Comparison of student global perspectives pre- and post-COVID for a study abroad program

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Abstract

In our increasingly globalized world, it is important for engineers to develop global competencies and skills needed to work in a diverse environment. One way of integrating global competency learning into the engineering curriculum is through study abroad programs and courses that examine the importance of culture and context in engineering practice. The Rising Sophomore Abroad Program (RSAP) at Virginia Tech introduces first-year engineering students to global engineering with the combination of a semester-long course - focused on global engineering and international practices - and a 2-week international experience. This travel abroad, however, was paused during the COVID-19 pandemic. During this period of uncertainty, restricted travel, quarantine, and increased connectivity with remote-work, it is possible that some students' perceptions of globalization and culture may have been impacted. The purpose of this study is to characterize the extent that COVID-19 may have had an effect on the development of student global competencies upon arrival into a study abroad program. Student global perspectives are assessed using the Global Perspectives Inventory (GPI) and compared pre-COVID (2020) and post-COVID (2022) for a study abroad program. Thus, the study seeks to answer the following research question: How do students' global perspectives vary between pre-COVID and post-COVID? Data was quantitatively analyzed using Mann-Whitney non-parametric t-tests to compare groups from 2020 and 2022. Results showed a decrease in the Knowledge and Identity dimensions of the GPI data with statistical significance, but limited practical significance with a small effect size. Overall, this study provides a better understanding of students' perceptions of global perspectives pre-and-post COVID-19. Implications for practice and research are provided, as well as directions for future research.

1. Introduction

In our increasingly globalized world, it is important for engineers to develop global competencies needed to work in a diverse environment. Competencies needed for engineering students entering the workforce are interdependent technical and non-technical skills [1]. It is important for engineers to develop this sociotechnical thinking and balance an understanding of both the technical context with consideration for the social, contextual, and cultural influence on engineering, especially since different countries have different approaches to problem-solving, collaboration, and communication [2]. One way of integrating global competency learning into the engineering curriculum is through study abroad programs [3]. These programs range in duration such as two-week or summer-long time frames and focus on context, country, and language-learning components. However, one of the main barriers for these programs is accessibility and the lack of flexibility in engineering curricula. Hence, some programs offer

short international experiences during the summer to allow students to participate despite the demands of their academic programs. These programs can be successful in developing student cultural awareness and global engineering competencies [4].

The Rising Sophomore Abroad Program (RSAP) at Virginia Tech (VT) introduces first-year engineering students to global engineering with the combination of a semester-long course ENGE 1644 - Global STEM Practice: Leadership and Culture and a 2-week international travel abroad experience. Coupled with the study abroad experience, the course is designed to emphasize the importance of culture and context in engineering practice and teach students global engineering competencies [5]. Student global competencies are assessed using the Global Perspectives Inventory (GPI) which consists of three domains with six scales: Cognitive Knowing, Cognitive Knowledge, Intrapersonal Identity, Intrapersonal Affect, Interpersonal Interaction, and Interpersonal Responsibility [6]. The RSAP program and international travel was paused during the COVID-19 pandemic. During these times of uncertainty, restricted travel, quarantine, and increased connectivity with remote work, it is possible that student perceptions of globalization and culture may have been impacted. The purpose of this study is to understand the impact of COVID-19 on students' global perspectives by comparing student GPI survey data pre-COVID and post-COVID from RSAP. Thus, this study seeks to answer the following research question:

RQ1: How do students' global perspectives vary between pre-COVID and post-COVID based on the Global Perspectives Inventory (GPI)?

Prior work using the GPI instrument has mostly been used to assess the impact of study abroad courses or international experiences on students' global competencies. Studies have found that these types of experiences have a positive impact on developing students' cultural awareness and global competencies when measuring pre-course, post-course, and post-trip data [7].

2. Theoretical Framework

This study is based in the learning theory of connectivism and theoretical perspectives on cultural development and intercultural communication [8]. The GPI instrument was developed from these perspectives and is used to understand social interaction, social responsibility, and the impact of the COVID-19 global pandemic on society. In social constructivism theory, reality is constructed by members of a society together, knowledge is constructed collaboratively by groups, and learning is a social process; which all make up a unique culture of shared meaning [9]. Connectivism theory posits that knowledge and learning are related to the network of connections between both people and information [10]. Thus, learning has expanded from just the individual into the digital age with connections and learning across networks. According to Hammer et al. [11], "experience does not occur simply by being in the vicinity of events when

they occur. Rather, experience is a function of how one construes the events… In the case of intercultural relations, the "event" is that of cultural difference." In the context of this study, global perspectives are considered and measured using the GPI scales, and the "event" of the COVID-19 global pandemic is considered as a factor contributing to experiences and construction of learning and perceptions of society. COVID-19 impacted society in many ways, with restricted travel, social distancing and isolation, uncertainty, and increased connectivity with remote-work.

Although this study is centered around the impacts of COVID-19 on students, the specific context of this study focuses on students participating in a study abroad program. The RSAP program was paused during the COVID-19 pandemic for the years 2020 and 2021. It is anticipated that this significant change in social interactions and global connection will have an impact on students' global perspectives. Figure 1 outlines the two components of the RSAP program, the Spring, semester-long course on Global STEM practice, as well as the two-week international experience abroad. Students participating in the program are surveyed pre-course, post-course and post-trip.

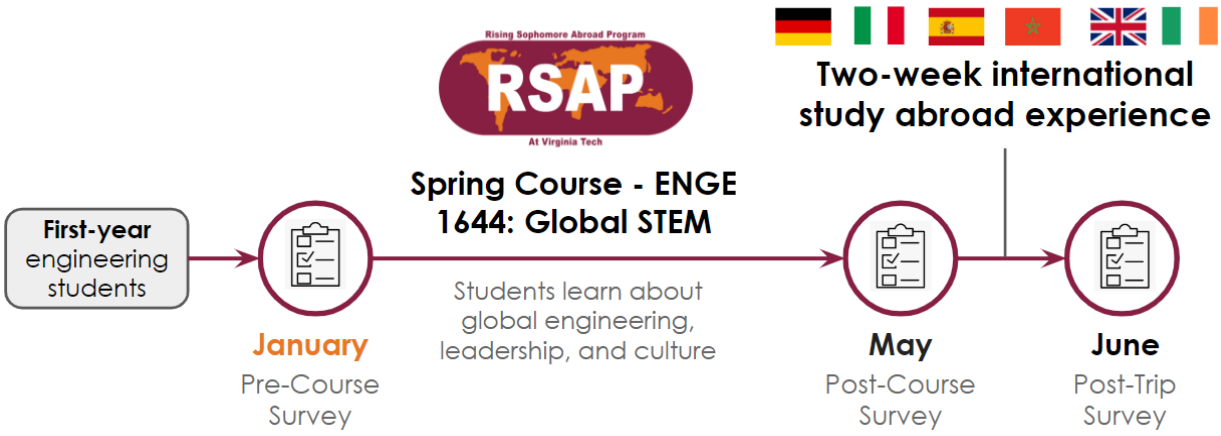

Figure 1. Overview of RSAP study abroad program and survey assessment timeline for 2022.

2.1 Survey Instrument

The validated Global Perspectives Inventory (GPI) consists of three domains with six scales: Cognitive Knowing, Cognitive Knowledge, Intrapersonal Identity, Intrapersonal Affect, Interpersonal Interaction, and Interpersonal Responsibility. The three domains of Cognitive, Intrapersonal, and Interpersonal are designed to capture different constructs related to global perspectives, especially with consideration for the experiences that can shape these areas for students, such as curriculum, co-curriculum, and community [6]. The GPI instrument has been validated and has shown to be reliable. The full survey instrument and items can be found from Braskamp et al.'s work [6].

3. Methods

3.1 Sampling and Data Collection

First-year engineering students participating in the RSAP program completed a pre-course survey in January 2022 at the beginning of the semester-long ENGE 1644 - Global STEM Practice: Leadership and Culture course at VT. A total number of n=83 students completed the pre-course survey, which included items for the GPI scale, with a total of 73 survey items including other survey instruments. For assessing changes in student global perspectives, surveys are conducted pre-course (January), post-course (May), and post-trip (June) immediately after the international study abroad experience. Survey data for both scales have been collected for 2018, 2019 and 2020 (pre-COVID) and 2022 (post-COVID). Due to COVID-19, the RSAP program was disrupted and paused in 2020 and 2021. Students who completed the ENGE 1644 course in 2020 did not travel in May for the international experience but a select few students rejoined the program to travel in May 2022. A breakdown of student survey data collected from 2018 - 2022 is shown in Table 1. This table includes COVID status as well as the total number of students surveyed each year. Data was collected for pre-course, post-course and post-trip for prior years, which could be used for repeated-measures testing, but for the purposes of this study, an independent design is utilized and students for the 2020 year and 2022 year are compared using the pre-course survey.

Table 1. Overview of data for pre, post, and post-trip for the ENGE 1644 course

COVID Status	Year	Students Surveyed	Pre-Course (January)	Post-Course (May)	Post-Trip (June)
Pre-COVID	2018	157	✔	✔	✔
Pre-COVID	2019	162	✔	✔	✔
Partial COVID-19 Impact	2020	187	✔	✔	✘
COVID-19 Impact	2021	N/A	✘	✘	✘
Post-COVID	2022	83*	✔	✔	✔

3.2. Instrument Measures

The GPI survey instrument has been previously developed, validated, and refined to include a limited number of survey items to measure each construct relevant to global perspectives [6]. The instrument uses Likert-type scale items to survey students. Respondents are asked “Please rate your level of agreement with each statement” on a scale from 1 (strongly disagree) to 5 (strongly agree) with 32 total survey items, some of which are reverse-scored.

Sample survey items for each domain scale: Cognitive Knowing, Cognitive Knowledge, Intrapersonal Identity, Intrapersonal Affect, Interpersonal Interaction, and Interpersonal Responsibility are shown in Table 2. There are 12 survey items in the Cognitive domain, 11 in the Intrapersonal domain, and 9 total survey items in the Interpersonal domain.

Table 2. Global Perspectives Inventory instrument breakdown with sample survey items.

GPI Domain	GPI Dimension Scale	Total Items	Sample Item
Cognitive	Knowing	7	I take into account different perspectives before drawing conclusions about the world around me.
	Knowledge	5	I understand how various cultures of this world interact socially.
Intrapersonal	Identity	6	I can explain my personal values to people who are different from me.
	Affect	5	I am open to people who strive to live lives very different from my own lifestyle.
Interpersonal	Interaction	4	I frequently interact with people from a country different from my own.
	Responsibility	5	I put the needs of others above my own personal wants.

3.3. Data Analysis

Data were analyzed for the GPI instrument to determine if there were significant differences for specific dimensions between the years 2020 and 2022. Descriptive statistics were used to report average means, differences, and standard deviations. Assumptions of homogeneity of variance and normal distribution of data were tested to determine the type of t-tests to be used for analysis, based on results from Levene's test [12]. The Mann-Whitney/ Wilcoxon Rank-Sum tests are used for data that is not normally distributed, as these are the non-parametric equivalents of the independent-measures t-test [12]. Missing data from 2020 and 2022 survey data were not imputed, but instead were dropped from each specific dimension, since there were only three instances of missing data from respondents for 2022. This can be seen in Table 4 with a range of n = 80-82 sample units for different dimensions of GPI rather than n=83. It should be noted that sample sizes between years are unequal: n = 187 for year 2020 data and n = 83 for year 2022 data, since the program size was reduced post-COVID and different groups are compared. This unequal sample size could potentially result in practical issues; however, for the scope of this study, the difference in sample sizes was not deemed to be significant since both sample sizes are n>30 [12]. The unequal sample sizes will be further assessed in this study based on equal variances [13], [14].

3.4 Data Quality and Limitations

Data were explored to check assumptions of normality and homogeneity of variance to ensure the data sets for years 2020, and 2022 for the GPI survey data are suitable for data analysis. Normality of data was tested using the Shapiro-Wilks test, histograms of data were plotted, as well as Quartile-Quartile (QQ)-plots.

Normality of Data

Data were first tested for normality using the Shapiro-Wilks test in R using the shapiro.test() function. A breakdown of the results of normality from the Shapiro-Wilk test are shown in Table 3. From this table, it can be seen that several instances in the GPI survey data have significant p-values with $p<0.05$, indicating a deviation from normality. All p-values related to the 2020 data, with n=182, are statistically significant for all dimensions; however, dimensions that are statistically significant for 2022 data are *Intrapersonal Affect:* $p = 0.010$; *Interpersonal Interaction*: $p= 0.011$; and *Interpersonal Responsibility*: $p= 0.001$. In these instances of $p<0.05$ for these dimensions, there has been deviation from normality in the data, which means non-parametric tests must be used for further data analysis.

Table 3. Results from Shapiro-Wilks normality test

	Year	**2020**		**2022**	
Scale	**Dimension**	**W-statistic**	**p-value**	**W-statistic**	**p-value**
GPI	Cognitive Knowing	0.982	**0.0189***	0.980	0.237
	Cognitive Knowledge	0.961	**0.0001***	0.977	0.164
	Intrapersonal Identity	0.976	**0.0032***	0.981	0.279
	Intrapersonal Affect	0.965	**0.0002***	0.958	**0.010***
	Interpersonal Interaction	0.979	**0.0071***	0.959	**0.011***
	Interpersonal Responsibility	0.980	**0.0109***	0.958	**0.011***
* indicates significant p-value **(p<0.05)**, deviation from normality					

In addition to the results from the Shapiro-Wilks test, data were plotted using histograms and QQ-plots to visually inspect for normality of data. QQ-plots allow us to compare our sample data against the expected normal distribution of the data [15]. Distribution of survey data for each GPI dimension is shown in Figure 2 for 2020 data and QQ-plots for 2022 are shown in Figure 3.

Homogeneity of Variance - Levene's Test

To test the assumption of homogeneity of variance, Levene's test was used for the student groups from years 2020 and 2022 for each GPI dimension. Results from Levene's test indicate that the variances for each GPI dimension are roughly equal and the assumption of homogeneity of variance is acceptable, since the differences between groups was not statistically significant: $p > 0.05$ [12]. Results from Levene's Test for each GPI dimension are as follows: **Knowing**: $F(1,260) = 2.43$, $p = 0.12$; **Knowledge:** $F(1, 261) = 0.17$, $p = 0.68$; **Identity**: $F(1, 262) = 0.07$, $p = 0.79$; **Affect:** $F(1, 261) = 0.43$, $p = 0.51$; **Interaction:** $F(1, 261) = 0.007$, $p = 0.93$; **Responsibility**: $F(1, 261) = 0.24$, $p = 0.62$.

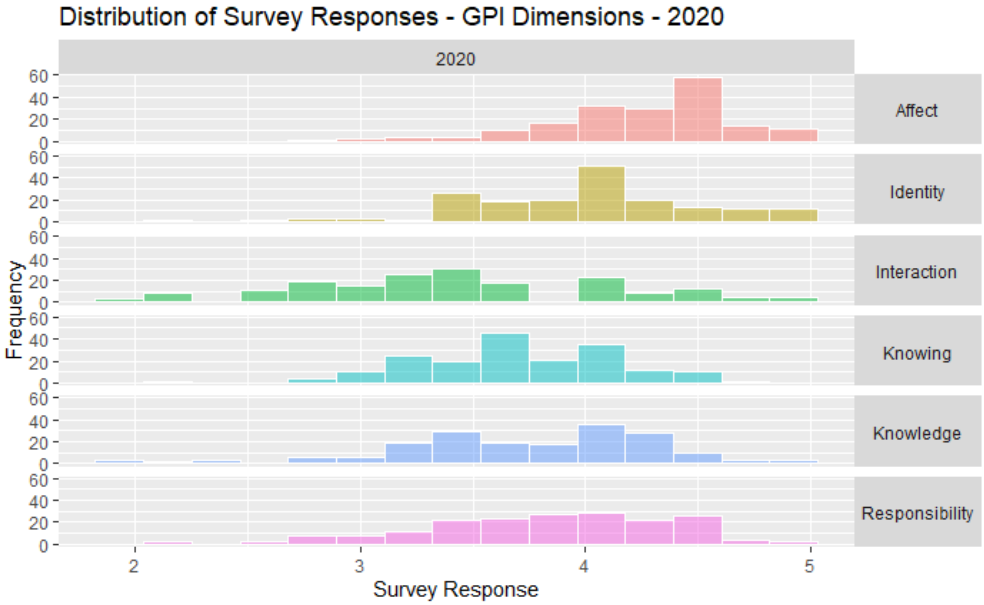

Figure 2. Distribution of survey responses for GPI dimensions, year = 2020.

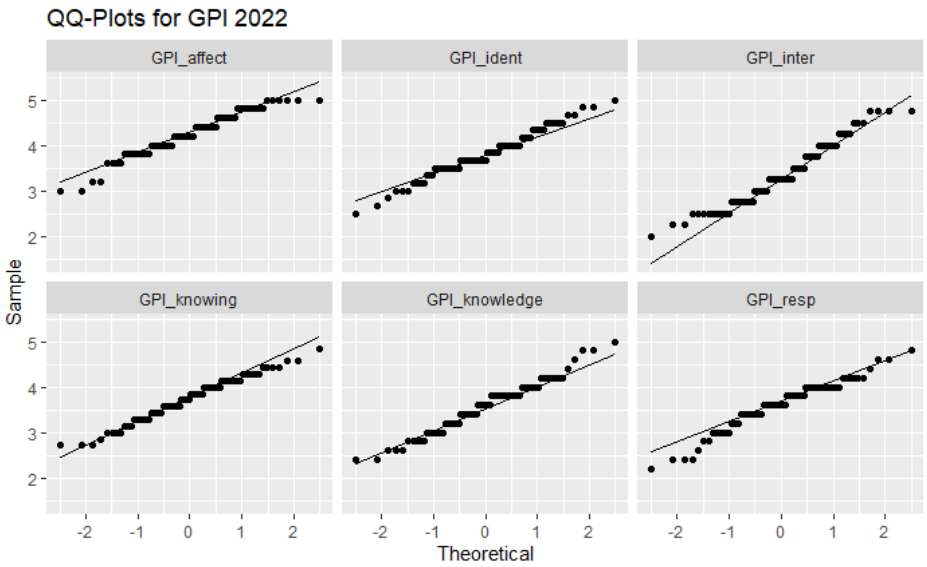

Figure 3. QQ-plots for each GPI dimensions, year = 2022.

Reliability

To ensure reliability of the GPI survey instrument, Cronbach's Alpha (α) was determined for each dimension to evaluate internal consistency of survey items. Coefficients of alpha, $\alpha > 0.6$ are considered to be generally reliable values that indicate internal consistency of the scales [12, 16]. Table 4 shows the dimensions for each scale, the number of survey items and sample units, along with Cronbach's α. The GPI instrument, which utilizes a 5-point Likert-scale, overall did not have high internal consistency. All six dimensions had reliable coefficients $\alpha > 0.6$: **Cognitive Knowledge:** $\alpha = 0.728$; **Intrapersonal Identity:** $\alpha = 0.708$; and **Intrapersonal Affect:** $\alpha = 0.712$ and the other three dimensions with slightly less reliable internal consistency between survey items: **Cognitive Knowing:** $\alpha = 0.65$; **Interpersonal Interaction:** $\alpha = 0.654$; and **Interpersonal Responsibility:** $\alpha = 0.68$.

Table 4. Scale dimensions and Cronbach's α.

Year	Scale	Dimension	Survey Items	Sample units	Cronbach's alpha (α)
2022	**GPI**	Cognitive Knowing	7	80	0.654
		Cognitive Knowledge	5	81	**0.728**
		Intrapersonal Identity	6	82	**0.708**
		Intrapersonal Affect	5	81	**0.712**
		Interpersonal Interaction	4	81	0.617
		Interpersonal Responsibility	5	81	0.68

4. Results

Results from data analysis show the comparison of students' GPI scores between the years 2020 and 2022. Detailed in this section are descriptive statistics for GPI comparison, as well as results from Mann-Whitney non-parametric t-tests.

Descriptive Statistics

For the GPI instrument survey data, descriptive statistics were determined for each dimension and year, including the mean, standard deviation, median, interquartile range (IQR), skew, kurtosis, and difference in means. The count, mean, standard deviation and difference in means are shown in Table 5, comparing years 2020 to 2022 for each GPI dimension: Knowing, Knowledge, Identity, Affect, Interaction, and Responsibility.

Table 5. Descriptive statistics of Global Perspectives Inventory by dimension and year.

GPI Dimension	Year	count	mean	sd	Difference in means
Knowing	2020	182	3.702	0.431	0.043
	2022	80	3.745	0.478	
Knowledge	2020	182	3.698	0.579	-0.128
	2022	80	3.570	0.553	
Identity	2020	182	3.992	0.516	**-0.190**
	2022	80	3.802	0.498	
Affect	2020	182	**4.224**	0.441	0.016
	2022	80	**4.240**	0.468	
Interaction	2020	182	**3.446**	**0.689**	-0.112
	2022	80	**3.334**	**0.677**	
Responsibility	2020	182	3.787	0.528	**-0.174**
	2022	80	3.613	0.516	

From Table 5, comparison between years 2020 and 2022 did not show a large difference in means, with generally lower mean scores in 2022 than 2020. The biggest difference was seen in the *Identity* and *Responsibility* dimensions, with difference in means of -0.190 and -0.174, respectively. The *Affect* dimension showed the highest mean scores compared to other dimensions, with means of 4.224 and 4.240 for 2020 and 2022, respectively. The *Interaction* dimension had the lowest mean scores of 3.446 and 3.334 and the highest standard deviation of 0.689 and 0.677 for 2020 and 2022, respectively.

Mann-Whitney/Wilcoxon Rank-Sum Test

Because the GPI data was non-parametric, based on results from Shapiro-Wilks test ($p < 0.05$), Mann-Whitney/Wilcoxon Rank-Sum test was used on both datasets. The Mann-Whitney/ Wilcoxon Rank-Sum test is the non-parametric equivalent of the independent t-test and is determined using the wilcox.test() function in R [12]. Results from the Wilcoxon Rank-sum test, shown in Table 6, indicate that while there are a handful of statistically significant p-values, there is little practical significance, since the effect sizes are small. Significance level indicators for p-values are as follows: p-value ($p <0.05$)*, ($p<0.01$)**. Three dimensions of the GPI instrument had statistically significant results, including the *Knowledge* dimension: $p = 0.0396$*; *Identity* dimension: $p = 0.00193$**; and *Responsibility* dimension: $p = 0.018$*. Given the

calculation to determine the W-statistic as W = ranked sum - mean rank, the value range of W= 6750.5 to W = 9024.5 is realistic since the total sample size N = 267 when combining the years 2020 and 2022. The effect size for all dimensions is small, with the highest r = -0.190 for the *Identity* dimension. Effect sizes above 0.5 are considered a large effect and below 0.3 considered a small effect [12].

Table 6. Results from Mann-Whitney/Wilcoxon Rank-Sum test

Instrument	**Dimension**	**W-statistic**	**p-value**	**Effect Size, *r***
GPI	Knowing	6844	0.440	-0.047
	Knowledge	8434.5	**0.0396***	**-0.126**
	Identity	9024.5	**0.00193****	**-0.190**
	Affect	7126	0.784	-0.017
	Interaction	8056	0.167	-0.085
	Responsibility	8607	**0.018***	**-0.145**
significance levels indicator: p-value **(p <0.05)*, (p<0.01)****				

5. Discussion

Comparison of means for the GPI instrument in Table 5 shows the largest difference in the *Intrapersonal - Identity* and *Interpersonal - Responsibility* dimensions, with difference in means of -0.190 and -0.174, respectively. These results may indicate that students in 2022, post-COVID have slightly lower global perspectives in these two scale dimensions. Based on the GPI survey instrument, the *Interpersonal Responsibility* scale consists of survey items such as "I put the needs of others above my own personal wants," which is interesting to consider given the impact of COVID-19 on our social interactions and sense of interpersonal responsibility in consideration for ourselves and the impact we have on others. Cronbach's alpha results indicate that further analysis should be conducted on the GPI instrument scales for *Cognitive Knowing***,** *Interpersonal Interactions, and Interpersonal Responsibility*, since these three dimensions had Cronbach's Alpha scores of $\alpha < 0.7$, which is considered reliable [16] but below the threshold of other generally accepted values that indicate internal consistency of the scales [12]. Confirmatory factor analysis could be used to take a deeper look at the individual survey items related to each scale dimension and uncover specific differences between the two groups pre and post-COVID.

Connectivism theory posits that knowledge and learning are related to the network of connections between both people and information [9]. Thus, learning has expanded from just the individual into the digital age with connections and learning across networks. Results were not statistically significant for the *Interpersonal Interaction* dimension, which includes survey items

such as “I frequently interact with people from a country different from my own.” This dimension also had the lowest Cronbach’s $\alpha = 0.617$, indicating that survey items could be looked at further. It is important to consider how the digital age can impact survey instruments. For example, survey items related to *Interpersonal Interaction* do not specify whether these interactions or context is in-person or virtually online.

Three dimensions of the GPI instrument had statistically significant results, including the *Knowledge* dimension: p = 0.0396*; *Identity* dimension: p = 0.00193**; and *Responsibility* dimension: p = 0.018*. The effect size for all dimensions is small, with the highest $r = -0.190$ for the *Identity* dimension. Effect sizes above 0.5 are considered a large effect and below 0.3 considered a small effect [12]. Although three dimensions showed statistically significant results, these differences have little practical significance due to the small effect size. Still, it is worthwhile to consider the influence of COVID-19 as a factor for students to have lower scores than pre-COVID.

Moreover, it is difficult to distinguish solely through quantitative analysis whether these differences could be due to group differences or impact from COVID-19. There are clear limitations in interpretation of results. Since independent t-tests were conducted with different groups, data comparison from 2020 to 2022 does not account for other possible experiences which could have impacted student global perspectives other than COVID-19. The systematic variation of the study takes the year of pre-course survey as a cross-sectional snapshot of students perceptions and thinking, labeling January 2020 as pre-COVID and January 2022 as post-COVID; however, the unsystematic variation related to different world events and time as a differing factor for student perceptions was not accounted for.

This study is limited in generalizability to the general population and understanding student global perspectives, since it focused on engineering students participating specifically in the RSAP program at Virginia Tech, with a limited number of survey participants. Research could be conducted at a national level to determine if there are significant differences in how students show up to study abroad programs post-COVID.

6. Conclusion

In this study, global perspectives were compared from pre-COVID to post-COVID for undergraduate first-year engineering students participating in a study abroad program. Students participating in the Rising Sophomore Abroad Program (RSAP), which includes a semester-long course teaching engineering global leadership and culture and a two-week study abroad experience, were given pre-course surveys prior to starting the ENGE 1644 - Global STEM Practice: Leadership and Culture course. Students were surveyed using the Global Perspectives Inventory (GPI) which is a previously validated instrument [6]. A sample size of n = 187 from

January 2020 (pre-COVID) was compared to a sample size of n = 83 students from January 2022 (post-COVID) in all dimensions of the GPI instrument. Data was quantitatively analyzed using Mann-Whitney non-parametric t-tests to compare groups from 2020 and 2022. Results showed a decrease in the *Knowledge* and *Identity* dimensions of the GPI data with statistical significance, but limited practical significance with a small effect size. Overall, this study provides a better understanding of students' perceptions of global perspectives pre-and-post COVID-19.

7. Future Work

Future work could explore the pre-course survey data more deeply to gain a better understanding of the impacts of COVID-19 on incoming student global perspectives and cultural intelligence. What are the lasting effects of COVID-19 on students and society as a whole pertaining to views of culture and global perspectives? To what extent is this able to be quantitatively captured using existing survey instruments geared towards global perspectives? Confirmatory factor analysis (CFA) could be used to gain a better understanding of the individual survey items with factor loadings to determine how appropriate these survey items are for the context of this study. Additionally, a qualitative study could be conducted to interview students to better understand perceptions of COVID-19 and the impact it may have had on global perspectives. This could also take a more exploratory approach to inform and evaluate the survey items included in both instruments, especially the interpersonal domain of the global perspectives inventory. The GPI instrument includes survey items in the *Interpersonal Interaction* and *Interpersonal Responsibility* scales such as “I frequently interact with people from a country different from my own” and “I put the needs of others above my own personal wants”, respectively. Perhaps the shift towards remote work may have increased the ability for students to interact with people from different countries; however, this may be limited for students depending on involvement in extracurricular activities, professional societies, internships and co-ops, as well as massive online open courses (MOOCs) [10]. It should also be noted that the survey instrument does not specify whether the interactions are in-person or virtually - which could potentially be an important distinction. Nevertheless, it would be worthwhile to interview students pre-trip and post-trip traveling abroad to determine their perception on how COVID-19 has impacted their global views and perceptions of travel. Further analysis should be conducted using the Cultural Intelligence Scale (CQS) and Sojourn Readiness Assessment (SRA) instrument, especially in the domain of anxiety and uncertainty related to travel [17].

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