Cultural Intelligence and Experiences in International Engineering Programs

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***Abstract*—Given increasingly globalized economic trends and the global nature of many of the most pressing humanitarian problems the world faces, this full paper addresses engineers' needs to be prepared with the skills and competencies necessary to work with diverse clients and peers and on projects that span international borders.**

To foster such skills, engineering schools across the country are offering more international engineering programs at the undergraduate level. These programs, charged with the important task of preparing future engineers for globalized work, need to be appropriately evaluated to determine their effectiveness in promoting intercultural outcomes. Similarly, it is important to understand which aspects of these programs are most essential to helping foster intercultural outcomes in students. Therefore, in this paper, we investigate the following research questions: 1) Is there a significant change in students' cultural intelligence before and after they participate in international engineering programs, and 2) What relationships exist between students' cultural intelligence and their experiences in intercultural educational programs, when controlling for student characteristics and program variables?

The answers to both questions are of great importance to the field of engineering, as they provide evidence to inform decisions around how to create, modify, and structure international programs in engineering. We found that participants' cultural intelligence as measured by the Cultural Intelligence Survey [13] significantly grew from pretest to posttest on the overall cultural intelligence (CQ) measure, as well as all four cultural intelligence dimensions. We also found that students' experiences abroad—specifically the frequency with which they built relationships and had meaningful conversations about culture with locals—was positively related to an increase in CQ score from pretest to posttest. Together, these findings suggest that not only are international programs in engineering successful in promoting intercultural outcomes, but also that students' frequency of interaction with local people is an important component of successful international programs.

These findings have the potential to shape a range of international programs to better meet the needs of both future engineers and the clients, employers, and members of society that stand to benefit from their readiness to tackle global engineering challenges.

Keywords—international programs, cultural intelligence, study abroad, experiences

I. Introduction

As the global economy becomes increasingly integrated, engineering graduates are much more likely to interact with both customers and colleagues across the world. Engineering work is not confined to domestic projects, clients, and interests. Many engineering companies have launched more plants and offices across the globe, servicing an increasingly diverse clientele [1-3]. As a result, engineers are more likely to work on long-term assignments in different countries. Those who work domestically are likely to take business trips abroad to meet with clients and international partners or work virtually to collaborate with engineers and customers across borders [1, 3]. Though the nature of international appointments, partnerships, or projects may take many different forms, the trend toward increasingly global engineering work is likely to touch current and future generations of engineers alike [1-3].

Engineering work has also become more international in response to the nature of intrinsically interconnected global problems in need of engineering solutions [2,3]. For example, a significant portion of the world's population are in need of sanitation, health care, clean water, and infrastructure improvements to meet their basic needs [2]. Similarly, global challenges related to food, climate change, and sustainable global development affect people across international boundaries and therefore necessitate a response from the global engineering community [1].

Scholars and educators have recognized the need to equip engineering undergraduates with a set of skills and abilities in addition to their technical training [1-2, 4] to be successful in these increasingly global contexts. These include interpersonal skills that enable engineers to work in unfamiliar cultures with diverse clients and alongside diverse colleagues. Also important are future engineers' cross-cultural communication skills, necessary for effective partnerships with international clients and colleagues. Additionally, engineers need intercultural skills, such as the ability to understand cultural differences, recognize how people from different cultures may approach problem solving, and identify how engineering problems may manifest differently across various cultural contexts. Potential employers also look for engineers with personal skills—such as flexibility and willingness to take risks—thought to make them more effective in international work [1].

Undergraduate engineering programs offer a variety of international programs to expand students' horizons, provide a foundation for life-long learning, and equip them with necessary skills to learn, interact, and work with others in global engineering contexts [1, 3]. These programs often include a variety of opportunities, such as studying abroad, interning internationally, volunteering in programs related to engineering, working abroad, studying a second language during their undergraduate years [1], obtaining a dual degree from an international university, engaging in exchanges, field trips, project-based learning, researching abroad, or participating in international co-ops [2]. Though the number of these international programs offered to engineering students was once quite low, it has been increasing since the early 2000s, as schools began to integrate such programs into undergraduate curricula [1, 2]. As early as the mid-2000s, some of the leading schools in international educational opportunities saw up to 35% of their students participating in some form of international program—which some attribute to changes in accreditation standards, such as ABET 2000's requirement of international components in engineering curricula [1]. Even as the availability of international engineering programs increases, scholars continue to call on schools to incorporate more international opportunities into undergraduate engineering curricula [5]. As such, both the overall number of programs offered as well as the number of engineering students participating in these programs are likely to increase.

Because of the expansion of international programs for engineers, increasing participation, and their charge to prepare the next generation of engineers with vital skills, it is important to measure the outcomes of these programs. Assessment should include both an examination of student learning outcomes and an investigation of what aspects of these programs foster such outcomes and why. Of particular interest are outcomes related to students' personal, communicative, interpersonal, and intercultural skills—those thought to improve their abilities to work in diverse teams, with diverse clientele, in international locations, and on projects focused on global issues [1, 2]. But simply assessing whether certain international programs help foster such outcomes is not in itself sufficient; rather, researchers and educators need to understand the participants' *experiences* in these programs that help or hinder the development of such outcomes. That is, what happens in these international programs that fosters participant outcomes? Understanding the relationships between students' experiences in international programs and their development of outcomes is useful far beyond the context of the programs we examine in this study, as these findings can be adapted across educational contexts to create new programs or modify existing offerings in order to better prepare students with these vital skills.

This paper uses pre-trip and post-trip survey data collected at a large research university in the Midwestern United States from students who participated in a variety of international engineering experiences (i.e., study abroad, research abroad, international project work, internship abroad) during the summer of 2019 to empirically investigate international program outcomes. Specifically, this study examines the following research questions: 1) Is there a significant change in students' cultural intelligence [6] before and after they participate in international engineering programs, and 2) What relationships exist between students' cultural intelligence and their experiences in intercultural educational programs, when controlling for a variety of student characteristics and program variables?

II. Literature Review

A. Intercultural Outcomes of International Programs in Engineering

Extant literature on the outcomes of international engineering programs does not currently converge around a single measure, instrument, or method [7]. In fact, there is not even agreement in the literature on what to call the types of outcomes related to cross-cultural experiences. For the purpose of clarity in this paper, we will call this category of outcomes *intercultural outcomes* because they center on students' cognition, attitudes, and behaviors relating to interacting across cultures.

In their review of empirical literature on the intercultural outcomes of global engineering programs, Johri & Jesiek [7] note that researchers have used a range of assessment instruments and methods to study these types of outcomes. Qualitative approaches analyze student data from reflective essays, individual interviews, group interviews, case studies, and scenario-based assessment instruments. Along with questionnaires and self-reports of intercultural outcomes, quantitative methods often utilize pretest posttest survey instruments. Though pretest posttest survey designs are common, the specific survey instruments researchers choose vary from study to study. Some examples include the Intercultural Development Inventory (IDI) [8], the Miville-Guzman Universality-Diversity Scale short form (MGUDS-S) [9], and the Engineering Global Preparedness Index (EGPI) [10]. The following examination of the actual instruments and their development demonstrates key differences among them.

A useful organizing principle in understanding the differences among the various instruments used in engineering education research on international programming is Deardorff's [11] categorization of internal and external outcomes. Internal outcomes as involve "an internal shift in frame of reference" in the participant (p. 255), which is thought to enhance the observable, external outcome, defined as "behaving and communicating appropriately and effectively in intercultural situations" (p. 255). That is, internal outcomes involve unobservable shifts in one's viewpoints or frames of reference, which are thought to be connected to external or behavioral outcomes displayed through communication and behavior. Through Deardorff's [11] framework, the IDI's measurement of "intercultural sensitivity" is an internal outcome, as it measures one's sensitivity to cultural differences [12]. The creators of the IDI explain, "We argue that greater intercultural sensitivity is associated with greater potential for exercising intercultural competence" (p. 422)—where intercultural competence is an external outcome focused on observable behavior. In this way, the IDI does not actually measure any external outcomes related to behavior—just the

internal outcomes theorized to influence behavior. As such, the IDI is a purely internal instrument.

The MGUDS-S [9] is similarly internally focused. It measures what the authors call "intercultural competence," though an analysis of the actual survey items demonstrates that its conceptualization is different from intercultural competence as defined by the authors of the IDI [8]. While intercultural competence as conceptualized by the IDI authors is an external outcome focused on behavior, only two of the 15 items on the MGUDS-S scale measure behavior (i.e., *I attend events where I might get to know people from different racial backgrounds*; *I often listen to music of other cultures*). Moreover, the behaviors these items assess do not concern the types of skills or competencies identified in the previous section as essential to future engineers, such as successfully interacting with people from diverse cultural backgrounds.

Like the IDI and MGUDS-S, the EGPI [10] also focuses on internal outcomes. The instrument "is intended to measure the preparedness of engineering students for global workforces" (p. 3) and is comprised of four sub-constructs (i.e., engineering ethics, engineering efficacy, engineering global-centrism, and engineering community connectedness)—the names of which indicate behaviorally focused concepts; however, an examination of the definitions and items that comprise global preparedness and its sub-constructs demonstrates instead that the instrument actually measures moral values, beliefs about whether and how engineers can make a difference in the world, feelings of belonging or kinship to humanity, and awareness and appreciation for the ways in which people across the world are interconnected. Therefore, like the IDI, though this instrument is intended to assess readiness for working with diverse others, its items instead measure attitudes, beliefs, and values toward action rather than the behaviors themselves.

More recent research on engineering international educational programs has brought scholars' attention to the study of *cultural intelligence* [e.g., 5, 4]. Cultural intelligence, or "CQ," is the "capability to function effectively in culturally diverse settings" [13, p. 335]. Unlike the IDI, MGUDS-S, and EGPI, the Cultural Intelligence Survey (CQS) [13] is much more focused on external outcomes, as it includes several behavioral measures. In additional to the Behavioral CQ dimension, which exclusively measures students' self-reported behaviors, even the Metacognitive and Motivational dimensions contain items that measure metacognition and motivation directly related to cross-cultural interaction.

Previous research has also empirically demonstrated positive relationships between individuals' cultural intelligence scores and a number of cross-cultural behaviors and adaptation. For example, one study [13] found significant, positive relationships among several CQ dimensions and external outcomes such as cultural judgment and decision making, cultural adaptation, and task performance—all of which are outcomes similar to those educators and industry professionals have identified as essential to the next generation of engineers [1]. Combined with the conceptual aspects of the CQS focused on extrinsic outcomes, findings from prior studies linking CQ to the types of skills and competencies engineers will need to succeed in a more globally connected context position the CQS as an ideal instrument for assessing whether international programs in engineering are actually helping foster the types of outcomes with which they are charged.

B. *Experiential Aspects of International Programs*

Research on international experiences suggests that simply encountering a different culture does not in itself foster learning outcomes in undergraduate students [14]. Factors related to programs' curricula, pedagogy, classroom activities, and assignments or fieldwork all influence outcomes of international programs. The individuals with whom students interact in the classroom and outside the classroom based on course requirements or assignments can also influence learning [14, 15].

Similarly, the co-curricular context can play an important role in outcome development. Student interactions with the host community, structured experiential learning activities, and unstructured time can influence student outcomes. Studies also show that the languages students speak with locals and the interactions students have with one another can be central to their development [14].

Also potentially important are the identities of the students themselves, which can play a role in the ways in which they interact with peers, locals, instructors, and others, as well as the ways in which these other members of the social environment interact with the students. Research has found that students' individual characteristics can influence the extent to which they venture into new cultural territory or pursue unfamiliar cultural experiences that may be too uncomfortable for other students [14]. This suggests that the individual decisions students make in the ways in which they spend their time abroad shape their experiences and therefore their learning, outside of the influence of the prescribed formal program.

III. METHODS

A. *Sample*

The research team received approval from the Internal Review Board to collect data from undergraduate students who attend a large U.S. research university, all of whom participated in one of 19 different summer 2019 international programs offered through the college of engineering's international programming office. Students were administered a pre-departure survey during the winter semester before they departed, and they were administered a posttest the fall semester after they returned. Three hundred and fifty-six students were given the survey. Three hundred and eight students completed the pre-departure survey, and 256 students completed the post-return survey.

B. *Measures*

1) *Cultural Intelligence*

The dependent variable in this study is cultural intelligence. Cultural intelligence, or CQ, is a measure of "an individual's capability to function and manage effectively in culturally diverse settings" [13, p. 336]. The CQS, an instrument designed to measure cultural intelligence, is comprised of four cultural

intelligence dimensions: cognitive (6 items), metacognitive (4 items), motivational (5 items), and behavioral (5 items) (see appendix for full instrument). The cognitive dimension measures one's knowledge regarding cultural norms, practices, and conventions in various cultural settings. The metacognitive dimension regards one's ability to evaluate cultural knowledge, with attention to self-awareness and cognitive processes during intercultural interactions. The motivational dimension measures one's mental ability to focus and sustain one's energy on performance during cross-cultural interactions. Finally, the behavioral dimension assesses one's ability to modify behavior to be appropriate in various cultural contexts [15]. Together, these four sub-dimensions form the cultural intelligence construct.

The CQS [13] is comprised of 20 questions on a Likert-type scale. Participants are asked to select the degree to which they agree with the statements provided (1 = Strongly Disagree, 7 = Strongly Agree). Sample items include: *I am conscious of the cultural knowledge I use when interacting with people from different cultural backgrounds* (Metacognitive); *I know the legal and economic systems of other cultures* (Cognitive); *I enjoy interacting with people from different cultures* (Motivational); *I vary the rate of my speaking when a cross-cultural situation requires it* (Behavioral).

To ensure the fit of our data to the theorized CQ factor structure, we performed a confirmatory factor analysis (CFA) using Stata 16 on pretest and posttest data. Rather than the theorized four-factor structure, our data showed stronger fit with a three-factor structure, which excluded the metacognitive dimension. An examination of the rotation matrix revealed that the four items we would expect to load onto the Metacognitive factor instead loaded onto two different factors (i.e., two items loaded onto factor 1, and two items loaded onto factor 2). Factor 1 and factor 2 were negatively correlated with one another, indicating that they should not be combined into a single factor of Metacognitive CQ, given item-level correlations. Without a strong measure of Metacognitive CQ from either factor 1 or factor 2, we made the decision to drop this factor from our analysis and proceed with a three-factor structure for overall CQ.

The pretest data demonstrated stronger model fit (SRMR = 0.055, RMSEA = 0.060, CFI = 0.932, TLI = 0.920) than the posttest data (i.e., SRMR = 0.071, RMSEA = 0.078, CFI = 0.904, TLI = 0.886); however, given the strength of the pretest model and its similarity to the theorized model, as well as the strength of the factor loadings in the pretest (i.e., individual items all > 0.548, factors all > 0.0.771) and posttest (i.e., individual items all > 0.583, factors all > 0.761) and Chronbach's alphas for each of the dimensions in both the pretest (all > 0.787) and posttest data (i.e., all > 0.801), the authors determined the models demonstrated acceptable fit.

A CQ change variable, which calculates this difference, was created to measure the change in cultural intelligence from pretest to posttest across participants. The variable is a difference in row-means for pretest and posttest scores that calculates a group average for all participants, removing missing scores from the average so that a score of zero does not artificially pull down the average. This process was repeated for each of the sub-dimensions to enable sub-dimension comparisons. Thus, the change variable represents the change in group mean from pretest to posttest, such that a positive value indicates an increase from pretest to posttest.

2) Personal Characteristics and Prior Experiences

Personal characteristics collected include: self-identified ethnicity (American Indian 2.48%, Asian 28.48%, Black 4.64%, Hispanic 12.38%, White 45.82%, Non-indicated 6.19%), self-identified member of an immigrant family (non-immigrant 62.16%, immigrant 37.84%), in-state resident (resident 53.46%, non-resident 46.54%). Prior travel experience was measured by asking students if they had ever traveled outside their home country (no 6.88%, yes 93.12%).

3) International Program

Our study controls for the specific program in which each student participated to account for program-level differences. There were 19 programs in total. One program was removed from the model because it had no undergraduate participants. Programs duration ranged from three weeks to eight weeks. Programs also varied by the following characteristics: internship experiences, field experiences, research components, classes taught by home-university faculty, classes taught by local faculty, housing format, language of instruction, and the presence or number of formal cultural excursions or experiences built into each program.

4) Experience Factors

The post-return survey asked participants 15 questions about the frequency with which they engaged in a range of activities and behaviors documented in the literature to be related to intercultural learning outcomes. We performed a principle components factor analysis with promax rotation for 15 items from the post-return survey, which resulted in three factors we used as independent variables in this study. The three factors are comprised of six items. One additional factor that was comprised of two items was eliminated from consideration for lack of conceptual integrity. All other items with acceptably high factor loadings loaded onto factors individually and were therefore eliminated, as the authors rejected the use of single-item factors for this study. Table 1 below shows factor loadings and Cronbach's alpha for the six variables determined to constitute usable factors for the analysis in this paper.

Table I. Experience Factors

Factor	**Factor loadings and communalities based on a principle components analysis with promax rotation for 15 items from the post-return international program survey**		
	Survey Item	***Factor Loading***	***Cronbach's alpha***
Language	Spoke the host country language inside the classroom/learning environment	0.786	0.820
	Spoke the host country language outside the classroom/learning environment	0.800	
Intercultural Interaction	Built relationships with local people	0.834	0.716
	Had meaningful conversations about culture	0.469	

Factor	Factor loadings and communalities based on a principle components analysis with promax rotation for 15 items from the post-return international program survey		
	Survey Item	***Factor Loading***	***Cronbach's alpha***
Negative Interactions	Had guarded, cautious interactions	0.678	0.668
	Had tense, somewhat hostile interactions	0.640	

IV. Analysis

All analyses were performed using Stata 16 statistical software.

A. T-Tests

To determine whether participants' cultural intelligence scores changed significantly from pretest to posttest, we performed t-tests on the group mean total CQ scores before students studied abroad and after they returned. We also performed t-tests on each of the CQ sub-dimension group mean scores. Listwise deletion removed cases with missing values for any of the variables included in the model, which resulted in an analytical sample of 157 participants.

B. Linear Regression

We used the change in total CQ variable—which measures the difference from pretest to posttest by subtracting the group mean total CQ pretest score from the group mean total CQ posttest score—as our outcome variable. We controlled for participants' personal characteristics and prior experiences, international program effects, and experience factors. We used robust standard errors to estimate these effects. Listwise deletion removed cases with missing values for any of the variables included in the model, which resulted in an analytical sample of 151 participants.

V. Results

A. T-Tests

Table 2 displays the results of t-tests for statistical significance between CQ total scores from pretest to posttest, as well as all three sub-dimension scores from pretest to posttest.

Table II. Change in Cultural Intelligence

N	Change in cultural intelligence group means from pretest to posttest using t-tests		
	CQ Group Mean Score	***Mean (SD)***	***Diff***
157	Pre-CQ Total	4.78 (0.741)	0.612***
	Post-CQ Total	5.39 (0.694)	
157	Pre-Cognitive	4.76 (1.029)	0.756***
	Post-Cognitive	4.01 (1.030)	
157	Pre-Motivational	5.91 (0.772)	0.539***
	Post-Motivational	5.37 (0.779)	
157	Pre-Behavioral	5.35 (0.74)	0.566***
	Post-Behavioral	4.79 (0.069)	

*p<0.05, **p<0.01, ***p<0.001

As Table 2 shows, the total CQ score and each of the sub-dimensions increased significantly from pretest to posttest. This indicates not only that participants' overall cultural intelligence increased after they studied abroad, but also that their cognitive, motivational, and behavioral cultural intelligence scores increased as well.

Though this sample is not necessarily a nationally- or internationally-representative sample of students, the results of these tests of statistically significant differences are promising for those who study international engineering education. These results provide evidence in support of the notion that international program participation may help foster cultural intelligence among engineering undergraduates. They also offer further evidence in support of the use of the CQS instrument and of cultural intelligence as a measure to assess intercultural learning outcomes of international engineering programs.

B. Linear Regression

Table 3 displays results from our linear regression analysis, which measured relationships between the pretest-posttest change in participants' group mean scores for total CQ.

Table III. Linear Regression Results for Change in CQ Total Score from Pretest to Posttest controlling for Student Characteristics and Prior Experiences, International Program, and Experience Factors

Linear Regression Results for Change in CQ Total Score from Pretest to Posttest controlling for Student Characteristics and Prior Experiences, International Program, and Experience Factors				
Variables (Reference)	***B***	***R SE***	***t***	***p***
Personal Characteristics and Prior Experiences				
Ethnicity (White)				
American Indian	0.697	0.507	1.37	0.172
Asian	-0.142	0.166	-0.86	0.392
Black	0.231	0.445	0.52	0.606
Hispanic	-0.366	0.245	-1.50	0.137
Immigrant Status (Immigrant)				

Linear Regression Results for Change in CQ Total Score from Pretest to Posttest controlling for Student Characteristics and Prior Experiences, International Program, and Experience Factors				
Variables (Reference)	***B***	***R SE***	***t***	***p***
Non-Immigrant	0.082	0.166	0.49	0.622
State Resident Status (Resident)				
Non-Resident	0.327*	0.129	2.54	0.012
Prior International Travel (Yes)				
No	-0.218	0.260	-0.80	0.425
International Experience Program (Berlin)				
Aachen	0.778*	0.340	2.29	0.024
Argentina	1.156***	0.321	3.60	0.000
Copenhagen	-0.171	0.354	-0.48	0.630
Dublin	0.435*	0.292	1.49	0.139
Cergy-Pontoise	0.761*	0.320	2.38	0.019
Hong Kong	0.737*	0.319	2.31	0.022
Lyon	0.932	0.741	1.26	0.211
Shanghai	0.466	0.300	1.58	0.118
Lund	0.311	0.334	0.93	0.355
Portugal	0.303	0.357	0.86	0.392
Rome	0.862	0.353	0.86	0.392
Spain (spring)	0.633	0.659	0.96	0.338
Spain (summer)	0.227	0.357	0.64	0.526
Troyes	0.647	0.328	1.98	0.050
Xiamen	1.064**	0.380	2.80	0.006
Experience Factors				
Language	-0.022	0.050	-0.44	0.658
Intercultural Interaction	0.155**	0.052	3.01	0.003
Negative Interactions	0.009	0.056	0.17	0.869
Constant	-0.469	0.473	0.99	0.324

*p<0.05, **p<0.01, ***p<0.001

Results from Table 3 show a number of personal characteristics and prior experiences, international programs, and experience factors are significantly related to participants' changes in CQ total score from pretest to posttest.

1) Personal Characteristics and Prior Experiences

There is no evidence to suggest that changes in total CQ are significantly related to ethnicity, immigrant identity, or prior travel experiences. Regression results do indicate a significant ($p<0.05$) relationship between state residency and change in total CQ, such that compared to residents, non-resident post CQ total scores increased by 0.327 more points. Though prior research on the relationships between student characteristics and international program intercultural learning outcomes indicates that a number of individual identities and personal characteristics often influence the extent to which students develop such outcomes [14], no research to date has reported a significant relationship between students' state residency status and intercultural learning outcomes. It is also possible that there are other meaningful characteristics that lie within the differences between in-state and out-of-state students that are not accounted for in this model that could be investigated in further study.

2) International Experiences

Regression results offer strong evidence that changes in CQ total scores from pretest to posttest are significantly related to students' participation in specific international programs. Because this variable is categorical, we needed to hold one program constant to serve as a comparison group. We chose the

Berlin program, as it was decided by the research team to be an average international program, in that it is a well-established program (i.e., not a new program), and it has an average enrollment size with 15 students. Six programs demonstrated a change in total CQ score significantly different from that of the Berlin program, all of which were positive. They include: Aachen ($p<0.05$), Argentina ($p<0.001$), Cergy-Pontoise ($p<0.05$), Hong Kong ($p<0.05$), Rome ($p<0.05$), and Xiamen ($p<0.01$). The program with the greatest difference in mean score is Argentina, reporting a positive shift in magnitude of 1.156 points, compared to Berlin. The program with the smallest significant difference in mean score is Hong Kong, which reported a magnitude of 1.065 points, compared to Berlin.

Though these scores do not indicate what aspects of the program may be responsible for significant differences reported, they offer strong evidence that programmatic differences are significantly related to changes in cultural intelligence scores. These results are congruent with previous research, which suggests that programmatic differences among international programs likely influence the degree to which students develop intercultural learning outcomes [14]. Future work of this research team will use these results to inform a more detailed investigation of these programs' common characteristics to discover any salient relationships between these programs and their students' development of cultural intelligence.

3) Experience Factors

Linear regression results provide evidence to support the notion that spending more time in intercultural interactions has a significant, positive relationship with cultural intelligence. These results demonstrate that the *intercultural interaction* factor variable—which indicates the time students reported spending building relationships with locals and having meaningful conversations about culture—is significantly related to a positive CQ total score change. Specifically, for every one-unit increase in the amount of time students reported spending engaging in intercultural interactions, the mean CQ total score increased by 0.155 points. This finding is congruent with prior research, which indicates the ways in which students interact with locals and their willingness to seek intercultural experiences are both related to intercultural learning outcomes [14].

This finding is noteworthy, particularly given the unique way in which this variable is defined. Rather than measuring formal aspects of the program, built-in excursions, or structured experiences, this variable simply measures how students spent their time. It is possible that students who reported a higher frequency of either meaningful cross-cultural conversations with others or a higher frequency of time spent building relationships with locals did so as a result of aspects of the formal program (e.g., homestay experiences, assignments). But it is also possible that this variable captures student initiative and choice as to how they spent their time abroad, particularly as its effects were estimated controlling for a host of individual and program variables. It may also indicate group-level influences, if for example peer groups within the international program formed which then influenced the degree to which multiple students spent their unstructured time engaging with other cultures in this way. While much of the research that measures program-level differences in international outcomes assesses program components, this finding offers important insights to the international program literature by measuring more specifically how students chose to spend their time abroad.

VI. Discussion and Implications

The purpose of this study was to answer the following questions: 1) Is there a significant change in students' cultural intelligence before and after they participate in international engineering programs, and 2) What relationships exist between students' cultural intelligence and their experiences in intercultural educational programs, when controlling for a variety of student characteristics and program variables?

In response to the first research question, this study provides evidence that students' cultural intelligence scores were significantly higher after their return from international programs, compared to their scores before they departed. In addition, results from the confirmatory factor analysis match the theorized factor structure of the CQ. Model fit indices indicated a stronger fit without the metacognitive sub-dimension, which was therefore excluded from these analyses. Additionally, the CQS proved useful in measuring not only overall CQ differences from pretest to posttest, but also finer-grained changes in all three sub-dimensions of cultural intelligence. This evidence suggests that the instrument is sufficiently sensitive for assessing learning outcomes in short-term programs (i.e., less than one semester in duration). Overall, the CQS appears to be a good measure of intercultural outcomes for this set of engineering international programs.

In response to the second research question, we found significant relationships between participants' personal characteristics, international program variables, and experiences abroad in relation to changes in cultural intelligence total scores from pretest to posttest. This finding is consistent with the evidence demonstrated in prior research that not all international experience programs foster intercultural outcomes to the same degree. As such, international programs should not be thought of or treated empirically as singular, monolithic experiences. Doing so masks important differences among programs. Better understanding about what characteristics either promote or hinder outcome development are key considerations for researchers and educators.

Perhaps the most important finding of this study is the relationship between the frequency of students' intercultural interactions and their development of cultural intelligence. It is noteworthy that this experience variable was significant in the model despite the presence of personal characteristic variables and program variables. This suggests that the individual choices students make around how to spend their time while abroad play a key role in outcome development—independent of program-level effects and student characteristics.

At first, this finding may not seem useful to those responsible for creating and structuring international programs, since it indicates that students' personal choices in how they spend their time influence their learning outcomes. After all, how students spend their free time is somewhat beyond the control of international educators. While this is true, there are likely many opportunities for educators, administrators, or even peers to influence students' choices through counseling, mentorship,

pre-trip preparation, or simply providing advice regarding how students might get the most out of their international experience. For example, if students are motivated to gain intercultural outcomes from their international experience, receiving advice and encouragement to seek as many opportunities as possible to build relationships with locals and spend time in meaningful conversation about culture with others might be just the nudge they need to push past other distractions, temptations, or myriad ways in which they might otherwise spend their limited time abroad. Findings from this study therefore have significant implications for how educators can work with students to help them get the most out of their time abroad.

Aside from students' personal decisions around how to spend their time, programs that are intentionally structured to provide opportunities for students to interact with and build relationships with local people across cultures may have a significant impact on the amount of time students spend in these types of interactions. For example, programs that build such interactive and relational opportunities into the program structure (e.g., teams comprised of students from various cultures, group projects with diverse group members, living arrangements that promote cross-cultural peer relationships) may be able to shape environments that encourage these relationships or at least make it easier for such relationship building to take place. We plan to investigate these ideas in future empirical work.

APPENDIX

The Cultural Intelligence Scale (CQS) [13]
Read each statement and select the response that best describes your capabilities. Select the answer that BEST describes you as you really are (1 = strongly disagree; 7 = strongly agree)

Construct	**Item**
Metacognitive CQ	I am conscious of the cultural knowledge I use when interacting with people with different cultural backgrounds.
	I adjust my cultural knowledge as I interact with people from a culture that is unfamiliar to me.
	I am conscious of the cultural knowledge I apply to cross-cultural interactions.
	I check the accuracy of my cultural knowledge as I interact with people from different cultures.
Cognitive CQ	I know the legal and economic systems of other cultures.
	I know the rules (e.g., vocabulary, grammar) of other languages.
	I know the cultural values and religious beliefs of other cultures.
	I know the marriage systems of other cultures.
	I know the arts and crafts of other cultures.
	I know the rules for expressing nonverbal behaviors in other cultures
Motivational CQ	I enjoy interacting with people from different cultures.
	I am confident that I can socialize with locals in a culture that is unfamiliar to me.
	I am sure I can deal with the stresses of adjusting to a culture that is new to me.
	I enjoy living in cultures that are unfamiliar to me.
	I am confident that I can get accustomed to the shopping conditions in a different culture.
Behavioral CQ	I change my verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it.
	I use pause and silence differently to suit different cross-cultural situations.
	I vary the rate of my speaking when a cross-cultural situation requires it.
	I change my nonverbal behavior when a cross-cultural situation requires it.
	I alter my facial expressions when a cross-cultural interaction requires it.

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