’ GPI scores [28]. Miller and Gonzalez ran a comparative study between two service-learning projects – an international one that took place in China and a domestic one that took place in California. Though the international service experience was determined to be more impactful than the domestic experience,

both show a positive effect on learning outcomes regarding academic achievement, civic engagement, career goal clarification, and the development of cultural competencies [29]. These studies highlight the potential and need for local practices of improving global perspectives, such as George Kuh's high impact educational practices.

High Impact Educational Practices

Liberal Education and America's Promise (LEAP) is a decade long-initiative launched by the Association of American Colleges and Universities (AAC&U) in 2005 to align the goals for college learning with the needs of the new global century [18]. LEAP seeks to engage the public with core questions about what really matters in college and is especially concerned with students who have been underserved in higher education historically. The aims of a liberal education include broad knowledge, strong intellectual skills, and a grounded sense of ethical and civic responsibility. The LEAP initiative resulted in four learning outcomes deemed essential in reaching these aims. The learning outcomes include knowledge of human cultures and the physical and natural world, intellectual and practical skills, personal and social responsibility, and integrative and applied learning.

George Kuh, member of the LEAP National Leadership Council (NLC), teamed up with LEAP and developed 10 high impact educational practices with these four learning outcomes in mind. Educational research suggests that these practices increase rates of student retention and engagement. The ten practices and their descriptions can be found in Table 3, below.

Table 3

Kuh's High Impact Educational Practices

High Impact Educational Practice	Description
First-year Seminars and Experiences	Programs that bring small groups of students together with faculty or staff on a regular basis
Common Intellectual Experiences	A set of required common courses or a vertically organized general education program
Learning Communities	An environment that encourages integration of learning across courses and to involve students with questions that matter beyond the classroom
Writing Intensive Courses	Courses that emphasize writing at all levels of instruction and across the curriculum
Collaborative Assignments and Projects	Assignments in which students learn to work and solve problems in the company of others
Undergraduate Research	Connecting key concepts and questions with involvement in systematic investigation
Diversity/Global Learning	Courses and programs that help students explore culture, life experiences, and worldviews different from their own
Service/Community-Based Learning	Field-based experiential learning with community partners
Internships	Providing students with direct experience in a work setting
Capstone Courses and Projects	Culminating experiences requiring students to create a project of some sort that integrates and applies all they've learned

The majority of the high impact educational practices developed by Kuh can be executed within local, national borders, and/or on-campus. Many are even already offered by a lot of universities across the country. They have been proven effective by prior research in higher education but have not been tested sufficiently within the engineering space [18]. The effectiveness of these practices in producing globally prepared students is especially worthy of exploration amongst engineering students since it is difficult for them to fit global learning, or study abroad into their curricula. This effect is one of many that this thesis will explore to better universities' efforts in globally preparing their students.

Chapter 3

Research Approach

Data and Methodology

In an effort to better comprehend the experiences engineering students have before college and during college and how they affect student global perspectives and interests in certain international educational practices, two samples were analyzed: engineering students entering their first year of college and graduating engineering students in their last semester. Data was collected from each of these sample groups using a survey instrument that included items from the GPI as well as some additional parts and questions. The survey retrieved slightly different information from each of the two groups. From first-year engineering students the survey acquired information regarding their educational background (courses and co-curriculars) from high school, their global perspectives (GPI instrument), and their desire to have an international experience or any of Kuh's other high impact educational practices while in college. From graduating engineering students, the survey retrieved information regarding their educational background (courses & co-curriculars) during college, their global perspectives (GPI instrument), and which of Kuh's high impact educational practices they participated in while in college. This information is displayed below.

Table 4

The information retrieved from each sample by their respective surveys to be analyzed and compared

First-Year Engineering Students	Graduating Engineering Students
Courses taken in high school	Courses taken in college
Co-curricular activities in high school	Co-curricular activities in college
Global Perspectives	Global Perspectives
<i>Interest in:</i> <ul style="list-style-type: none"> a. International Experience in college b. High Impact Educational Practices in college 	<i>Participation in:</i> <ul style="list-style-type: none"> a. High Impact Educational Practices in college

The key difference to note in Table 4 includes that the first-year students are asked about the experiences that they had while in high school and *wish to have* during college, while graduating students were simply asked about experiences they *had during college*. This set up the study so that the data from each sample could be analyzed individually and comparatively, thus, answering the research questions. Another difference in surveying the two groups includes gathering the first-year students' interest in having an international experience, which if students lack, they are offered the opportunity to provide a reason explaining why they feel that way. This information was beneficial in answering the third research question. Among both surveys, students were asked how many courses that they had, how frequently they participated in co-curricular

activities, and whether or not (yes or no) they had interest in, or participated in any high impact educational practices.

In examining the first-year sample, multiple relationships were sought out. The first were the relationships that the courses first-year students took and the co-curricular activities they participated in during high school have with the students' global perspective scales. The effect that participation levels in these courses and co-curriculars have on global perspectives offers insight into what experiences develop global mindsets and a better idea of what experiences students are coming into college with. Another relationship examined that includes the courses and co-curricular activities is the one they have with student interest in certain high impact educational practices. These practices were designed with the goal of producing students better prepared to be global members of society and knowing which experiences harbor interest in them is immensely beneficial. First-year student interest in these practices also connects well to the senior portion of this study examining the practices' effectiveness on developing global perspective scales, elaborated on later.

The last of the information collected from the first-year engineering students was regarding their interest in having an international experience while in college. Students have the opportunity to state their level of interest in having an international experience by responding with a "yes," "no," or "maybe" on their survey. Students that respond "no" or "maybe" are prompted with an open-ended question asking them to state why they responded in such a way. The global perspectives were examined and compared amongst the students that responded "yes," "no," and "maybe" and a thematic analysis of

the student open-ended responses was done by dividing them into commonly mentioned themes and categories, as displayed in Table 5.

Table 5

Three examples of student open-ended responses of why they did not wish to pursue an international experience and the reason category they were assigned to

Student Open-ended Response	Assigned Reason Category
“I don’t really care about it”	Does not care about international education/experience
“It doesn’t fit into my schedule”	Difficulty in engineering
“America is the greatest country in the world. Why would I leave?”	Unwilling to leave the United States

Three of the most commonly mentioned themes included 1) not caring about an international experience/education, 2) being unwilling to travel outside of the U.S., and 3) cost. The first-year sample’s average course and co-curricular participations were organized by students who responded “yes,” “no,” and “maybe” and then by the themes corresponding to the “no” and “maybe” students. This allowed for an examination of the effect that participation in certain courses and co-curricular activities in high school had on their interest in an international experience as well as their reason(s) behind that interest or lack thereof.

Harboring interest does not benefit students without knowing which experiences are best to harbor interest in. The information gathered from the graduating students was used to try and figure this out by seeking effect from the courses, co-curricular activities, and educational practices students participated in during college on global perspective

development. This information not only provides insight on which practices are best to emphasize but was compared to the same experiences students had in high school in order to theorize when it is best for students to have them.

The last portion of the study included comparing the information gathered from each sample to one another. To do so, the average global perspective scales of the first-year students were compared to those of the graduating students, which provided insight on the potential for global development at their institution. In Braskamp, Braskamp, and Engberg's research they surveyed students of all majors from one hundred universities across the country to acquire average global perspective scales that are considered national norms [15]. They are divided by year and were compared to each of the samples' averages in order to determine where these engineering students compare to the average student across the country. This is done in search of more evidence for the need of increased awareness toward global preparation by engineering educators, especially at this university.

Instrumentation and Variables

This study was implemented using two survey instruments both heavily based on Braskamp, Braskamp, and Engberg's GPI instrument, but with some additions in order to include George Kuh's high impact educational practices in the analyses. The GPI instrument has many forms with two of which being a "New Student Form" and another a "General Student Form." In this study, the parts of the first-year survey from the GPI are from the New Student Form and the parts of the senior survey from the GPI are from the General Student Form [15]. Both surveys included four parts that each varied slightly depending on which sample they were applied. The first part asked students about their

educational backgrounds including certain courses and co-curricular activities that they participated in. First-years are asked which of the experiences they had in high school, while graduating students are asked which they had in college. The wording of the survey and selection options for each sample were as follows.

Table 6

Course and co-curricular questions from each student survey

First-year Survey: In high school , how many courses have you taken in the areas below?	
Graduating Senior Survey: In college , how many courses have you taken in the areas below?	
Multicultural/addressing issues of race, ethnicity, gender, class, religion, or sexual orientation	Foreign Language
World History	Service-Learning
Global Issues	With opportunities for intensive dialogue among students from different backgrounds
Participant Response Options: 0, 1, 2, 3, 4, 5 or more	
First-year Survey: In high school , how often have you participated in the following?	
Graduating Senior Survey: In college , how often have you participated in the following?	
Events/activities sponsored by groups reflecting your own cultural heritage	Events/activities sponsored by groups reflecting cultural heritage different from your own
Religious/spiritual activities	Leadership programs that stress collaboration and teamwork
Community service activities	Attend a lecture, workshop, or campus discussion on global issues
Read a newspaper/magazine	Watched a news program on TV
Followed an international event/crisis	Discussed current events with other students
Interacted with students from a country different from their own	Interacted with students from a race/ethnic group different from their own
Participant Response Options: Never, Rarely, Sometimes, Often, Very Often	

The next important part of the survey includes Kuh’s high impact educational practices. The first-year survey asks solely about *interest* in these activities and includes a question that is not included in the survey given to seniors. This question is “Are you interested in participating in an international experience (i.e., study abroad) while at Rowan University?” which first-year students are given the option of responding “yes,” “maybe,” or “no” to. Students that respond “maybe” or “no” are given the chance to supply an open-ended response for why they lack interest in having an international experience.

Table 7

Part of first-year student survey acquiring information regarding student interest in having an international experience

First-year Survey: Are you interested in participating in an international experience (i.e., study abroad) while at Rowan University?		
Yes	Maybe	No
Maybe/No?	What is the reason for being unsure of or not wanting to participate in an international experience?	

Following this question, is one that was included in both surveys, but in slightly different manners. This question asks the first-year sample which of Kuh’s high impact educational practices they are *interested* in participating in during college, while the senior survey asks students which of the practices they *did* participate in during college.

For these questions, participants simply responded whether they were/were not interested or did/did not participate in the experience listed, unlike the first part of the survey where students were asked to report *frequency* of participation. The wording of the questions for each survey along with the educational practices that each group of students chose from is as follows.

Table 8

Portion of the student survey asking about experience and interest in George Kuh's high impact educational practices

First-year Survey: Which of the following are you interested in pursuing as an undergraduate student at Rowan University?	
Graduating Senior Survey: Which of the following did you pursue as an undergraduate student at Rowan University?	
First Year Seminars	Learning Communities
Engineers Without Borders	Undergraduate Research Experiences
Internships/Co-ops	Additional Writing Intensive Courses
Engineering Conferences	Global Engineering Courses
Study Abroad	Engineering Professional Societies
Student Government	Volunteering Regularly
Participant Response Options: Check, No check	

The next part of the survey is extremely important because it is responsible for assessing the global perspectives of each student in a detailed and quantified manner. This section includes the 35-item instrument developed by Braskamp, Braskamp, and Engberg for measuring global perspectives in students. This instrument is a list of statements made about how participants may, or may not interact with the world around them, to which participants responds how strongly they agree with such statement on a 5-point Likert scale: Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree. A

portion of the 35 items corresponds to each of the six scales of global perspectives defined in Chapter 2: Cognitive Knowing, Cognitive Knowledge, Intrapersonal Identity, Intrapersonal Affect, Interpersonal Social Responsibility, and Interpersonal Social Interaction. Depending on how strongly students agree or disagree with certain items within the GPI instrument they receive an average value for global perspectives within each scale. The values are always between zero and five because they are calculated using 5-point Likert scale responses. An example of these statements with each of the scales they correspond to is below.

Table 9

The six scales of global perspectives with corresponding sample items from the GPI instrument

Scale	Subscale	Alpha	Sample Index Item
Cognitive	Knowing	0.657	"I consider different cultural perspectives when evaluating global problems"
	Knowledge	0.773	"I can discuss cultural differences from an informed perspective"
Intrapersonal	Identity	0.740	"I know who I am as a person"
	Affect	0.734	"I do not feel threatened emotionally when presented with multiple perspectives"
Interpersonal	Social Responsibility	0.732	"I think of my life in terms of giving back to society."
	Social Interaction	0.700	"I frequently interact with students from a country different from my own."

The third column in Table 9. contains the coefficient alpha values for each of the GPI scales calculated by Braskamp, Braskamp, & Engberg in determining the reliability

of their instrument. The reliability of their instrument was determined through testing for internal consistency, which was done by having students take the survey then take it again three weeks later and see if these students make the same selections. The more similar the student responses, the more internally consistent and reliable the instrument is. The alpha column contains the alpha values calculated for this instrument. They are typically used to measure the internal consistency within a single sample and to ensure that students are responding in the same manner to multiple question prompts with the same construct of interest [33].

The final part of the survey instrument used in this study asks participants for information on their personal background. This information is important to be sure the samples properly represent the population of interest and to explore further trends displayed in the data. This section includes about nine questions that all originate from Braskamp, Braskamp, and Engberg's GPI instrument. These questions ask about the participant's gender, academic year, academic major, country of birth and citizenship status, racial identity, and second languages in the following format.

Table 10

Personal background questions from student survey for gathering description of each sample

What is your gender?	Please indicate your academic level.	Please indicate your major at Rowan University.
Which of the following most accurately describes your country of birth and citizenship status?	How long have you lived in the United States?	Have you lived outside of the U.S.? How long?
How do you identify yourself racially/ethnically?	Do you know one or more second languages?	Can you converse in your second language? Can you take an academic course in your second language?

Sample

This thesis gathered and analyzed data from a total of 535 Rowan University engineering students consisting of 480 first-year students and 55 graduating students. These students were surveyed as part of signing up for their first-year and senior engineering clinic courses, which every engineering student at Rowan University must sign up for each semester. Though they must sign up for the course, they were not required to complete the survey so respondents were acquired on a voluntary basis. This study was submitted and approved by the Rowan University Institutional Review Board (#Pro2018000043). Amongst these samples there are some demographic distributions worth noting.

Table 11

Gender breakdown of each sample

	First-year Engineering Students	Graduating Engineering Students
Male	76%	70.9%
Female	22.5%	29.1%

Table 11 shows that both samples were male-dominant. It would be ideal to have more of an evenly split sample, but unfortunately this result is an example of a bigger issue amongst many universities and the engineering professional community. Women are drastically underrepresented within the field of engineering both in industry and academics. According to an American Society of Engineering Education (ASEE) study by Joseph Roy females made up 21.9% of the undergraduates enrolled in engineering programs in 2018 [32]. By these numbers the sample is actually higher than average.

Table 12

Racial/ethnic identity breakdown of each sample

	First-year Engineering Students	Graduating Engineering Students
African	4.0%	1.8%
Asian	8.8%	7.3%
Pacific Island	0.8%	3.6%
Indigenous Person (Aboriginal, Alaskan Native, Maori, Native American, etc.)	2.1%	1.8%
Hispanic, Latino/Chicano	8.8%	5.5%
Arab or Middle Eastern	2.1%	1.8%
Caucasian European, not Hispanic	82.7%	83.6%
I choose not to self-identify	2.7%	1.8%

The racial/ethnic identity of the participants in each sample shows that they disproportionately identified as Caucasian. A research study with more control over the sample may try to balance out the diversity amongst the samples, but this disproportionality is another common one in the industry and academic communities of engineering. According to an analysis done by Yoder this disproportion is accurate, but drastically exaggerated in this sample. The study found students enrolled in undergraduate engineering programs in the United States to consist of 55% Caucasian, 13% Asian, and 10% Hispanic identifying students. This sample had a much higher percentage of Caucasian students than the study done for ASEE by Roy [32].

Table 13

The breakdown of engineering disciplines within the sample

	First-year Engineering Students	Graduating Engineering Students
Biomedical Engineering	9.2%	0%
Civil and Environmental Engineering	20.2%	16.4%
Chemical Engineering	12.1%	20.0%
Electrical and Computer Engineering	27.1%	18.2%
Engineering Entrepreneurship	1.9%	9.1%
Mechanical Engineering	29.6%	36.4%

According to Table 13, both samples contained the most students studying majors of mechanical engineering, electrical and computer engineering, and civil and environmental engineering. According to Roy across the country the most engineering degrees were awarded to mechanical engineers, computer engineers, electrical engineers, and civil engineers in that order. Their percentages of the sample were 24%, 12%, 10%, and 9.5% respectively. This shows that the samples are representative of the population of engineering students nationwide while showing a higher concentration of civil engineers than the national average [32]. For more percentages of personal background information of the samples included in this study, see the Appendices.

Analysis

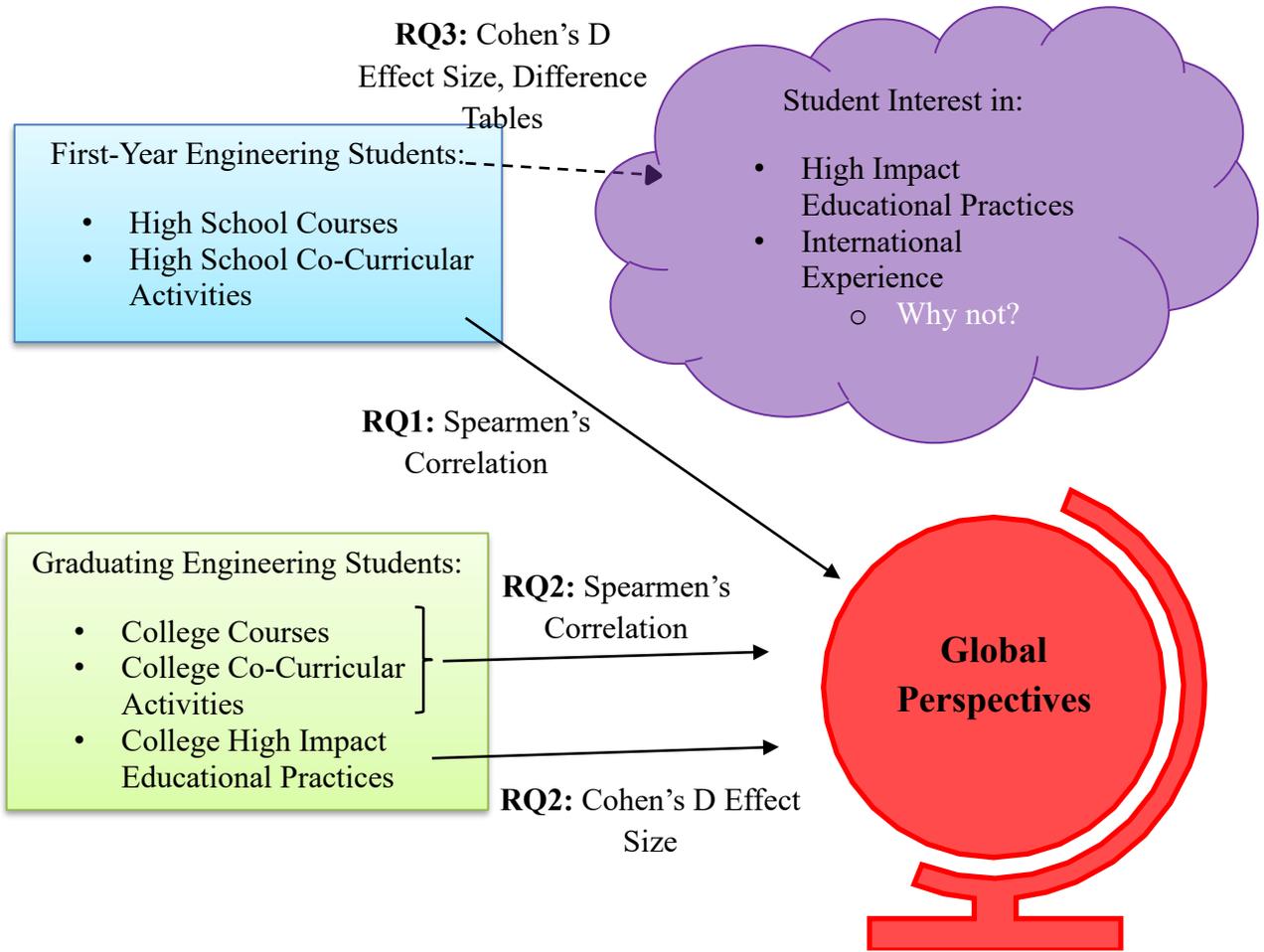


Figure 3. Analytic framework of this thesis

As pictured in Figure 3, different methods of statistical analysis were used in relating each of these variables and answering the research questions. In order to answer research questions one and two by testing the relationships between the courses and co-curriculars they experienced and their global perspective scales, Spearman's correlation coefficients were calculated. The Spearman's correlation is commonly used to measure

the strength and direction of association between two ranked variables when the assumptions of the Pearson correlation are clearly violated [34]. These correlation coefficients were calculated using the software IBM SPSS Statistics 26 as well as p-values for each test. Correlation coefficients take on a value between zero and one, expressing percentage of variability in one variable that can be represented by the variability in the other.

Another analysis used to answer the second research question is Cohen's d effect size. This was used to test the effect that the participation in high impact educational practices during college had on the global perspectives of the graduating engineering students. An effect size was used for this data because the responses for student participation were binary, meaning just having two options, unlike the ranked data used for the Spearman's coefficients [35]. Cohen's d effect sizes were also used in answering the third and final research question. Effect sizes were calculated between how often the first-year engineering students participated in certain courses and co-curriculars during high school and whether or not they were interested in Kuh's high impact educational practices.

The final analysis of this study did not include any formal statistical testing. Students were divided by their responses (yes, no, or maybe) to whether or not they were interested in having an international experience while at Rowan University. Difference values were calculated between the average quantity of a course, or co-curricular activity to see which experiences students with interest in an international experience had more or less of. The reasons students gave for responding "yes," "no," or "maybe" were analyzed

in a similar manner to see which experiences students had more or less of depending on the reason they gave.

Organization of Results

The results of this thesis are organized by research question. Chapter 4 contains the results in regards to the first two research questions which include the effects that participation in courses, co-curricular, and HIEPs has on first-year and graduating engineering students. The first research question isolates the first-year sample and examines the effect that their participation in courses and co-curricular activities in high school had on their global perspectives. The second focuses on the graduating engineering students in testing the effect their participation in courses, co-curricular activities, and HIEPs during college has on their global perspectives as well as a comparison between the two samples.

Chapter 5 discusses how the results of this thesis answer the third research question focusing on first-year student interest in having an international experience and/or HIEPs during college. This chapter addresses this research question by examining the relationship between participation in courses and co-curricular activities in high school and interest in the HIEPs as well as exploring the reasons students may not want to have an international experience. The chapter concludes with the exploration of the relationship between these reasons and the courses and co-curricular activities students participated in during high school.

Chapter 4

The Effect of Courses, Co-Curriculars, and HIEPs on the Global Perspectives of First Year and Graduating Engineering Students at Rowan University

This chapter discusses how the results of this study answer research questions one and two regarding courses, co-curricular activities, and educational practices and their effects on the global perspectives of first year and graduating engineering students. To answer the first research question, Spearman's rank correlation coefficients were calculated between the courses and co-curricular activities first-year students had in high school and their GPI scales. To answer the second research question, Spearman's correlation coefficients were also calculated between the courses, co-curricular activities, and HIEPs that graduating engineering students had during college and their global perspectives.

The chapter concludes with a comparison of the resulting global perspectives of the first year students and graduating students, while also comparing these results to those of Braskamp et al. who surveyed students from 100 universities across the country [18]. Their sample did not only include students within the engineering disciplines, but students of all majors.

RQ1: How do Precollege Courses and Co-curricular Activities Effect the Global Perspectives of First-Year Engineering Students?

To answer the first research question, Spearman's correlations were calculated in order to test the effectiveness of first-year students having certain courses and co-curriculars before college. These correlation coefficients are displayed in Table 14.

Table 14

Spearman's correlation coefficients between high school courses and GPI subscales including statistical significance of each

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Multicultural Course	0.149	0.119	0.142	0.074	-0.026	0.127	0.098
Sig. (2-tailed)	0.001	0.009	0.002	0.103	0.571	0.005	
Foreign Language Course	0.113	0.031	0.041	0.090	0.072	0.034	0.064
Sig. (2-tailed)	0.013	0.504	0.365	0.050	0.113	0.464	
World History Course	-0.059	-0.024	0.069	-0.078	-0.127	0.034	-0.031
Sig. (2-tailed)	0.195	0.605	0.133	0.086	0.005	0.452	
Service Learning Course	0.085	0.038	0.078	-0.047	-0.079	0.152	0.038
Sig. (2-tailed)	0.063	0.410	0.090	0.300	0.086	0.001	
Global Issues Course	0.078	0.067	0.062	0.014	0.033	0.156	0.068
Sig. (2-tailed)	0.087	0.144	0.173	0.754	0.465	0.001	
Dialogue Opportunity	0.137	0.093	0.163	0.157	0.099	0.207	0.143
Sig. (2-tailed)	0.003	0.042	0.000	0.001	0.029	0.000	
Average Correlation	0.084	0.054	0.093	0.035	-0.004	0.118	

From these correlations it is evident that *courses with an opportunity for intensive dialogue with students of different backgrounds* had the strongest general effect on GPI, which is expressed by its average correlation value of 0.143, which is more than each of the other types of courses. These types of courses showed to have some of the highest correlations of the group with correlations of 0.207, 0.163, and 0.157 in the *knowledge*, *identity*, and *affect* subscales respectively. Recalling from the literature review section that the knowledge subscale has to do with the complexity of one's view of the importance of cultural context in judging what is important to know and value. According to this data, students who took more of these courses see cultural context as something important to know and value. Identity has to do with a person's level of awareness of their unique identity and degree of emotional confidence in complex situations. The correlation expresses students with many of these courses that include intensive dialogue with multicultural students showed to have higher emotional confidence in these complex situations. Correlation in the affect subscale shows these students as having a higher level of respect for and acceptance of cultural perspectives different from their own, the more of these courses they took.

The course that showed the next highest average correlation with the GPI subscales at 0.098 is the *multicultural course that addresses issues of race, ethnicity, gender, class, religion, or sexual orientation*. It showed highest correlations in the subscales of *social responsibility*, *identity*, and *knowledge* with correlations of 0.149, 0.142, and 0.127 respectively. The high correlation in social responsibility shows the students exhibited a stronger level of interdependence and social concerns for others when having more of these multiculturally focused courses. These courses also raise the

level of awareness students have of their own identity in terms of ethnicity, race, and gender, expressed through its correlation with the identity subscale. Multicultural courses' correlation in the knowledge subscales shows students with more of these courses have a high degree of understanding and awareness of various cultures and their impacts on our global society. They may also show proficiency in more than one language.

An interesting outcome from these results is that students who had many *world history courses* actually showed a negative average correlation of -0.031. Though it is a small value the negative is certainly surprising. Its correlation with the knowledge subscale of -0.127 is not a small correlation in comparison to the other results regarding high school courses and expresses that students who had more world history courses in high school lack a degree of understanding and awareness of various cultures and their impact on our global society. This may occur if American world history courses at the high school level happen to be ethnocentric and display history in a manner that emphasizes American ways and cultures as “right” while denouncing others.

Among the six subscales, *knowledge*, *identity*, and *social responsibility*, showed the highest average correlations in these courses while in high school. This exemplifies that students who participated in many of the courses included in the Global Perspectives Inventory instrument showed a higher degree of understanding and awareness of various cultures and their impact on our global society, an increased level of awareness of one's unique identity and degree of acceptance of their own differences within their cultural environment. In addition to high school courses, the co-curricular activities that students participated in before college were tested to see their effect on the GPI subscales.

Table 15

Spearman's correlation coefficients between frequency of co-curricular activities participated in during high school and the six GPI scales including the statistical significance of each

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Reflect Own Heritage	0.232	0.111	0.118	0.081	-0.020	0.200	0.120
Sig. (2-tailed)	0.000	0.015	0.010	0.075	0.668	0.000	
Reflect Diff Heritage	0.255	0.234	0.068	0.250	0.139	0.195	0.190
Sig. (2-tailed)	0.000	0.000	0.135	0.000	0.002	0.000	
Religious Activity	0.141	0.109	0.215	0.039	0.032	0.082	0.103
Sig. (2-tailed)	0.002	0.017	0.000	0.394	0.478	0.072	
Leadership Program	0.334	0.110	0.215	0.158	0.084	0.217	0.186
Sig. (2-tailed)	0.000	0.016	0.000	0.000	0.065	0.000	
Community Service Act	0.403	0.133	0.154	0.192	0.101	0.145	0.188
Sig. (2-tailed)	0.000	0.004	0.001	0.000	0.028	0.001	
Global Lecture	0.245	0.136	0.113	0.113	0.020	0.176	0.134
Sig. (2-tailed)	0.000	0.003	0.013	0.013	0.669	0.000	

Table 15 (continued)

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Read News	0.197	0.073	0.105	0.188	0.180	0.226	0.162
Sig. (2-tailed)	0.000	0.110	0.021	0.000	0.000	0.000	
Watched News	0.164	0.168	0.129	0.132	0.018	0.266	0.146
Sig. (2-tailed)	0.000	0.000	0.005	0.004	0.693	0.000	
Followed Int Crisis	0.192	0.095	0.163	0.236	0.188	0.398	0.212
Sig. (2-tailed)	0.000	0.038	0.000	0.000	0.000	0.000	
Discussed Current Event	0.183	0.119	0.207	0.236	0.218	0.321	0.214
Sig. (2-tailed)	0.000	0.009	0.000	0.000	0.000	0.000	
Interacted Diff Country Students	0.187	0.476	0.105	0.208	0.135	0.246	0.226
Sig. (2-tailed)	0.000	0.000	0.021	0.000	0.003	0.000	
Interacted Diff Race Students	0.148	0.480	0.062	0.312	0.185	0.158	0.224
Sig. (2-tailed)	0.001	0.000	0.174	0.000	0.000	0.001	
Average Correlation	0.223	0.187	0.138	0.179	0.107	0.219	

From these correlations it is evident that *interacting with students from a country different than one's self* and *interacting with students from a race/ethnic group different from one's own* showed the highest average correlations with the GPI subscales at 0.226 and 0.224 respectively. Both courses expressed their highest correlations with the *social interaction* subscale, which shows that these students have experience in and do well engaging with others who are different from themselves. They also exhibit a higher degree of cultural sensitivity in pluralistic settings. Having many interactions with students of a different racial group also showed a higher correlation in the *affect* subscale of 0.312, which shows these students have a heightened level of respect for and acceptance of cultural perspectives different from one's own and a high degree of emotional confidence in complex situations. Having interactions with students from a country different than one's self also showed a higher correlation in the *knowledge* subscale showing that these students have a higher degree of understanding and awareness of cultures and their impact on society.

Student involvement in *discussing current events* and *following an international crisis* resulted in the next two highest average correlations of 0.214 and 0.212 respectively. They both showed highest correlations in the *knowledge* subscale of 0.321 for *discussing current events* and 0.398 for *following an international crisis*. This expresses that these students have a heightened degree of understanding and awareness of various cultures and their impact on our society as a whole. From the co-curricular activities as a whole, strongest effect sizes were found in the *social responsibility*, *knowledge*, *social interaction*, and *affect* with average correlations of 0.223, 0.219, 0.187, and 0.179 respectively. This shows that students that participated in these co-curricular

activities often exhibited higher levels of interdependence and social concern for others, more understanding and awareness of various cultures and their impact on society, a higher degree of engagement with others who are different from themselves, and a higher level of respect for and acceptance of cultural perspectives different from one's own.

In comparing the courses that these students took in high school to the co-curricular activities that they participated in during that time, we see that the co-curricular activities generally show higher correlations with global perspectives than the courses do. This is evident when looking at both the highest correlations and average correlations found in each with the co-curriculars showing correlations above 0.40 in some subscales, while the courses having only one correlation slightly above 0.20. The definition of a correlation states that the coefficient defines the percentage of variability in one variable that can be explained by the other. For example, we see in Table 15 that the correlation coefficient found between *interacting with a student of racial/ethnic background different from one's own* and the *social interaction* subscale was 0.480. This means that 48% of the variability in the students' social interaction perspectives can be explained by the variability in their interactions with students of different racial/ethnic backgrounds. In Table 15, below the correlation coefficient, the statistical significance of the correlation test is displayed. This value is the probability of committing a Type II error, or rejecting the null hypothesis when it was incorrect to do so. The null hypothesis, in this case, being that the students' frequency in interacting with students of different racial/ethnic backgrounds than their own had no effect on their outcome in the social interaction subscale, or more generally, that the course/co-curricular at hand had no effect on said subscale of global perspectives.

RQ2: How do the Courses, Co-curriculars, and HIEPs that Graduating Engineering Students Participated in During College Effect their Global Perspectives?

To answer the second research question Spearman's correlations were calculated to examine the relationship between the course, co-curriculars, and HIEPs that graduating engineering participated in during college and their global perspectives. These correlations are presented in Table 16.

Table 16

Spearman's correlation coefficients between frequency of courses participated in during college and the six GPI subscales including the statistical significance of each

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Multicultural Course	0.021	0.249	0.166	0.139	0.207	0.210	0.234
Sig. (2-tailed)	0.880	0.067	0.225	0.311	0.130	0.124	
Foreign Language Course	-0.081	0.203	-0.065	0.157	0.109	-0.008	0.048
Sig. (2-tailed)	0.557	0.137	0.638	0.253	0.430	0.954	
World History Course	0.034	0.085	-0.120	-0.034	0.115	-0.028	0.038
Sig. (2-tailed)	0.803	0.539	0.382	0.806	0.404	0.841	
Service Learning Course	0.193	0.226	-0.157	0.007	0.045	0.153	0.163
Sig. (2-tailed)	0.158	0.097	0.251	0.962	0.742	0.264	
Global Issues Course	0.028	0.268	0.078	0.152	0.32	0.211	0.251
Sig. (2-tailed)	0.841	0.048	0.572	0.267	0.017	0.121	
Dialogue Opportunity	-0.094	0.196	0.062	0.095	0.326	-0.099	0.115
Sig. (2-tailed)	0.494	0.152	0.654	0.490	0.015	0.471	
Average Correlation	0.017	0.204	-0.006	0.086	0.187	0.073	

Of the courses that the graduating engineering students participated in during college, it is evident that having a *global issues course*, a *multicultural course*, and a *service-learning course* had the most effect on the six global perspective subscales as a whole. The three resulted in the highest average correlation coefficients of 0.251, 0.234, and 0.163 respectively. Global issues courses and multicultural courses both showed largest effects in the *social interaction* and *knowledge* subscales, meaning that students with these courses in college displayed a higher degree of engagement with others who are different from oneself with heightened cultural sensitivity and a degree of understanding and awareness of various cultures and their impact on society. Student participation in *service learning courses* displayed their largest correlation in the *social interaction* subscale as well showing these students also exhibit a higher degree of cultural sensitivity when engaging with others from different backgrounds than them.

Another interesting result to point out is the highest correlation coefficient of the group which is that between having *courses with opportunity for dialogue with students of different backgrounds* and the global perspective subscale of *knowing* at 0.326. This correlation also has a low p-value of 0.015 showing it is statistically significant at the 95% confidence interval. It suggests that the graduating engineering students who had many of these courses exhibited a complex view of the importance of cultural context in judging what is important to know and value.

Overall, participation in these courses with global aspects showed the highest correlations in the *social interaction* and *knowing* subscales with average correlation coefficients of 0.204 and 0.187 respectively. Again, this shows that these students do well with engaging with others who are from backgrounds different than their own and

that they have a complex view of the importance of cultural context in what to know and value.

Table 17

Spearman's correlation coefficients between frequency of co-curricular activities participated in during high school and the six GPI subscales including the statistical significance of each

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Reflect Own Heritage	-0.049	0.032	0.034	-0.291	-0.142	0.008	-0.068
Sig. (2-tailed)	0.721	0.815	0.806	0.031	0.300	0.954	
Reflect Diff Heritage	0.162	0.054	-0.006	-0.039	0.116	0.126	0.069
Sig. (2-tailed)	0.239	0.698	0.965	0.777	0.401	0.360	
Religious Activity	0.135	-0.136	-0.059	-0.033	-0.070	-0.367	-0.088
Sig. (2-tailed)	0.325	0.321	0.667	0.809	0.613	0.006	
Leadership Program	0.328	-0.032	0.179	0.313	0.136	0.181	0.184
Sig. (2-tailed)	0.015	0.816	0.190	0.020	0.321	0.185	
Community Service Act	0.303	-0.203	0.060	0.169	0.058	-0.084	0.000
Sig. (2-tailed)	0.024	0.138	0.665	0.218	0.673	0.543	

Table 17 (continued)

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Correlation
Global Lecture	-0.054	0.166	-0.050	0.049	0.157	0.123	0.065
Sig. (2-tailed)	0.694	0.225	0.717	0.722	0.253	0.370	
Read Newspaper	0.253	0.256	0.052	0.276	0.280	0.293	0.235
Sig. (2-tailed)	0.062	0.059	0.704	0.041	0.039	0.030	
Watched News	0.071	0.320	0.040	0.059	-0.110	0.28	0.110
Sig. (2-tailed)	0.606	0.017	0.772	0.667	0.425	0.039	
Followed Int Crisis	0.281	0.329	0.299	0.301	0.385	0.600	0.366
Sig. (2-tailed)	0.038	0.014	0.027	0.025	0.004	0.000	
Discussed Current Event	0.240	0.173	0.342	0.331	0.426	0.378	0.315
Sig. (2-tailed)	0.077	0.206	0.011	0.014	0.001	0.004	
Interacted Diff Country Students	0.112	0.531	0.032	0.111	0.445	0.282	0.252
Sig. (2-tailed)	0.419	0.000	0.819	0.426	0.001	0.039	
Interacted Diff Race Students	0.255	0.197	0.321	0.268	0.221	0.094	0.226
Sig. (2-tailed)	0.060	0.150	0.017	0.048	0.105	0.494	
Average Correlation	0.158	0.141	0.104	0.126	0.159	0.160	

The data gathered from the graduating engineering students above shows highest average correlation coefficients amongst the co-curricular activities that they participated in while in college and global perspectives to result from *following an international crisis*, *discussing current events*, and *reading the newspaper* with average correlation coefficients of 0.366, 0.315, and 0.235 respectively. The most notable relationship was identified to be between *following an international crisis* and the *knowledge* subscale with a correlation coefficient of 0.600 and a p-value less than 0.001. This means that 60% of the variability in the students' results within the knowledge subscale can be explained by how often they followed an international crisis. Following an international crisis also showed correlation coefficients of at least 0.275 in all six subscales expressing that students who often followed international crisis exhibited broad and diverse global perspectives in all ways defined by Braskamp et al [15]. This may be because times of crisis cause people to become more empathetic to the issues and viewpoints of those around them when their own safety is at risk, but more research must be done to conclude the true reasoning behind this relationship.

Discussing current events and reading the newspaper similarly also had consistently high correlations across all six subscales. Discussing current events' largest correlation coefficients were found in *knowing*, *knowledge*, and *identity* subscales at 0.426, 0.378, and 0.342. This shows that students who often discuss current events have a complex view of the importance of cultural context in society, a higher degree of understanding of cultures and their impact on society, and more of a level of awareness and acceptance of one's own unique identity in addition to showing promising positive effects in the other subscales as well. Reading the newspaper showed very consistent correlations across all

subscales of about 0.275 except for in the identity subscale where it only produced a correlation coefficient of 0.05, suggesting keeping up with the news via the newspaper may broaden global perspectives as a whole, but not necessarily improve the students' sense of self.

In analyzing how the six subscales were affected by the co-curricular activities as a whole, it became apparent that they all have rather consistently similar average correlation coefficients suggesting that participation in these co-curricular activities has a balanced, thorough effect on students' global perspectives. The highest of the correlation coefficients were found in the *knowledge*, *knowing*, and *social responsibility* subscales. This supports the claim that graduating engineering students who participated in many of these co-curricular activities also exhibited a great degree of understanding and awareness of various cultures' effects on the global society, a complex view of the importance of cultural context in knowledge, and a developed level of social interdependence and concern for others.

Another reason the correlation coefficients above peak interest is their abundance of negative correlation coefficients describing the relationships between the graduating seniors participation in certain co-curricular activities and their global perspectives subscales determined by the GPI aspect of the instrument. These values are in red and the largest of them are also bolded. Many of these values do not hold statistical significance at the 95% confidence interval due to their high p-values, but it is possible that if the sample size was increased that they would become significant.

The largest average negative correlation coefficient was found in participation in *religious activities* with the *knowledge* subscale having a statistically significant value of

-0.367 and p-value of 0.006. A negative correlation coefficient was also discovered in the *social interaction* subscale of -0.203 and a p-value of 0.138. Though this value is not statistically significant it still shows an inverse relationship with frequency of participation in religious activities, like the *knowledge* subscale does. This shows that graduating engineering students of this group that participated in many religious activities while in college displayed a lack of understanding, or awareness of various cultures and their global impact. They also did not exhibit strength in engagement with others who are different than them culturally according to the GPI instrument.

Another co-curricular activity that produced a negative average correlation coefficient were *activities in which one reflects on their own heritage*. This activity produced a negative, statistically significant correlation coefficient in the *affect* subscale of -0.291 and a p-value of 0.031, which makes it significant at the 95% confidence interval. It also displayed a negative, but not statistically significant correlation coefficient in the *knowing* subscale of -0.142. This show that students who participated in many activities that reflected their own heritage during college showed a lower level of respect for and acceptance of cultural perspectives different from their own and a lower degree of complexity in their view of the importance of cultural context in what one should value than students who participated in few or none.

Table 18

The Cohen's d Effect sizes between high impact educational practices and global perspective scales

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge	Average Effect Size
First Year Seminars	0.370	-0.034	-0.246	0.167	0.435	-0.377	0.054
Learning Communities	0.976	-0.450	0.108	0.197	0.252	-0.330	0.164
Engineers Without Borders	0.270	0.047	-0.014	0.217	0.395	-0.363	0.098
Undergraduate Research Experiences	0.488	0.534	0.509	0.245	0.541	0.241	0.620
Internship/Co-ops	0.103	-0.109	0.590	-0.037	0.046	0.435	0.300
Additional Writing Intensive Courses	-0.257	-0.220	0.228	0.101	0.058	0.150	0.018
Engineering Conferences	0.564	-0.431	-0.095	0.219	0.098	-0.121	0.066
Engineering Global Courses	0.185	0.013	0.434	0.452	-0.066	0.009	0.247
Study Abroad	0.061	-0.153	-0.391	0.460	-0.406	0.034	-0.115
Engineering Professional Societies	0.833	-0.001	0.612	0.885	0.447	0.472	0.868
Student Government	0.354	-0.235	0.633	0.051	0.097	-0.918	-0.021
Volunteer Regularly	0.439	-0.243	-0.081	0.496	0.060	-0.038	0.142
Average Effect Size	0.366	-0.107	0.191	0.288	0.163	-0.067	

Table 18 shows the Cohen's d effect sizes calculated between participating in and not participating in each of the twelve high impact educational practices listed. The practices with the strongest effects on global perspectives were engineering professional societies and undergraduate research experiences with average effect sizes of 0.868 and 0.620 respectively. Cohen's d is considered large when above, or around 0.8, medium around 0.6, and small when close to or less than 0.2. The scales that were most affected include the social responsibility and affect scales, which show students who participated in these high impact educational practices had a heightened level of interdependence and social concern for others and level of respect for their own cultural perspectives.

Another notable result is the negative average effect size that occurred in study abroad. This shows that the graduating seniors who participated in study abroad actually displayed lower global perspectives than those who did not, on average. This speaks to the research that states sending students to a location abroad for academic study is not enough toward facilitating the larger goal of creating effective global citizenship [17]. It also draws more value to local means of broadening global perspectives in students, such as professional societies and undergraduate research.

- a. How does having certain courses and co-curricular activities before college compare to having them during college in terms of global perspectives?

There are multiple methods used in comparing the effects that these courses and co-curricular activities had on students' global perspectives depending on when they participated in them. The simplest way used involved taking a general look at the difference in Spearman's correlation coefficients between the two samples. When analyzing the correlation coefficients of the first-year and graduating engineering

students, it is clear that the graduating seniors exhibited generally higher correlation coefficients with both the courses and co-curricular activities discussed. This may be due, in part, to the fact that the graduating engineering students have a much smaller sample size of 55 than that of the first-year students at 480. This is evident in the fact that the graduating students' data exhibited higher p-values, suggesting less statistically significant data due to the smaller sample. According to the data present, participating in the courses and co-curricular activities mentioned in the New Student and General Forms of the GPI has more effect on the global perspectives subscales when done so during college than it does in high school.

Table 19

Average Global Perspective Subscale Results of first-year and graduating students from Rowan University and a study done by Braskamp, Braskamp, and Engberg on students from 100 American universities

	Engineers at Rowan University				Students from Braskamp, Braskamp, & Engberg's Samples from 100 Universities		
	First-years	Std. Deviation	Graduating	Std. Deviation	First-years	Graduating	Std. Deviation of whole sample
Social Responsibility	3.40	0.65	3.52	0.70	3.69	3.74	0.59
Social Interaction	3.19	0.68	3.28	0.65	3.42	3.36	0.73
Identity	3.77	0.56	3.91	0.50	4.05	4.07	0.50
Affect	3.92	0.54	4.05	0.44	4.10	4.17	0.50
Knowing	3.52	0.49	3.61	0.42	3.51	3.70	0.54
Knowledge	3.44	0.58	3.54	0.76	3.62	3.63	0.60
Average GPI	3.56		3.67		3.74	3.80	

The table above displays the average global perspective subscale results of four different samples. The first two are the first-year and graduating engineering students from Rowan University and the next two are the first-year and graduating students that

were sampled from 100 universities across the United States in a study performed by Braskamp, Braskamp, and Engberg. According to the data, the graduating engineering students surveyed at Rowan University have higher average global perspectives in every subscale than that of the first-year engineering students sampled from Rowan University with the largest difference being in the identity subscale of 0.14. Due to large standard deviations it is not reasonable to consider this a significant increase, but is evidence that engineering students at Rowan University may broaden their global perspectives during their four years at the university, if a longitudinal study were completed.

The average global perspective discovered by Braskamp et al were not taken from specifically engineering students. They are from students of all majors and are considered to be the “national norm” of global perspectives [15]. In comparing the first-year engineering students from Rowan University to these national norms, it is evident that the students came below the national norms in every subscale other than *knowing*, in which they scored 0.01 higher than the national norm. This shows that this group of first-year students exhibited about the same degree of complexity of their view of the importance of cultural context in judging what is important to know and value as students across the country of all majors. The fact that the engineering students came below the national norm in every other subscale is not an ill representation of Rowan University, but shows that whatever experiences these students are having before college are not bringing them up to par with the national norms. Standard deviation data was not presented in the study completed by Braskamp et al. for each of the grade levels’ results, so further statistical analysis could not be completed in determining the significance of these differences, but this still highlights why it is important for Rowan University to

focus their attention to better globally preparing its students and which practices are most effective in doing so.

In analyzing the average global perspectives subscales of graduating students from Rowan University and Braskamp et al.'s sample, it is seen that the Rowan students performed under the national norm in every category with the biggest difference being in *social responsibility* at 0.22 below the norm. This shows that the graduating engineering students from Rowan University do not have global perspectives that amount up to that of the average non-major specific graduating college student. This result is supported by the research of Grandin and Hirleman stating the lack of tradition of international programs and foci within the engineering space and a more common presence of these practices in the humanities and social sciences [7]. This is concerning because engineering students who are increasingly expected to tackle global issues should encompass global perspectives that at least meet the norms of the average student.

Chapter 5

The Relationships Between Precollege Courses and Co-Curriculars and Interest in HIEPs in First Year Engineering Students

This chapter focuses on how the results of this thesis answer the third research question regarding the courses and co-curricular activities first year students participated in during high school, the effect they had on student interest in Geroge Kuh’s high impact educational practices, and the effect they had on student interest in having an international experience during college. This chapter also explores the reasons why students lack interest in having an international experience during college and how they relate to the courses and co-curricular activities that students had in high school.

RQ3: How do Precollege Courses and Co-curriculars Effect the Interests of First-Year Engineering Students in an International Experience or any of Kuh’s HIEPs?

Table 20

The average Cohen’s D effect size of courses taken in high school on first-year student interest in high impact educational practices while in college

	Multicultural Course	Foreign Language Course	World History Course	Service Learning Course	Global Issues Course	Course with Opportunity for Dialogue
Average Effect Size on Interest in High Impact Educational Practices	0.145	0.094	-0.070	0.052	0.080	0.193

The table above shows the average Cohen’s D effect size values gathered from the relationships between the courses that the first-year students took in high school and which of Kuh’s high impact educational practices they expressed interest in. From previous sections we know that Kuhs’s high impact educational practices for this study include the following.

Table 21

Twelve HIEPs used in this study

First Year Seminars	Learning Communities
Engineers Without Borders	Undergraduate Research Experiences
Internships/Co-ops	Additional Writing Intensive Courses
Engineering Conferences	Global Engineering Courses
Study Abroad	Engineering Professional Societies
Student Government	Volunteering Regularly

Cohen’s d was used because students simply responded with whether they were interested or not, so the data is binary. From the data, it is evident that involvement in *courses with an opportunity for extensive dialogue with students of backgrounds different from one’s own and multicultural courses* had the strongest effect on student interest in high impact educational practice with average effect size values of 0.193 and 0.145 respectively. This means that students who had many courses with opportunities for

dialogue with students different from themselves culturally and many multicultural courses exhibited more interest in Kuh's high impact educational practices.

Another important fact to point out is that the average effect size discovered from participation in *world history courses* is negative. This shows that student participation in world history courses prior to college resulted in less interest in Kuh's high impact educational practices during college. This effect was found to be most negative in the practices of *engineering professional societies*, *undergraduate research experiences*, and *engineering conferences* with small effect sizes of -0.270, -0.198, and -0.178 found in each, respectively. This means that students who participated in many world history courses expressed especial lack of interest in having these three experiences as college students. It is possible that this is due to their high school world history courses displaying the world in an American ethnocentric manner, while denouncing the importance of other countries and their cultures. More research would have to be done on the world history courses of these students in order to determine this.

Table 22

Average Cohen's d effect size of participation in co-curricular activities in high school on interest in high impact educational practices during college

	Reflect Own Heritage	Reflect Different Heritage	Religious Activity	Leadership Program	Community Service Act	Global Lecture
Average Effect Size on Interest in High Impact Educational Practices	0.223	0.300	0.187	0.390	0.321	0.279

Table 23

Average Cohen's d effect size of participation in co-curricular activities in high school on interest in high impact educational practices during college

	Read News	Watched News	Followed International Crisis	Discussed Current Events	Interacted w/ Students from Different Country	Interacted w/ Students of Different Race
Average Effect Size on Interest in High Impact Educational Practices	0.269	0.110	0.272	0.314	0.172	0.182

The tables above show the effect that participation in certain co-curricular activities during high school had on first-year student interest in high impact educational practices during college. According to the tables, the highest average effects were discovered in involvement in *leadership programs*, *community service activities*, and *discussing current events* with average effect sizes of 0.390, 0.321, and 0.314 respectively. Though they are only small-medium effect sizes for a Cohen's d test, they held many high and medium effects on specific high impact educational practices, such as between leadership programs and interest in *student government* which exhibited a large effect size of 1.029, the largest of the co-curricular activities. The effect sizes calculated from participation in co-curricular activities were larger and more positive as a whole than the effect sizes that resulted from participating in the previously mentioned high school courses. This information supports that participation in global co-curricular activities during high school creates more interest in these high impact educational practices than the courses do.

Table 24

Average GPI based on interest in having an international experience in college and effect size between answering “Yes” and answering “No”

	Social Responsibility	Social Interaction	Identity	Affect	Knowing	Knowledge
Yes N = 134	3.63	3.35	3.83	4.08	3.61	3.59
Standard Deviation	0.59	0.70	0.55	0.53	0.50	0.54
Maybe N = 244	3.39	3.15	3.78	3.91	3.50	3.40
Standard Deviation	0.63	0.67	0.54	0.50	0.48	0.56
No N = 102	3.13	3.07	3.67	3.75	3.46	3.35
Standard Deviation	0.67	0.63	0.63	0.59	0.50	0.64
Cohen's D Effect Size (between Yes and No)	0.790	0.426	0.271	0.604	0.297	0.419

In addition to the effect that prior courses and co-curriculars had on first-year student interest in participating in high impact educational practices during college, the effect that interest in having an international experience, such as study abroad, had on the subscales of global perspectives of these students was calculated and analyzed. From the table above it is evident that students who responded “Yes” to the question “Do you have interest in pursuing an international experience (i.e., study abroad) while at Rowan University?” exhibited higher global perspective subscale results in all six subscales than students who responded “Maybe,” or “No.” The Cohen’s d effect sizes calculated between the average global perspectives of the students who responded “Yes” and the students who responded “No” are all positive and range from a variety of small-medium

(0.271) to large (0.790). The largest effect sizes were found in the *social responsibility*, *affect*, and *social interaction* subscales. This demonstrates that students who express interest in having an international experience while in college exhibit broad global perspectives with emphasis on their level of interdependence and social concern of others, level of awareness of one's own unique identity and how it pertains to the global society, and their degree of engagement with others who come from backgrounds different than their own.

- a. What are the reasons for students lacking interest in having an international experience and how do they relate to their experiences in high school?

In addition to simply being asked, “Do you have interest in pursuing an international experience (i.e., study abroad) while at Rowan University?” the students who responded with a “No” or “Maybe” were asked why they lacked interest in such an experience with the opportunity to give an open-ended response. These open-ended responses were informally broken into categories based on similar responses and analyzed to see what the biggest reasons were that are keeping these first-year engineering students from wanting to have an experience outside of this country.

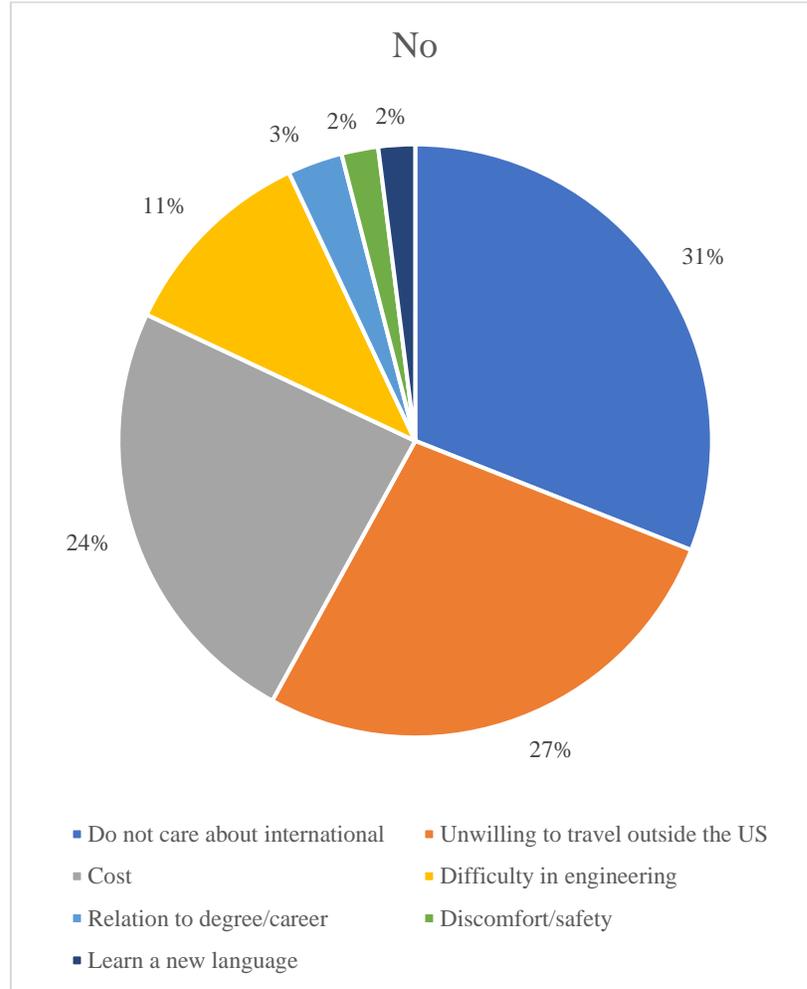


Figure 4. Pie chart presenting the distribution of various reasons students that responded “No” gave for not wanting to have an international experience

From the pie chart, it is evident that the biggest reasons that students that responded “No” gave for not wanting to have an international experience were that they simply *do not care about international education/experience, unwilling to travel outside of the United States, and cost*. This shows that, other than cost, these students just do not have interest in leaving the United States, or even improving their global mindset whether it be through an international experience or not. For these students, it is important for

Rowan and other universities to provide other means of globally preparing their students than physical excursions abroad. Local means have to be utilized if universities expect to broaden the global mind sets of students even if they have no interest in doing so.

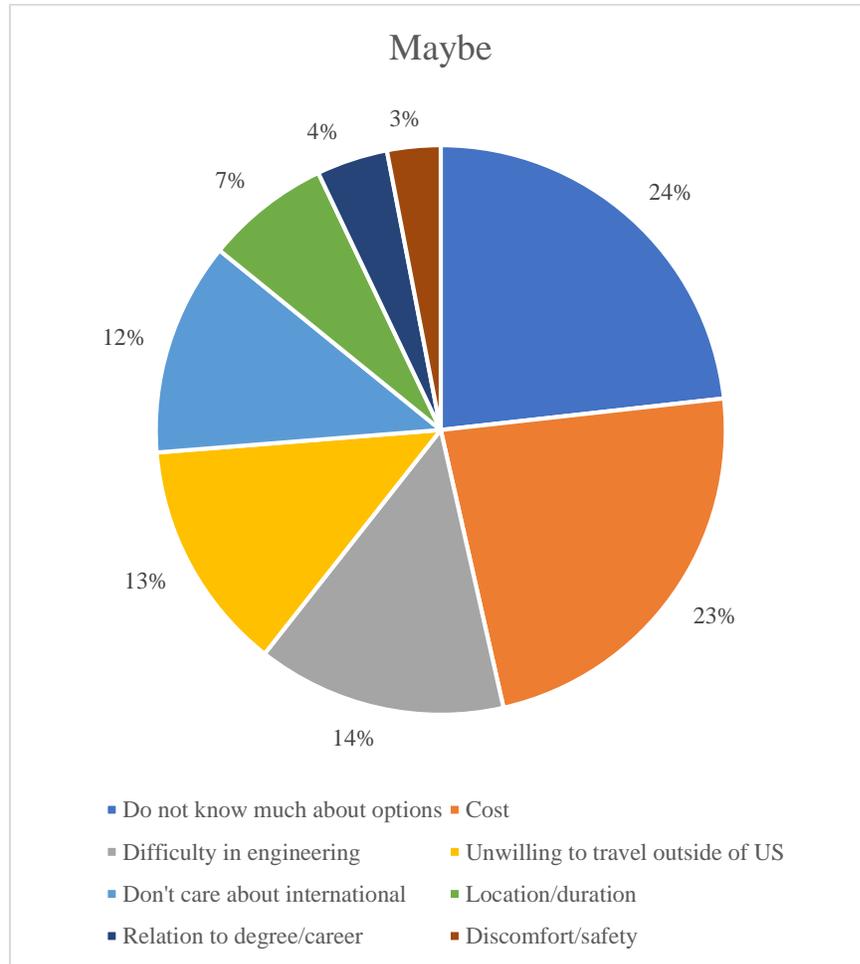


Figure 5. Pie chart presenting the distribution of various reasons students that responded “Maybe” gave for not wanting to have an international experience

This pie chart expresses that the biggest reasons the students that responded “Maybe” to whether or not they wanted to have an international experience abroad

include that they *do not know much about their options/programs available*, they find it to be *too costly*, and that they *find the engineering curriculum too difficult* for them to fit these experiences in and also complete all of their necessary coursework in time to graduate in four years. These issues can be abolished by providing international experiences specifically designed for engineering students of all disciplines that fit easily into their program and are not as costly as they can be currently, but this goal will take time to achieve if even at all possible. Once again this calls for the need for local means of improving global mindsets in students, such as emphasis on the effective high impact educational practices developed by George Kuh.

In addition to simply analyzing the quantity of the reasons as to why first-year engineering students were hesitant to want to participate in an international experience, analysis was done in making connections between what courses and co-curriculars they were a part of during high school, their interests in an international experience, and their reasons for lacking interest when that occurred. Average frequencies were calculated for student participation in each of the courses and co-curriculars and organized by whether or not they had interest in an international experience and the reason given for lacking interest, if so. In analyzing the differences based on student interest in an international experience, the following differences table was developed.

Table 25

Differences between the average frequency of high school courses/co-curricular activities participated in by first-year engineering student based on interest in having an international experience in college

	Multicultural course	Foreign Language Course	World History Course	Service-Learning Course	Global Issues Course	Opportunities for dialogue
yes-no	0.302	0.285	-0.219	0.004	0.011	0.231
yes-maybe	0.202	0.125	-0.027	0.130	0.132	0.241
maybe-no	0.100	0.160	-0.192	-0.126	-0.121	-0.010
	Reflect your own cultural heritage	Reflect a different cultural heritage	Religious Activities	Leadership programs	Community Service	Global Lectures
yes-no	0.381	0.490	0.384	0.665	0.691	0.174
yes-maybe	0.284	0.295	0.245	0.168	0.185	0.065
maybe-no	0.097	0.195	0.138	0.498	0.506	0.109
	Read a newspaper	Watched news	Followed an international crisis	Discussed current events	Interacted with students from a different country	Interacted with students from a different race/ethnic group
yes-no	0.565	0.504	0.567	0.606	0.460	0.260
yes-maybe	0.084	0.285	0.197	0.281	0.207	-0.078
maybe-no	0.481	0.219	0.370	0.325	0.254	0.339

In analyzing this data, it is evident that the majority of the largest differences are found in course and co-curricular participation between the students who responded yes and the students who responded no (“yes-no” rows). All of these differences are also

positive with the exception of the difference in participation in world history courses. This shows that students who expressed interest in having an international experience also had more involvement in these globally related courses and co-curriculars as a whole. However, students who participated in more world history courses were actually more likely to not have interest in an international experience while in college. Some notable differences amongst the courses include those found in having multicultural courses and foreign language courses. It was found that students who responded “yes” participated in 0.302 more multicultural courses and 0.285 more foreign language courses on average than students who responded “no.” This finding is important because it supports the idea that more exposure to these types of courses early on in a students’ engineering education may make them more inclined to pursue an international experience.

In analyzing the differences in participation in the co-curricular activities mentioned in the GPI instrument amongst students based on their varying interests in having an international experience during college as shown in Table 25, no substantial negative differences were found. This supports the fact that increased participation in these activities before college may result in more students being interested in having an international experience. Generally the differences between the students based on their high school co-curriculars are greater than those based on their courses so that suggests that involvement in co-curriculars may have a stronger effecting in swaying students than courses. Most notable are the difference found between “yes” students and “no” students in the activities of community service leadership programs and discussing current events. Students who said yes took 0.691, 0.665, and 0.606 more of these co-curriculars than

students who responded no. It is likely that students who involve themselves in these experiences develop interest in the cultures around them through each activity's call for cultural awareness and seek to explore people's differences more thoroughly with an international experience.

These differences are important in determining how to get students more interested in having international experiences and, in turn, broadening their global perspectives. The courses and co-curriculars that show the largest differences in participation based on interest in having an international experience may contribute more so to swaying students to become interested than those with small differences. The overall goal of this result is to determine which courses and activities will be most beneficial in turning students who responded "no" into students that respond "maybe" and turning students who responded "maybe" into students that respond "yes."

Table 26

Average frequencies of participation in high school courses and co-curriculars according to reason given for why students lack interest in having an international experience in college

	Multicultural course	Foreign Language Course	World History Course	Service-Learning Course	Global Issues Course	Opportunities for dialogue
Do not know much about options	0.320	2.720	2.120	0.240	0.600	1.000
Cost	0.507	3.014	2.099	0.338	0.690	0.789
Difficulty in engineering	0.696	2.978	2.000	0.326	0.804	1.130
	Reflect your own cultural heritage	Reflect a different cultural heritage	Religious Activities	Leadership programs	Community Service	Global Lectures
Do not know much about options	1.000	0.920	0.840	2.160	2.400	0.320
Cost	0.845	0.930	0.690	1.859	2.127	0.577
Difficulty in engineering	0.978	1.065	0.978	2.522	2.652	0.978

Table 26 (continued)

	Read a newspaper	Watched news	Followed an international crisis	Discussed current events	Interacted with students from a different country	Interacted with students from a different race/ethnic group
Do not know much about options	1.720	1.960	2.200	2.560	1.480	3.240
Cost	1.690	1.958	2.155	2.577	1.732	3.211
Difficulty in engineering	1.891	2.043	2.413	2.674	1.696	3.174

The table above shows the average number of courses and co-curricular activities that the first-year engineering students participated in based on their reason for responding “maybe” when asked if they were interested in having an international experience while at Rowan University. The three most frequently cited reasons are included. Amongst the students that responded no there was not much a difference discovered in their frequencies of courses taken and activities participated in. Regardless of the reason, these students lacked participation in *multicultural courses*, *service-learning courses*, and *attending global lectures*. The students that reported not knowing much about their options as their reasons also reported the lowest participation in each of these experiences of the three groups separated by reason.

Table 27

Average frequencies of participation in high school courses and co-curriculars according to reason given for why students claim to have no interest in having an international experience in college

	Multicultural course	Foreign Language Course	World History Course	Service Learning Course	Global Issues Course	Opportunities for dialogue
Do not care about international /No reason given	0.174	2.565	2.348	0.174	0.435	0.783
Unwilling to travel outside US	0.710	3.032	2.258	0.548	0.871	1.226
Cost	0.360	2.640	2.400	0.480	0.880	0.680
	Reflect your own cultural heritage	Reflect a different cultural heritage	Religious Activities	Leadership programs	Community Service	Global Lectures
Do not care about international /No reason given	0.565	0.478	1.000	1.565	1.565	0.435
Unwilling to travel outside US	0.645	0.806	0.935	1.548	1.645	0.581
Cost	0.880	0.560	0.360	1.880	1.960	0.560

Table 27 (continued)

	Read a newspaper	Watched news	Followed an international crisis	Discussed current events	Interacted with students from a different country	Interacted with students from a different race/ethnic group
Do not care about international/ No reason given	1.478	2.087	1.826	2.174	1.435	2.783
Unwilling to travel outside US	0.968	1.774	1.871	2.129	1.581	2.935
Cost	1.280	1.520	1.760	2.360	1.240	2.840

The table above presents the students' frequencies of participation in the high school courses and co-curriculars separated by the three most abundant reasons for why these students do not want to have an international experience. Students who claimed to not care about international engineering, or travel reported especially low participation in *multicultural courses*, *service-learning courses*, *global issues courses*, *reflecting on a different cultural heritage*, and *global lectures*. Students who claim to be unwilling to travel outside of the United States reported especially low participation in none of the categories, but its lowest were reported in *service-learning courses* and *multicultural courses*. Students who cited cost as their main reason for not wanting to study abroad reported low participation in *multicultural courses*, *service-learning courses*, and *religious activities*.

Chapter 6

Summary and Contributions

Chapter Summaries

This thesis provided a quantitative analysis of student global perspectives in examining the effect that certain courses, co-curricular activities, and HIEPs have on them. The effect that certain course and co-curricular participation before college has on student interest in HIEPs and reasons why students may lack these interests was analyzed as well. The design of the thesis followed the framework demonstrated in Figure 1B.

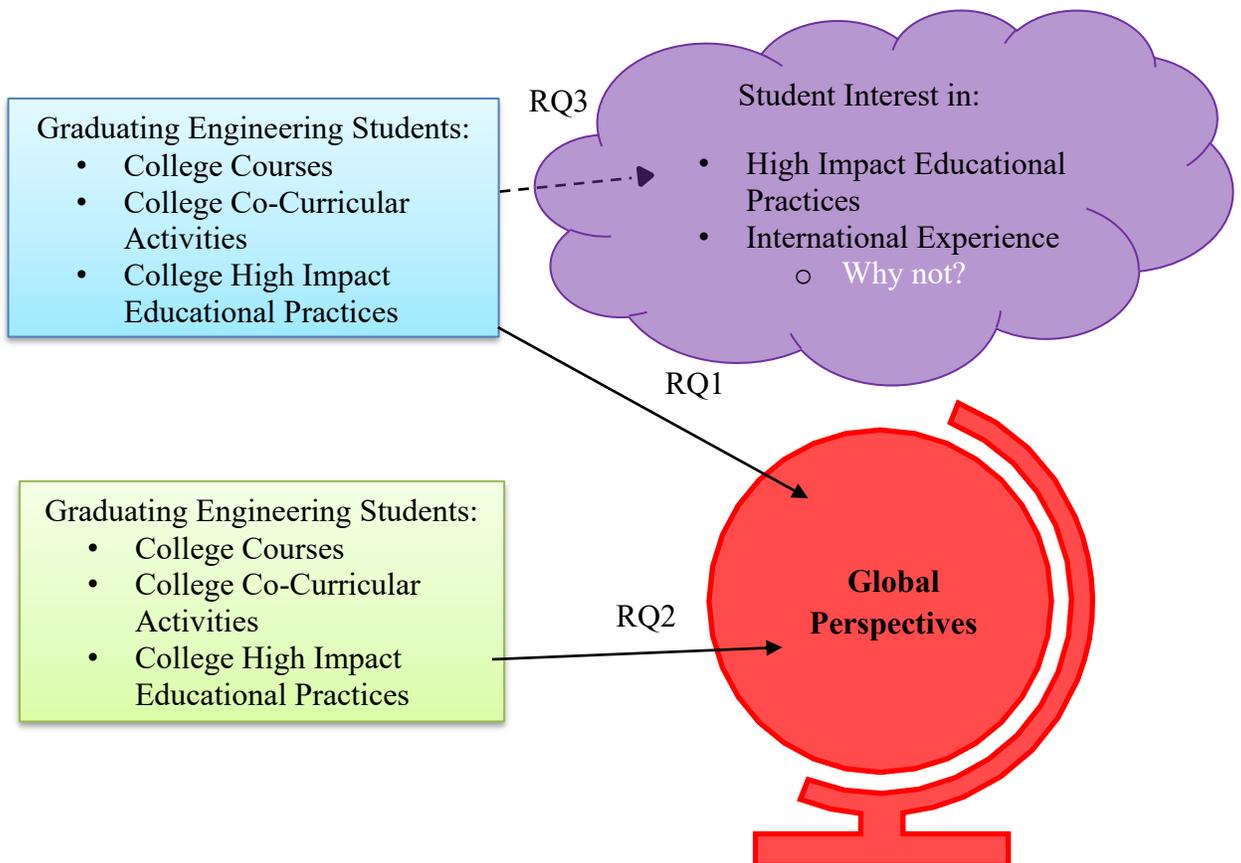


Figure 1B. Thesis Framework

Empirical Contributions

Research questions 1 and 2. The results of answering the first two research questions, described in Chapter 4, determined courses, co-curricular activities, and HIEPs that broaden global perspectives in students. These results show that multi-cultural courses, discussing current events, and following an international crisis have strongest effect on global perspectives in first year and graduating engineering students. HIEPs found most effective included undergraduate research experience and engineering professional societies. These findings are very beneficial to engineering educators trying to better prepare their students for the globalized workforce because they can cater their program design specifically to the needs of their students. Chapter 4 details the effect that each course, co-curricular activity, and HIEP had on each of the six scales of global perspective, which allows educators to emphasize experiences based on which perspectives their students' lack.

Research question 3. The results of answering the third research question, described in Chapter 5, determined the effect of high school courses and co-curricular activities on first year student interest in having an international experience or any of the HIEPs during college. Respondents that lacked interest in an international experience also provided reasons as to why. According to this research, students who participated in courses with opportunity for dialogue with students of different backgrounds, leadership programs, community service activities, and discussed current events displayed more interest in HIEPs in college on average. The most common reasons students gave for not wanting to pursue an international experience while in college included not caring about an international education, not knowing much about available options, cost, and the

perceived difficulty of engineering curricula. In combination with the results from Chapter 4, these findings can be used by engineering educators to harbor interest in the educational practices that will benefit each student depending on their global perspective deficiencies. They also provide educators and institutions with many of the reasons that students are not pursuing a complete education with hopes that they make strides in reducing these barriers for students.

Chapter 7

Limitations and Future Work

Limitations

There are a number of ways that this study could have been improved. First of all, the GPI instrument produces self-reported data, meaning that every student's GPI was calculated based on their own opinion of themselves and how they may handle certain situations. Regardless, the GPI is a nationally normed instrument that has underwent many iterations and tests of validity since its emergence. One thing that should definitely change about the study in future passes is the number of graduating engineering students included. A difference of 480 to 55 students between the first-years and graduating samples makes it difficult to compare results amongst the two samples since the drastic difference in sample size may affect the scalability of certain statistic values. Increasing the sample size also increases the significance of each statistical test and other form of analysis.

Lastly, this study is not longitudinal. It includes two separate samples consisting of entirely different students. The study would become longitudinal if the same first-year students were surveyed four years later when they are graduating and all analyses are done then. This design of study would allow the researcher to analyze the *change* in students' global perspectives based on the courses, co-curricular activities, and HIEPs they participated in during college. This thesis simply associates the experiences students have had with their global perspective measurements and cannot verify these experiences causing improvement in their global perspectives.

Future Work

An important transition from this study is to complete the longitudinal version of the work as described in the previous section. If it is possible to resurvey all of the first-year engineering students from this study when they are graduating, it would be interesting to compare the differences in their global perspective measurements based on the experiences that they decided to have in college. This would also allow for the effect of certain experiences provoking interest in specific HIEPs to be tested more explicitly. Another interesting supplement to this study would include following through with the first-year students and recording whether or not they actually participate in the HIEPs that they expressed interest in.

One important theory supported by this research and its literature is that students do not need to travel abroad in order to broaden global perspectives. Local means of developing global perspectives are much easier for schools to implement. Many of Gege Kuh's HIEP can be implemented on-campus and within national borders. It would be interesting to compare the effect on global perspectives of the local HIEP against that of a study abroad experience on engineering students. This would not only provide information to compare the two types of experiences, but more research on the experiences' effect on engineering students in general, which is also under researched. This thesis is simply a microcosm of the research available and necessary in achieving the goal of engineering graduates developing global mindsets organically through their engineering curriculum without having to seek out secondary experiences.

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Appendix A
First Year Student Survey

Rowan Seed Grant - First Year Survey

Start of Block: Info script

Page Break

Q1 *Assessing Global Perspectives of Engineering Students*

Q2

You are being asked to complete this online research survey entitled "Assessing Global Perspectives of Engineering Students" as part of your class work activities.

Your participation in the data collection is voluntary. If you do not wish to participate in this data collection select no below in response to the question "Do you consent to have your data included as part of this research study?" Selecting yes to the aforementioned question indicates that you are voluntarily giving consent to participate in the data collection.

The survey may take approximately 10 minutes to complete. The purpose of the research study is to determine how educational practice and student backgrounds impact global perspective development.

There are no risks or discomforts associated with this survey. There may be no direct benefit to you, however, by participating in this study you may help us understand how modifications to classroom instruction and curricular strategies could lead to more globally prepared engineers.

Your response will be kept confidential. We will store the data in a secure computer file and the file will be destroyed once the data has been published. Any part of the research that is published as part of this study will not include individual information. If you have any questions

about the survey, you can contact Dr. Scott Streiner (lead researcher in the study) at streiner@rowan.edu, but you do not have to give your personal identification.

	Yes (1)	No (2)
To participate in this survey, you must be 18 years or older. Select Yes if you are over 18 (1)	<input type="radio"/>	<input type="radio"/>
Do you consent to have your data included as part of this research study? (2)	<input type="radio"/>	<input type="radio"/>

Skip To: End of Survey If You are being asked to complete this online research survey entitled "Assessing Global Perspectiv... = Do you consent to have your data included as part of this research study?"

Page Break



Q246 To prepare your unique numerical identifier, answer the follow three questions and then provide the combined six digits in the box below.

1. What is your day of birth (01-31)?
2. What is the number associated with the first letter in your middle name (00-26) where 00 indicates you have no middle name; A=01, B=02,...,Y=25,Z=26.
3. What is your shoe size (rounded up to the nearest whole number)(1-14)

For example, if you were born on October 7th, your middle name is James and your shoe size is 10.5, your numerical id you would enter is 071011.

Note you will need to provide a number that is exactly six digits to move forward

Page Break

Q3 This questionnaire should take an estimated time of **10 minutes** to complete. It consists of the following three sections:

- Part 1.** Educational Background: 5 questions
- Part 2.** Global Perspective Inventory: 35 questions
- Part 3.** Your Background: 9 questions

We suggest that you complete the survey in one sitting as you will not be able to exit the survey and return later. Thank you ahead of time for your participation!

End of Block: Info script

Start of Block: Part 1. Educational Background

Q4

Part 1. Educational Background (2-3 min)

In high school, how many courses have you taken in the areas listed below?

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5+ (6)
Multicultural course addressing issues of race, ethnicity, gender, class, religion, or sexual orientation (1)	<input type="radio"/>					
Foreign language course (2)	<input type="radio"/>					
World history course (3)	<input type="radio"/>					
Service learning course (4)	<input type="radio"/>					
Course focused on significant global/international issues and problems (5)	<input type="radio"/>					
Course that included opportunities for intensive dialogue among students from different backgrounds and beliefs (6)	<input type="radio"/>					

Q5

In high school, how often have you participated in the following?

	Never (1)	Rarely (2)	Sometimes (4)	Often (5)	Very Often (7)
Events or activities sponsored by groups reflecting your own cultural heritage (1)	<input type="radio"/>				
Events or activities sponsored by groups reflecting a cultural heritage different from your own (2)	<input type="radio"/>				
Religious or spiritual activities (3)	<input type="radio"/>				
Leadership programs that stress collaboration and teamwork (4)	<input type="radio"/>				
Community service activities unrelated to a course (5)	<input type="radio"/>				
Attend a lecture, workshop, or campus discussion on international or global issues (6)	<input type="radio"/>				

Q6

In high school, how often have you participated in the following?

	Never (1)	Rarely (2)	Sometimes (4)	Often (5)	Very Often (7)
Read a newspaper or news magazine (online or in print) (1)	<input type="radio"/>				
Watched news program on television (2)	<input type="radio"/>				
Followed an international event/crisis (through a newspaper, social media, or other media source) (3)	<input type="radio"/>				
Discussed current events with other students (4)	<input type="radio"/>				
Interacted with students from a country different from your own (5)	<input type="radio"/>				
Interacted with students from a race/ethnic group different from your own (6)	<input type="radio"/>				

Page Break

Q7 Are you interested in participating in an international experience (i.e., study abroad) while at Rowan University?

- Yes (1)
- Maybe (2)
- No (3)

Display This Question:

If Are you interested in participating in an international experience (i.e., study abroad) while at... != Yes

Q8 What is the reason for being unsure of or not wanting to participate in an international experience (i.e, study abroad)?

Page Break

Q9 Which of the following have you or are interested in pursuing as an undergraduate student at Rowan University?

- First Year Seminars (1)
- Learning Communities (2)
- Engineers Without Borders (3)
- Undergraduate Research Experiences (4)
- Internship or Co-Op (5)
- Additional writing-intensive courses (6)
- Engineering conferences (7)
- Engineering course with a global focus (8)
- Study abroad (any duration) (9)
- Engineering professional societies (i.e., IEEE, SWE, NSBE, ASME) (10)
- Involvement in student government (11)
- Volunteer regularly (1+ time per month for 6 months or longer) (12)

End of Block: Part 1. Educational Background

Start of Block: Part 2. Global Perspective Inventory(35 items)

Q10

Part 3. Global Perspective Inventory (3-5 min)

Please indicate the extent to which the items most closely describe you by marking the response that most closely matches your experiences and/or self-perception. Please be candid in your responses, as no individual will be identified from the index.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
When I notice cultural differences, my culture tends to have the better approach. (1)	<input type="radio"/>				
I have a definite purpose in my life. (2)	<input type="radio"/>				
I can explain my personal values to people who are different from me. (3)	<input type="radio"/>				
Most of my friends are from my own ethnic background. (4)	<input type="radio"/>				
I think of my life in terms of giving back to society. (5)	<input type="radio"/>				
Some people have a culture and others do not. (6)	<input type="radio"/>				
In different settings what is right and wrong is simple to determine. (7)	<input type="radio"/>				
I am informed of current issues that impact international relations. (8)	<input type="radio"/>				
I know who I am as a person. (9)	<input type="radio"/>				

I feel threatened around people from backgrounds very different from my own. (10)

I often get out of my comfort zone to better understand myself. (11)

I am willing to defend my own views when they differ from others (12)

I understand the reasons and causes of conflict among nations of different cultures (13)

I work for the rights of others. (14)

I see myself as a global citizen. (15)

I take into account different perspectives before drawing conclusions about the world around me. (16)

I understand how various cultures of this world interact socially. (17)

I put my beliefs into action by standing up for my principles. (18)

I consider different cultural perspectives when evaluating global problems. (19)

I rely primarily on authorities to determine what is true in the world (20)

I know how to analyze the basic characteristics of a culture. (21)

I am sensitive to those who are discriminated against. (22)

I do not feel threatened emotionally when presented with multiple perspectives. (23)

I frequently interact with people from a race/ethnic group different from my own (24)

I am accepting of people with different religious and spiritual traditions. (25)

I put the needs of others above my own personal wants. (26)

I can discuss cultural differences from an informed perspective. (27)

I am developing a meaningful philosophy of life. (28)

I intentionally involve people from many cultural backgrounds in my life. (29)

I rarely question what I have been taught about the world around me (30)

I enjoy when my friends from other cultures teach me about our cultural differences. (31)

I consciously behave in terms of making a difference. (32)

I am open to people who strive to live lives very different from my own life style. (33)

Volunteering is not an important priority in my life. (34)

I frequently interact with people from a country different from my own. (35)

Page Break

End of Block: Part 2. Global Perspective Inventory(35 items)

Start of Block: Part 3. Your Background

Q11

Part 1. Your Background (2-3 min)

What is your gender? (Select one)

▼ Male (1) ... Prefer not to answer (4)

Q12 Please indicate your academic level based on the number of years on your campus. (Select one)

▼ First year (Freshman) (1) ... Fourth and plus years (Senior) (4)

Q13 Please indicate your major at Rowan University. (Select all that apply)

- Biomedical Engineering (1)
 - Civil and Environmental Engineering (2)
 - Chemical Engineering (3)
 - Electrical Engineering (4)
 - Engineering Entrepreneurship (5)
 - Mechanical Engineering (6)
 - Other (7) _____
-

Q14 Which of the following most accurately describes your country of birth and citizenship status? (Select one)

- At least one of my grandparents, my parents and I were born in the U.S. (1)
 - At least one of my parents and I were born in the U.S. (2)
 - I was born in the U.S. but not my parents (3)
 - Foreign born (4)
 - Citizen of another country, student or visa (6)
 - Other (please explain) (5) _____
-

Display This Question:

If Which of the following most accurately describes your country of birth and citizenship status? (S... = Foreign born

Or Which of the following most accurately describes your country of birth and citizenship status? (S... = Citizen of another country, student or visa

Or Which of the following most accurately describes your country of birth and citizenship status? (S... = Other (please explain)

Q15 How long have you lived in the United States? (Select one)

▼ Less than 1 year (1) ... 15+ years (5)

Display This Question:

If Which of the following most accurately describes your country of birth and citizenship status? (S... != Foreign born

And Which of the following most accurately describes your country of birth and citizenship status? (S... != Citizen of another country, student or visa

And Which of the following most accurately describes your country of birth and citizenship status? (S... != Other (please explain)

Q16 Have you lived outside of the U.S.? (Select one)

Yes (how long?) (1) _____

No (2)

Q17 How do you identify yourself racially/ethnically? (Select all that apply)

- African descent (1)
 - Asian descent (including the Indian subcontinent) (2)
 - Pacific Island descent (3)
 - Indigenous Person (Aboriginal, Alaskan Native, Maori, Native American, etc.) (4)
 - Hispanic, Latino/Chicano descent (5)
 - Arab or Middle Eastern descent (6)
 - Caucasian European descent, not Hispanic (7)
 - I choose not to self-identify (8)
-

Q18 Do you know one or more second languages? (Select one)

- Yes (1)
 - No (2)
-

Display This Question:

If Do you know one or more second languages? (Select one) = Yes

Q19 Please indicate your fluency of your *best* foreign language. (Select one)

	Yes (1)	No (2)
I am able to converse/take direction in that language (3)	<input type="radio"/>	<input type="radio"/>
I can take an academic course in that language (2)	<input type="radio"/>	<input type="radio"/>

Page Break

Q20 Do you own a past or current U.S. passport? (Select one)

Yes (1)

No (2)

Q21 What is your employment status? (Select one)

Work - all year (1)

Work - academic year only (2)

Work - summers only (3)

Not employed (4)

Q22 What is your parents' highest degree earned? (Select one)

- Less than high school (1)
- High school graduate (2)
- Some college (3)
- 2 year degree (Associates) (4)
- 4 year degree (Bachelors) (5)
- Some graduate school (6)
- Graduate degree (Masters, Doctorate, MD, JD, etc.) (7)
- Do not know (8)

End of Block: Part 3. Your Background

Appendix B
Graduating Student Survey

Rowan Seed Grant - Graduating Senior Survey

Start of Block: Info script

Q1 Assessing Global Perspectives of Engineering Students

Q2

You are being asked to complete this online research survey entitled "Assessing Global Perspectives of Engineering Students" as part of your class work activities. You will complete a survey that asks background questions, as well as questions about any international/intercultural experiences you may have had. In addition, you will take the Global Perspective Inventory. Once you have completed the survey you will be directed to a new site where you will enter your contact information for a chance to win a \$100 Visa gift card.

Your participation in the data collection is voluntary. If you do not wish to participate in this data collection select no below in response to the question "Do you consent to have your data included as part of this research study?" Selecting yes to the aforementioned question indicates that you are voluntarily giving consent to participate in the data collection.

The survey may take approximately 10 minutes to complete. The purpose of the research study is to determine how educational practice and student backgrounds impact global perspective development.

There are no risks or discomforts associated with this survey. There may be no direct benefit to

you, however, by participating in this study you may help us understand how modifications to classroom instruction and curricular strategies could lead to more globally prepared engineers.

Your response will be kept confidential. We will store the data in a secure computer file and the file will be destroyed once the data has been published. Any part of the research that is published as part of this study will not include individual information. If you have any questions about the survey, you can contact Dr. Scott Streiner (lead researcher in the study) at streiner@rowan.edu, but you do not have to give your personal identification.

	Yes (1)	No (2)
To participate in this survey, you must be 18 years or older. Select Yes if you are over 18 (1)	<input type="radio"/>	<input type="radio"/>
Do you consent to have your data included as part of this research study? (2)	<input type="radio"/>	<input type="radio"/>

Page Break



Q248 To prepare your unique numerical identifier, answer the follow three questions and then provide the combined six digits in the box below.

1. What is your day of birth (01-31)?
2. What is the number associated with the first letter in your middle name (00-26) where 00 indicates you have no middle name; A=01, B=02,...,Y=25,Z=26.
3. What is your shoe size (rounded up to the nearest whole number)(1-14)

For example, if you were born on October 7th, your middle name is James and your shoe size is 10.5, your numerical id you would enter is 071011.

Note you will need to provide a number that is exactly six digits to move forward

Page Break

Q3 This questionnaire should take an estimated time of **10 minutes** to complete. It consists of the following three sections:

Part 1. Educational Background: 6 questions

Part 2. Global Perspective Inventory: 35 questions

Part 3. Your Background: 9 questions

We suggest that you complete the survey in one sitting as you will not be able to exit the survey and return later. Thank you ahead of time for your participation!

Page Break

End of Block: Info script

Start of Block: Part 1. Educational Background

Q4

Part 1. Educational Background (2-3 min)

Since coming to college, how many courses have you taken in the areas listed below?

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5+ (6)
Multicultural course addressing issues of race, ethnicity, gender, class, religion, or sexual orientation (1)	<input type="radio"/>					
Foreign language course (2)	<input type="radio"/>					
World history course (3)	<input type="radio"/>					
Service learning course (4)	<input type="radio"/>					
Course focused on significant global/international issues and problems (5)	<input type="radio"/>					
Course that included opportunities for intensive dialogue among students from different backgrounds and beliefs (6)	<input type="radio"/>					

Q5

Since coming to college, how often have you participated in the following?

	Never (1)	Rarely (2)	Sometimes (4)	Often (5)	Very Often (7)
Events or activities sponsored by groups reflecting your own cultural heritage (1)	<input type="radio"/>				
Events or activities sponsored by groups reflecting a cultural heritage different from your own (2)	<input type="radio"/>				
Religious or spiritual activities (3)	<input type="radio"/>				
Leadership programs that stress collaboration and teamwork (4)	<input type="radio"/>				
Community service activities unrelated to a course (5)	<input type="radio"/>				
Attend a lecture, workshop, or campus discussion on international or global issues (6)	<input type="radio"/>				

Q6

Since coming to college, how often have you participated in the following?

	Never (1)	Rarely (2)	Sometimes (4)	Often (5)	Very Often (7)
Read a newspaper or news magazine (online or in print) (1)	<input type="radio"/>				
Watched news program on television (2)	<input type="radio"/>				
Followed an international event/crisis (through a newspaper, social media, or other media source) (3)	<input type="radio"/>				
Discussed current events with other students (4)	<input type="radio"/>				
Interacted with students from a country different from your own (5)	<input type="radio"/>				
Interacted with students from a race/ethnic group different from your own (6)	<input type="radio"/>				

Q246 Since coming to college, how often have you experienced the following with your faculty?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Very Often (5)
Discussed course topics, ideas, or concepts with a faculty member outside of class (1)	<input type="radio"/>				
Discussed your academic performance with a faculty member (2)	<input type="radio"/>				
The faculty challenge students' views and perspectives on a topic during class (3)	<input type="radio"/>				
The faculty presented issues and problems in class from a different cultural perspective (4)	<input type="radio"/>				

Q247 Please indicate the extent to which the items most closely describe you by marking the response that most closely matches your experiences and/or self-perception. Please be candid in your responses, as no individual will be identified

	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)
I have a strong sense of affiliation with Rowan (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that Rowan honors diversity and internationalism (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understand the mission of Rowan (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am both challenged and supported at Rowan (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have been encouraged to develop my strengths at Rowan (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel I am part of a close and supportive community of colleagues and friends (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q9 Which of the following have you participated in as an undergraduate student at Rowan University?

- First Year Seminars (1)
- Learning Communities (2)
- Engineers Without Borders (3)
- Undergraduate Research Experiences (4)
- Internship or Co-Op (5)
- Additional writing-intensive courses (6)
- Engineering conferences (7)
- Engineering course with a global focus (8)
- Study abroad (any duration) (9)
- Engineering professional societies (i.e., IEEE, SWE, NSBE, ASME) (10)
- Involvement in student government (11)
- Volunteer regularly (1+ time per month for 6 months or longer) (12)

End of Block: Part 1. Educational Background

Start of Block: Part 2. Global Perspective Inventory(35 items)

Q10

Part 3. Global Perspective Inventory (3-5 min)

Please indicate the extent to which the items most closely describe you by marking the response that most closely matches your experiences and/or self-perception. Please be candid in your responses, as no individual will be identified from the index.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
When I notice cultural differences, my culture tends to have the better approach. (1)	<input type="radio"/>				
I have a definite purpose in my life. (2)	<input type="radio"/>				
I can explain my personal values to people who are different from me. (3)	<input type="radio"/>				
Most of my friends are from my own ethnic background. (4)	<input type="radio"/>				
I think of my life in terms of giving back to society. (5)	<input type="radio"/>				
Some people have a culture and others do not. (6)	<input type="radio"/>				
In different settings what is right and wrong is simple to determine. (7)	<input type="radio"/>				
I am informed of current issues that impact international relations. (8)	<input type="radio"/>				
I know who I am as a person. (9)	<input type="radio"/>				

I feel threatened around people from backgrounds very different from my own. (10)

I often get out of my comfort zone to better understand myself. (11)

I am willing to defend my own views when they differ from others (12)

I understand the reasons and causes of conflict among nations of different cultures (13)

I work for the rights of others. (14)

I see myself as a global citizen. (15)

I take into account different perspectives before drawing conclusions about the world around me. (16)

I understand how various cultures of this world interact socially. (17)

I put my beliefs into action by standing up for my principles. (18)

I consider different cultural perspectives when evaluating global problems. (19)

I rely primarily on authorities to determine what is true in the world (20)

I know how to analyze the basic characteristics of a culture. (21)

I am sensitive to those who are discriminated against. (22)

I do not feel threatened emotionally when presented with multiple perspectives. (23)

I frequently interact with people from a race/ethnic group different from my own (24)

I am accepting of people with different religious and spiritual traditions. (25)

I put the needs of others above my own personal wants. (26)

I can discuss cultural differences from an informed perspective. (27)

I am developing a meaningful philosophy of life. (28)

I intentionally involve people from many cultural backgrounds in my life. (29)

I rarely question what I have been taught about the world around me (30)

I enjoy when my friends from other cultures teach me about our cultural differences. (31)

I consciously behave in terms of making a difference. (32)

I am open to people who strive to live lives very different from my own life style. (33)

Volunteering is not an important priority in my life. (34)

I frequently interact with people from a country different from my own. (35)

Page Break

Q11

Part 1. Your Background (2-3 min)

What is your gender? (Select one)

▼ Male (1) ... Prefer not to answer (4)

Q12 Please indicate your academic level based on the number of years on your campus. (Select one)

▼ First year (Freshman) (1) ... Fourth and plus years (Senior) (4)

Q13 Please indicate your major at Rowan University. (Select all that apply)

- Biomedical Engineering (1)
 - Civil and Environmental Engineering (2)
 - Chemical Engineering (3)
 - Electrical Engineering (4)
 - Engineering Entrepreneurship (5)
 - Mechanical Engineering (6)
 - Other (7) _____
-

Q14 Which of the following most accurately describes your country of birth and citizenship status? (Select one)

- At least one of my grandparents, my parents and I were born in the U.S. (1)
- At least one of my parents and I were born in the U.S. (2)
- I was born in the U.S. but not my parents (3)
- Foreign born (4)
- Citizen of another country, student or visa (6)
- Other (please explain) (5) _____
-

Q15 How long have you lived in the United States? (Select one)

▼ Less than 1 year (1) ... 15+ years (5)

Q16 Have you lived outside of the U.S? (Select one)

- Yes (how long?) (1) _____
- No (2)
-

Q17 How do you identify yourself racially/ethnically? (Select all that apply)

- African descent (1)
 - Asian descent (including the Indian subcontinent) (2)
 - Pacific Island descent (3)
 - Indigenous Person (Aboriginal, Alaskan Native, Maori, Native American, etc.) (4)
 - Hispanic, Latino/Chicano descent (5)
 - Arab or Middle Eastern descent (6)
 - Caucasian European descent, not Hispanic (7)
 - I choose not to self-identify (8)
-

Q18 Do you know one or more second languages? (Select one)

- Yes (1)
 - No (2)
-

Q19 Please indicate your fluency of your *best* foreign language. (Select one)

	Yes (1)	No (2)
I am able to converse/take direction in that language (3)	<input type="radio"/>	<input type="radio"/>
I can take an academic course in that language (2)	<input type="radio"/>	<input type="radio"/>

Page Break

Q20 Do you own a past or current U.S. passport? (Select one)

- Yes (1)
- No (2)

Q21 What is your employment status? (Select one)

- Work - all year (1)
- Work - academic year only (2)
- Work - summers only (3)
- Not employed (4)

Q22 What is your parents' highest degree earned? (Select one)

- Less than high school (1)
- High school graduate (2)
- Some college (3)
- 2 year degree (Associates) (4)
- 4 year degree (Bachelors) (5)
- Some graduate school (6)
- Graduate degree (Masters, Doctorate, MD, JD, etc.) (7)
- Do not know (8)

End of Block: Part 3. Your Background
