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Differences in Perceptions of Instructional Support between U.S. and International Students Before and During COVID-19

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Abstract

The COVID-19 public health crisis has influenced the way American higher education institutions operate and support student success. As a result of the crisis, institutions that traditionally provided in-person instruction abruptly moved to a virtual space with little preparation time in the spring of 2020. Considering the critical roles that both faculty and teaching assistants (TAs) play in student learning and engagement, this study explored the contribution that this abrupt transition to remote learning made in international students' perceptions of faculty and TA support, and positive emotional engagement, compared to U.S. students. Data collected from surveys in in-person settings prior to COVID-19 and in spring of 2020 immediately after COVID-19 impacted the delivery of higher education (N = 1,212) were used to study if and how the remote setting influenced international student perceptions of faculty and TA support and positive emotional engagement. The pre-COVID surveys were collected from students enrolled in sophomore and junior-level engineering courses prior to 2020, and the remaining surveys were collected from students enrolled in remote learning courses in the spring of 2020. Seven of the courses were the same in both the remote and in-person survey populations, and the remaining five courses were similar (in mechanical or electrical engineering and involving significant TA support).

The data were analyzed cross-sectionally using hierarchical linear models. All models considered demographics (gender and citizenship status), behavioral engagement, and emotional engagement variables. The study found that international students' perceived level of faculty support was more sensitive to their level of self-efficacy than that of their U.S. peers. International students' perceptions of TA support were also found to be generally higher than that of U.S. students. Finally, international students' positive emotional engagement was higher than that of U.S. peers, more sensitive to participation, and less sensitive to perceptions of TA support.

Faculty and TA support are both important to student learning and this is particularly true for international students. Contrary to the perception that remote learning is substandard compared to traditional learning, this study suggests that students overall felt that the instructional team provided adequate support during the COVID-19 crisis. This study was not able to explain whether this effect will "wear off" as remote learning continues, and students become less charitable in their assessments. Although this data was collected from only a single institution, it suggests that what engineering faculty and TAs did in the first term of remote learning worked; and carrying forward those practices into future remote instruction and instruction beyond the COVID-19 pandemic may be recommended.

Introduction

According to the 2019 Open Doors Report by the Institute of International Education (IIE), the number of international students studying in the U.S. was at its highest ever during the 2018-2019 academic year – almost 1.1 million students or 5.5% of the total population in higher

education [1]. In total, these students contributed over 44 billion dollars to the U.S. economy. And, of these students, over half pursued Science, Technology, Engineering, and Mathematics (STEM) degrees, with engineering remaining the most popular academic discipline among all majors of study. Over a third of international students have historically been Chinese but other countries also filled U.S. classrooms in significant numbers – over 200,000 international students were from India and over 50,000 were from South Korea in the 2018-2019 academic year [2].

In 2019-2020 academic year, these numbers began to decline as 20,000 fewer international students studied at U.S. institutions, but the percentage of those students pursuing STEM fields increased from 51.6% to 52%. Counterintuitively, within STEM fields, the number of students studying engineering decreased by over 4% [2]. These declines were dramatically amplified by the impact of the COVID-19 pandemic in 2020-2021 academic year. At the height of the pandemic, international student enrollment declined by 16% with new enrollments dropping by 43% [3].

International students play a critical role in the health and vibrance of the U.S. higher education system that goes well beyond the economic contributions that tuition dollars make to the financial well-being of individual institutions. International students not only bring a diversity of thought and immense multicultural exposure to the higher education classrooms and campuses but also make important contributions to the U.S. job market [4]. In engineering, attracting bright students from around the world enables innovation in U.S. technology to expand to levels that would simply not be possible otherwise [3].

Yet, despite how valuable international students are to the cultures of college and university campuses across the U.S., international students still face difficulty as they enter the U.S. and begin their education. Difficulty with the English language, culture shock, and differences between the education systems in their home country and those of the U.S. are compounded by discriminatory behaviors and biases that many international students face in their everyday lives and classroom experiences [5]. Gaining a greater understanding of these experiences, how they differ from those of U.S. students, and how faculty and TAs can better support international students not only benefits the U.S. in many ways but is also an ethical responsibility for faculty, staff, and others involved in the lives of these students.

Background

The COVID-19 public health crisis affected both domestic and international students in the U.S. when many institutions that traditionally provide in-person instruction abruptly moved to a virtual space with little preparation or structured guidance regarding how to do so in the spring of 2020 [6]. International students faced particularly difficult barriers to continuing their education at U.S. institutions. Because of international travel restrictions, some students were unable to travel back to their home countries and had to negotiate with their home institution for dormitory or other living space. In many situations, the need for a place to live extended beyond the spring term. Other students returned to their home countries after negotiations between higher education institutions and governments in securing their repatriation. Back in their home countries, many international students faced issues with unstable internet access, limited space to work and study in their own homes, and time zone differences which made it difficult to adapt to and learn in the

remote setting. These difficulties were compounded for Asian international students by a rise in anti-Asian sentiment and hate crimes in the wake of the COVID-19 pandemic. Significant increases in Sinophobic slurs on Twitter, social media, message boards, and other platforms of American culture reflected a shift toward blaming the Chinese for the COVID-19 pandemic and amplified negative bias against both international and U.S. Asian students in the classroom [7].

These problems compounded existing challenges that international students often face in U.S. classrooms and college campuses. Some of these challenges have little to do with biases against international students. International students coming to the U.S. in ordinary times need to navigate visa processes, adjust to new cultural norms, and adapt to a new academic system that is often very different from that in their home country [8], [9]. However, some challenges do indeed relate to bias. Compared to U.S. students, international students sometimes face unique cultural discrimination against them. Negative remarks associated with international students' accents and certain home countries are not uncommon, including verbal abusive comments and direct confrontation. These negative comments can make international students feel extremely uncomfortable or worse [5]. Furthermore, international students who are unfamiliar with the U.S. sociocultural context of race and ethnicity face discrimination because they share similar skin color to particular U.S. ethnic groups.

Research studies that explore international students' stressors tend to focus on individual factors rather than environmental influencers, such as faculty, peer, and institutional support [10]. Of those studies that focus on factors that influence all international students, the preparation of faculty and staff in American universities to support an increasing number of learners from diverse educational and cultural backgrounds has been put into question [11], [12], [13]. This is unfortunate because international students appear to benefit more than their domestic peers from enhanced support and tailored adjustments from instructional staff [14], [15], [16]. Compared to U.S. students, international students' low participation in the college classroom is concerning among faculty and staff in the U.S. universities [17]. U.S. students regard the task value of their classes much higher than international students [18] which can amplify existing tendencies for international students to participate less in their classes. Despite these barriers, in the traditional, in-person teaching environment in engineering, international students have been shown to be more responsive to how much support faculty provide than their domestic peers [19]. Further, international students are more likely to have positive feelings about being in the engineering classroom than their domestic peers [19].

The recent IIE survey on COVID-19 effects on U.S. higher education campuses revealed that more than half of the 441 institutions in the survey increased institutional support to international students on visa and travel advice, emergency funding, housing, and communication about health and wellbeing, but did not mention enhanced instructional or academic support [20]. In a separate survey on Student Experience in the Research University during COVID-19, the data highlighted that out of a sample of 22,519 undergraduate students and 7,690 graduate and professional students at five public research universities, international students have been more satisfied with their academic experiences and institutional support during the public pandemic than their U.S peers in terms of instructional support, quality of courses after moving online, and universities' response to the pandemic. Without providing explanations for why international students were more satisfied, the survey also reported that international students and U.S.

students faced similar challenges in transitioning to remote learning, such as lack of motivation and less interaction with peers. However, unlike their domestic peers, international students overwhelmingly reported more worries about travel restrictions, maintaining visa status, and personal safety [21].

Despite the fact that recent surveys have not emphasized academic and instructional support to international students during COVID-19, there is little doubt that faculty and TAs have an immense influence on the lives of students, both domestic and international. In the challenging circumstances for learning that abound during COVID-19, faculty and TAs can offset struggle and support students through difficult times and learning difficulties [22], [23]. Students who have high-quality interactions with faculty, staff, and peers enjoy the support they received and are more willing to reach out for help when in need. These interactions benefit students' academic performance and social interactions [24]. Students' perceptions of a supportive college environment, including faculty and TA support, contribute to students' overall satisfaction and engagement [25]. Instructors of all kinds including faculty and TAs play a central role in the academic and social integration that are critical to reducing drop-out rates in college [26].

Given the significant influence that faculty and TAs have on all students and disproportionately so for international students, this study sought to understand more thoroughly how international students are influenced by faculty and TA support both before the pandemic and during the remote learning necessitated by the pandemic. This study pays particular attention to how faculty and TAs may influence the experiences of international students in the most popular major of choice among these students—engineering. It also looks at these influences through the lens of positive emotional engagement or how students feel as they engage in their studies with the intention of identifying strategies that can help international students thrive in their engineering studies in the U.S.

Methods

Quantitative research methods were used to analyze ordinal, Likert-scale data from surveys distributed to undergraduate engineering students. This study is part of a larger, single-institution research project that evaluated the connections between various forms of support (from faculty, TAs, and peers) and multiple forms of course-level engagement (attention, participation, effort, positive and negative emotional engagement) both in traditional and remote learning settings. This investigation focused specifically on comparing the experiences of U.S. and international students with regard to what they brought into the classroom (task value, self-efficacy), how they participated in their classes, and what they thought of faculty and TA support influenced their affective state through positive emotional engagement.

Research Questions (RQ)

This study took a detailed look at the experience of domestic and international students through the lens of faculty support, TA support, and positive emotional engagement, resulting in the following research questions:

RQ1
Do international students perceive faculty support differently than domestic students?

RQ2
Do international students perceive TA support differently than domestic students?

RQ3
Do international students experience positive affect (positive emotional engagement) in the classroom differently than domestic students?

To gain a broader understanding of how the experience of international students in engineering may differ from the experience of domestic students, these three research questions were evaluated in the contexts of different educational settings (traditional vs. remote learning), varying levels of task value, the self-efficacy students brought into the classroom, and fluctuating levels of participation reported by students in different courses.

Procedures

Institutional Review Board (IRB) approval (STUDY00000378) was obtained to recruit and survey undergraduate students in this study. All participation was voluntary, and students were informed that their survey responses would remain confidential. In several courses, students were incentivized with a nominal amount of extra credit for the course in which they were recruited. In one traditional learning course, students completed a paper-and-pencil copy of the survey while in all remaining courses, students completed an electronic survey online and outside of class. Some students were present in more than one class; since survey questions referred to a specific class ("this class"), duplicate surveys were retained for analysis. All results were cross-sectional.

Participants

Students were recruited between fall 2016 and spring 2020 to complete a survey about the course in which they were enrolled. A total of 1,328 students completed the survey with no duplications. After the listwise deletion of cases with missing data, a sample of 1,212 students' responses remained for analysis. Most students were male ($N = 906$, 74.8%) and either Asian ($N = 516$, 42.6%) or Caucasian ($N = 311$, 41.2%). Most were US citizens or permanent residents ($N = 1{,}016$, 83.8%).

Twelve courses were surveyed during remote learning in the spring of 2020 and seven courses were surveyed during traditional learning between 2016 and 2018. 45.7% of survey respondents reported their experiences in remote learning while 54.3% reported their experiences in traditional college classrooms.

Instruments

The instrument used to collect data for this study was a student survey which asked students to report their perceptions of various items related to peer support, engagement, belonging, peer

harassment, task value, self-efficacy, TA and faculty support, and TA and faculty interactions. Survey participants also responded to multiple demographic items. The survey included five short answer questions which asked students to identify their primary expectations for faculty support (one question), TA support (one question), and peer support (three questions).

Demographic characteristics collected in the survey and used in this analysis included:

- Gender: Male, Female, Other
- International Status: U.S. Citizen and Permanent Resident, International Student

In the present analysis, student demographics were effect coded as dichotomous variables: gender (female = 1 vs. male = -1; other genders were present in very small numbers and were eliminated from the analysis) and international status (U.S. citizen or permanent resident = -1 vs. international student = 1). Instructional modality was also effect coded as a dichotomous variable (remote = -1 vs. traditional = 1).

Additional scales used in this study included those associated with task value, self-efficacy, participation, TA support, faculty support, and positive emotional engagement. Sample items, primary scales as well as the source of these scales are noted in Table 1.

Table 1: Independent and Dependent Variables

(α =Cronbach's Alpha measure of internal consistency)

References	Primary Scale	Sample Item
[27], [28]	Task value ($\alpha = 0.87$)	I think I will be able to use what I learn in this class in my chosen profession.
[27], [28]	Self-efficacy ($\alpha = 0.89$)	I expect to do well in the classes in my major.
[29]	Participation ($\alpha = 0.66$)	In this class, I participate in class discussions during quiz section with my classmates and instructors.
[19]	TA support ($\alpha = 0.92$)	The professor (primary instructor) has clearly explained course goals and requirements.
[30]	Faculty support ($\alpha = 0.92$)	The professor (primary instructor) in this class is interested in helping me learn.
[29]	Positive emotional engagement ($\alpha = 0.77$)	In this class, I enjoy learning new things.

Task value refers to a student's evaluation of how interesting, important, and useful a task is and includes items related to the interest, importance, and utility students perceive with regard to a task. Task value was measured with four items in the context of classes within the student's major using an adapted version of the Task Value subscale from the Motivated Strategies for Learning Questionnaire (MSLQ) [27], [28].

Self-efficacy was defined as the self-appraisal of one's ability to master a task and included judgments about one's ability to accomplish a task as well as one's confidence in one's skills to

perform that task. Self-efficacy was measured in the student's major domain using five items from the Motivated Strategies for Learning Questionnaire (MSLQ) [27] [28].

Participation measured how and to what level students participate in class discussions in their classes and in lab/study groups. The subscale consisted of two items, adapted from previous K-12 studies [29]. Although participation had internal reliability that was less than the standard 0.7, there is evidence that reliability between 0.6 and 0.7 is adequate [30].

Faculty support seeks to capture students' perceptions of the instructional support they received from faculty both in traditional and remote learning. The faculty support scale consisted of eleven items and asked students to report their perceptions of the quality of instruction, organization, and concern for learning that faculty brought to students [31]. Faculty support is critical for students' academic success in higher education, and especially in undergraduate engineering courses. It is especially essential to international students' academic success [8], [10]. In this study, faculty support was used as a dependent variable in the model used to address RQ1 and as an independent variable in the model used to address RQ3.

TA support is similar to faculty support and seeks to capture students' perceptions of the instructional support they received from TAs both in traditional and remote learning. The TA support scale used in this analysis consisted of twelve items that were similar to those used for faculty support but asked students to explicitly consider TAs separate from faculty. TA support is critical for student success in higher education, and especially in undergraduate engineering courses [23]. TA support serves as both instructional and peer support and contributes to international students' adjustment to the U.S. academic and social culture [10]. In this study, TA support was used as a dependent variable in the model used to address RQ2 and as an independent variable in the model used to address RQ3.

Positive emotional engagement is the third outcome variable of interest, using four items that were adapted for use in higher education [32] from previous studies in K-12 [29]. PEE was processed and coded such that higher scores meant better engagement. PEE seeks to capture the emotional motivators behind other forms of engagement and is as crucial for students' adaptation and learning as cognitive engagement measures [33]. The PEE construct served as a dependent variable in the model used to address RQ3.

Data Analysis

Hierarchical Linear Modeling (HLM) was used to explore all three research questions in this study. Two-level HLM models [33] were used to first examine the effect that student-level and class-level variables had on students' perceptions of faculty support and TA support, and whether international students' perceptions differed from those of U.S. students. In the third two-level HLM model, the effect of student-level, class-level variables including students' perceptions of faculty and TA support on students' positive emotional engagement with the class was examined. All the analyses were performed using software RStudio (Version 1.1.423). The student-level and class-level indices were scaled in a way that the higher the value indicated a more positive response. All continuous student-level and class-level variables were standardized to have a mean of zero and a standard deviation of one.

For all three HLM models, an unconditional model was also developed which contained only an outcome variable (perceptions of faculty support, perceptions of TA support, and positive emotional engagement) without any independent variables. This simple multilevel model is statistically equivalent to a one-way random effects analysis of variance (ANOVA). Further, the unconditional model decomposes the total variance in each outcome variable into a variance attributable to student-level factors and another variance that can be explained by class-level factors. Starting with unconditional models allows for determining whether or not there is systematic variation in the outcome variables and where that variation resides [35].

Results

Descriptive Statistics for support (faculty, TA) variables, predictor variables (self-efficacy, task value, participation), and positive emotional engagement are summarized in Table 2. All variables were scaled to values between 1 and 5 to facilitate comparison between measures.

Table 2: Descriptive Statistics

Measure	**U.S. Status**	**Traditional Learning**		**Remote Learning**	
		Mean	*SD*	*Mean*	*SD*
Participation	Domestic	3.11	1.06	3.15	0.96
	International	3.61	0.96	3.52	0.96
Self-Efficacy	Domestic	3.57	0.80	3.60	0.78
	International	3.60	0.83	3.78	0.82
Task Value	Domestic	3.94	0.71	3.94	0.79
	International	3.85	0.77	3.93	0.82
Faculty Support	Domestic	3.93	0.74	3.96	0.63
	International	4.01	0.75	3.95	0.68
TA Support	Domestic	3.65	0.78	3.55	0.77
	International	3.81	0.74	3.86	0.73
Positive Emotional Engagement	Domestic	3.44	0.82	3.41	0.76
	International	3.65	0.79	3.69	0.81

Pearson's correlations between all variables were also calculated (Table 3) to determine any patterns in which predictors have direct relationships with the outcome. These correlations indicate that being in a remote setting or traditional setting did not significantly correlate with any of the outcome variables (faculty support, TA support, positive emotional engagement). In contrast, task value, participation, and self-efficacy were significantly correlated with all three outcomes. Gender was only significantly correlated with positive emotional engagement, and being an international student was significantly and positively correlated with TA support and positive emotional engagement.

Most of the variables were also correlated with each other and may not uniquely predict the three outcome variables. Nevertheless, these variables were used in the HLM analyses in order to examine potentially different experiences that international students were having in engineering courses compared to their domestic peers.

Table 3: Zero-Order Correlations

Measure	1.	2.	3.	4.	5.	6.	7.	8.
Outcomes								
1. Faculty Support	--	--	--	--	--	--	--	--
2. TA Support	0.49***	--	--	--	--	--	--	--
3. Positive Emotional Engagement	0.58***	0.66***	--	--	--	--	--	--
Predictors								
4. Female	-0.01	-0.04	-0.07*	--	--	--	--	--
5. International	0.01	0.12***	0.12***	-0.09**	--	--	--	--
6. Participation	0.34***	0.44***	0.48***	-0.04	0.15***	--	--	--
7. Task Value	0.49***	0.48***	0.70***	-0.01	-0.02	0.32***	--	--
8. Self-Efficacy	0.36***	0.35***	0.50***	-0.15***	0.05	0.26***	0.36***	--
9. Remote	-0.02	0.04	0.01	0.03	-0.03	-0.01	-0.01	-0.04

Note. N = 1,212 students within 19 classes; Pearson's r reported.
* $p < .05$, ** $p < .01$, *** $p < .001$.

RQ1
Do international students perceive faculty support differently than domestic students?

Partitioning of Variance in Student Perceptions of Faculty Support
Table 4 presents the results of the HLM models for faculty support: the unconditional HLM model, model with demographic variables only, main effect model, and model with interaction effects. The final model had a pseudo R^2 of 0.42, meaning the independent variables collectively explained 42% of the variance in faculty support; and the pseudo R^2 increased from 0.3 in the intercept-only model with an improvement in BIC, meaning that the final model made a much better model fit.

When examining if any of the assumptions of HLM were violated, model residuals versus predictor were plotted to check for any violation against linearity. Then, a variation of Levene's test was performed to check for violation of homogeneity of variance; and finally, the estimated residuals of the model were plotted to check for violation of normality [36]. None of the above-mentioned assumptions for HLM—linearity, homogeneity of variance, and normality—were violated.

The unconditional model for all classes showed that the average faculty support levels also varied across classes, $\chi^2(18, N = 1{,}212) = 66.32$, $p < .001$. In the final model, class variability explained 12% of the total variance in students' perceptions of faculty support, whereas student variability was responsible for 88% of the total variance ($\hat{\rho}$ =0.12). The average faculty support score across classes was 3.99. The estimated variance between classes in faculty support was 0.06 and the estimated variance within classes (residual) was 0.42.

Table 4: Multilevel Linear Model Results for Faculty Support

Fixed Effects	**Model 1 (Intercept)**		**Model 2 (Demographics)**		**Model 3 (Main effects)**		**Model 4 (Interactions)**	
	Coeff	*SE*	*Coeff*	*SE*	*Coeff*	*SE*	*Coeff*	*SE*
Intercept (Mean)	3.99***	0.06	3.99***	0.06	3.95***	0.06	3.97***	0.06
Female			0.01	0.02	0.04*	0.02	0.06	0.03
International			0.001	0.03	-0.02	0.02	0.01	0.03
Participation					0.12***	0.02	0.10***	0.03
Task Value					0.25***	0.02	0.26***	0.03
Self-Efficacy					0.13***	0.02	0.18***	0.03
Remote					0.05	0.06	0.06	0.06
International*Self-Efficacy							0.06*	0.03
Random Effects	*Var*		*Var*		*Var*		*Var*	
Intercept (Classes)	0.06		0.06		0.05		0.05	
Residual (Students)	0.42		0.42		0.28		0.28	
Model Fit								
Approximate R^2	0.12		0.12		0.42		0.42	
BIC	2447.70		2461.90		1992.80		2016.30	
Deviance (-2LL)	2426.40		2426.40		1928.90		1916.90	
Residual *df*	1209		1207		1203		1198	
LRT Chi-square test	--		0.05		497.51***		12.00*	

Note. N = 1,212 students within 19 classes; metrical predictors are standardized in z-scores and categorical predictors are effect coded. Approximate R^2 calculated as the fitted variance divided by the sum of the fitted, class, and residual variances. Model estimated using R lme4 and lmerTest packages.
* $p < .05$, ** $p < .01$, *** $p < .001$.

Predictors of Student Perceptions of Faculty Support

The student-level and class-level variables were used to explain statistically significant variance in faculty support among all students. Table 4 presents the effects of student-level and class-level variables on perceptions of faculty support among all students. In examining the coefficients for model 3, at the student level, four variables were statistically significant predictors of faculty support. Model 3 indicated that being female, a high level of participation, high task value, and high student self-efficacy had statistically significant and positive effects on all students' perceptions of faculty support. Model 4 indicated significant interaction effects between being an international student and self-efficacy in predicting faculty support.

The intercept of model 3 indicated that the mean level of faculty support is 3.95 across classes, for students with average levels of participation, task value, self-efficacy, irrespective of gender and international status. Model 3 results indicated that an increase of 0.04 points for levels of faculty support for female students was expected compared to average, holding all else constant. While a one standard deviation increase in the level of participation was related to an increase in perceptions of faculty support of about 0.12 points (holding other variables in the model constant), a one standard deviation increase in task value was related to a larger increase in perceptions of faculty support of about 0.25 points (holding other variables in the model constant). Similarly, an increase of 0.13 points in perceptions of faculty support was expected for

every 1-standard deviation increase of self-efficacy, holding all else constant. In contrast, being an international student did not, in and of itself, result in significant changes in perceptions of faculty support.

When examining the single interaction term considered in the model for faculty support, predictions of faculty support for international students and U.S. students intersected at moderate levels of self-efficacy, indicating significant international-by-self-efficacy interaction (see Figure 1). For international students with a low level of self-efficacy (-2 SD), the predicted value of faculty support was 3.50, much lower than for U.S. students, 3.72. However, for international students with a high level of self-efficacy (+2 SD), the predicted value of faculty support was 4.46, higher than their U.S. peers, 4.20. This result suggests that international students' perceptions of faculty support was more sensitive to their self-efficacy than the case for U.S. students.

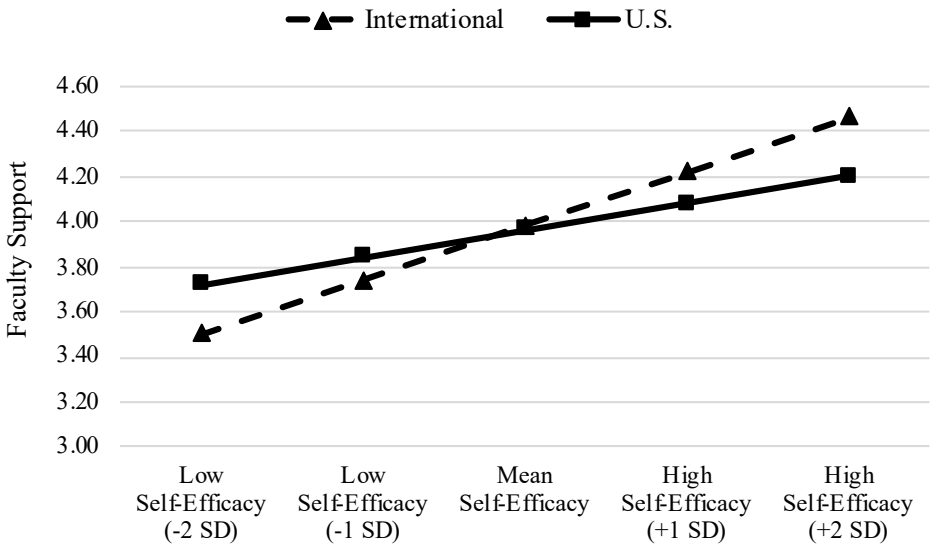

Figure 1: Faculty Support vs. Self-Efficacy for U.S. and International Students

RQ2
Do international students perceive TA support differently than domestic students?

Partitioning of Variance in Student Perceptions of TA Support
Table 5 presents the results of the HLM models for TA support: the unconditional HLM model, model with demographic variables only, and the main effect model. The final model had a pseudo R^2 of 0.42, meaning the independent variables collectively explained 42% of the variance in TA support; and the pseudo R^2 increased 0.22 from the intercept-only model together with an improvement in BIC, meaning it was a much better model fit than the intercept-only model.

Model residuals versus predictors were plotted to check for any violation against linearity. A variation of Levene's test was also performed to check for violation of homogeneity of variance, and the estimated residuals of the model were checked to check for violation of normality [36]. None of the above-mentioned assumptions—linearity, homogeneity of variance, and normality—for HLM were violated.

The unconditional model for all classes showed that the average TA support levels varied across classes, $\chi^2(18, N = 1{,}212) = 46.11$, $p < .001$ (Table 5). Class variability explained 20% of the total variance in students' perceptions of TA support, whereas classes attended by students were responsible for 80% of the total variance ($\hat{\rho}$ =0.20). The average TA support score across classes was 3.75. The estimated variance between classes in TA support was 0.08 and the estimated variance within classes (residual) was 0.46.

Table 5: Multilevel Linear Model Results for TA Support

Fixed Effects	**Model 1 (Intercept)**		**Model 2 (Demographics)**		**Model 3 (Main effect)**	
	Coeff	*SE*	*Coeff*	*SE*	*Coeff*	*SE*
Intercept (Mean)	3.75***	0.08	3.79***	0.08	3.74***	0.07
Female			-0.02	0.02	0.01	0.02
International			0.08**	0.03	0.05*	0.02
Participation					0.18***	0.02
Task Value					0.23***	0.02
Self-Efficacy					0.12***	0.02
Remote					0.03	0.07
Random Effects	*Var*		*Var*		*Var*	
Intercept (Classes)	0.11		0.11		0.07	
Residual (Students)	0.46		0.45		0.31	
Model Fit						
Approximate R^2	0.20		0.20		0.42	
BIC	2563.60		2568.20		2124.00	
Deviance (-2LL)	2542.30		2532.70		2060.00	
Residual *df*	1209		1207		1203	
LRT Chi-square test	--		9.63**		472.53***	

Note. $N = 1{,}212$ students within 19 classes; metrical predictors are standardized in z-scores and categorical predictors are effect coded. Approximate R^2 calculated as the fitted variance divided by the sum of the fitted, class, and residual variances. Model estimated using R lme4 and lmerTest packages.
* $p < .05$, ** $p < .01$, *** $p < .001$.

Predictors of Student Perceptions of TA Support

In examining the coefficients for model 3 at the student level, four variables were statistically significant predictors of TA support. Model 3 indicated that being international, a high level of participation, a high task value, and a high student self-efficacy had statistically significant and positive effects on all students' perceptions of TA support. No significant interaction effects were detected between being international students and other variables.

The intercept of model 3 indicated that the mean level of TA support is 3.74 across classes, for students with average levels of participation, task value, self-efficacy, irrespective of gender and international status. Model 3 results also indicated that an increase of 0.05 points for levels of TA support for international students was expected, compared to average, holding all else constant. While a one standard deviation increase in the level of participation was related to an increase in

perceptions of TA support of about 0.18 points (holding other variables in the model constant), a one standard deviation increase in task value was related to a 0.23-point increase in perceptions of TA support (holding other variables in the model constant). Similarly, an increase of 0.12 points in perceptions of TA support occurred for every one standard deviation increase in students' self-efficacy, holding all else constant.

RQ3

Do international students experience positive affect (positive emotional engagement) in the classroom differently than domestic students?

Partitioning of Variance in Positive Emotional Engagement

Table 6 presents the results of the HLM models for positive emotional engagement: the unconditional HLM model, model with demographic variables only, main effect model, and model with interaction effects. The final model had a pseudo R^2 of 0.71, meaning the independent variables collectively explained 71% of the variance in positive emotional engagement; and the pseudo R^2 increased 0.59 from the intercept-only model together with an improvement in BIC, meaning it made a much better model fit.

Model residuals were plotted versus predictors to check for any violation against linearity. A variation of Levene's test was also performed to check for violation of homogeneity of variance and the estimated residuals of the model were plotted to check for violation of normality [36]. None of the above-mentioned assumptions—linearity, homogeneity of variance, and normality—for HLM was violated.

The unconditional model for all classes showed that the average positive emotional engagement varied across classes, χ^2 (18, N =1,212) = 51.86, $p < .001$. Class variability explained 12% of the total variance in students' positive emotional engagement, whereas students were responsible for 88% of the total variance ($\hat{\rho} = 0.12$). The average positive emotional engagement score across classes was 3.56. The estimated variance between classes in positive emotional engagement was 0.07 and the estimated variance within classes (residual) was 0.55.

Predictors of Positive Emotion Engagement

The student-level and class-level variables were used to explain statistically significant variance in positive emotional engagement among all students. Table 6 presents the effects of student-level and class-level variables on positive emotional engagement among all students. In examining the coefficients for model 3 at the student level, six variables were statistically significant predictors of positive emotional engagement. Model 3 indicated that being international, a high level of faculty support, a high level of TA support, a high level of participation, a high task value, and high student self-efficacy had statistically significant and positive effects on all students' positive emotional engagement.

The intercept of model 3 indicated that the mean positive emotional engagement score was 3.53 across classes, for students with average levels of faculty support, TA support, participation, task value, self-efficacy, irrespective of gender and international status. Model 3 results also indicated that an increase of 0.07 points in positive emotional engagement occurred for international students compared to average and an increase of 0.14 points compared to U.S. students, holding

all else constant. While a one standard deviation increase in the level of faculty support was related to an increase in positive emotional engagement of about 0.15 points, a one standard deviation increase in TA support was related to an increase in positive emotional engagement of about 0.17 points. Similarly, a one standard deviation increase in participation was related to an increase in positive emotional engagement of about 0.10 points. Further, an increase of 0.30 points in positive emotional engagement occurred for every one standard deviation increase in task value, and an increase of 0.13 points in positive emotional engagement occurred for every one standard deviation increase in students' self-efficacy.

Table 6: Multilevel Linear Model Results for Positive Emotional Engagement

Fixed Effects	**Model 1 (Intercept)**		**Model 2 (Demographics)**		**Model 3 (Main effect)**		**Model 4 (Interactions)**	
	Coeff	*SE*	*Coeff*	*SE*	*Coeff*	*SE*	*Coeff*	*SE*
Intercept (Mean)	3.56***	0.07	3.60***	0.07	3.53***	0.04	3.54***	0.04
Female			-0.05*	0.02	-0.02	0.01	-0.01	0.02
International			0.11***	0.03	0.07***	0.02	0.08***	0.02
Participation					0.10***	0.01	0.14***	0.02
Task Value					0.30***	0.02	0.31***	0.02
Self-Efficacy					0.13***	0.01	0.14***	0.02
Faculty Support					0.15***	0.02	0.14***	0.03
TA Support					0.17***	0.02	0.11***	0.03
Remote					-0.01	0.03	-0.01	0.03
International*Participation							0.05*	0.02
International*TA Support							-0.08**	0.03
Random Effects	*Var*		*Var*		*Var*		*Var*	
Intercept (Classes)	0.07		0.07		0.01		0.01	
Residual (Students)	0.55		0.54		0.18		0.17	
Model Fit								
Approximate R^2	0.12		0.13		0.71		0.71	
BIC	2774.90		2770.30		1450.30		1428.40	
Deviance (-2LL)	2753.60		2734.80		1372.20		1354.60	
Residual *df*	1209		1207		1201		1194	
LRT Chi-square test	--		18.85***		1362.57***		17.67*	

Note. N = 1,212 students within 19 classes; metrical predictors are standardized in z-scores and categorical predictors are effect coded. Approximate R^2 calculated as the fitted variance divided by the sum of the fitted, class, and residual variances. Model estimated using R lme4 and lmerTest packages.
* $p < .05$, ** $p < .01$, *** $p < .001$.

When examining interaction terms in model 4, the predicted value lines of positive emotional engagement for international students and U.S. students intersected, indicating significant international status-by-TA support interaction (see Figure 2). For international students with a low level of TA support (-2 SD), the predicted value of positive emotional engagement was 3.56, much higher than U.S. students, 3.08; however, for international students with a high level of TA

support (+2 SD), the predicted value of positive emotional engagement is 3.68, much lower than U.S. students, 3.84. This result suggests that U.S. students' positive emotional engagement were more sensitive to varying levels of TA support than international students.

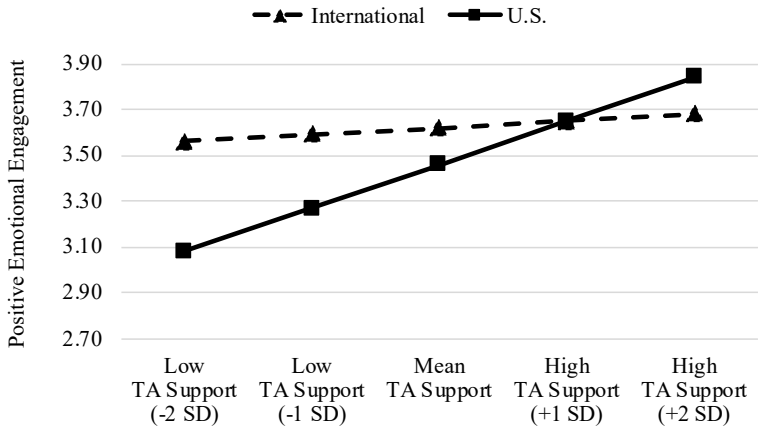

Figure 2: PEE vs. TA Support for U.S. and International Students

Model 4 demonstrated significant interaction effects between being an international student and TA support as well as between being an international student and participation level. Positive emotional engagement predictions for international students and U.S. students intersected as a function of participation (Figure 3). For international students with a low level of participation (-2 SD), the predicted value of positive emotional engagement is 3.24, very similar to that of U.S. students, 3.28; however, for international students with a high level of participation (+2 SD), the predicted value of positive emotional engagement is 4.00, much higher than U.S. students, 3.64. This result strongly suggests that participation level matters much more for international students' positive emotional engagement than that of U.S. students.

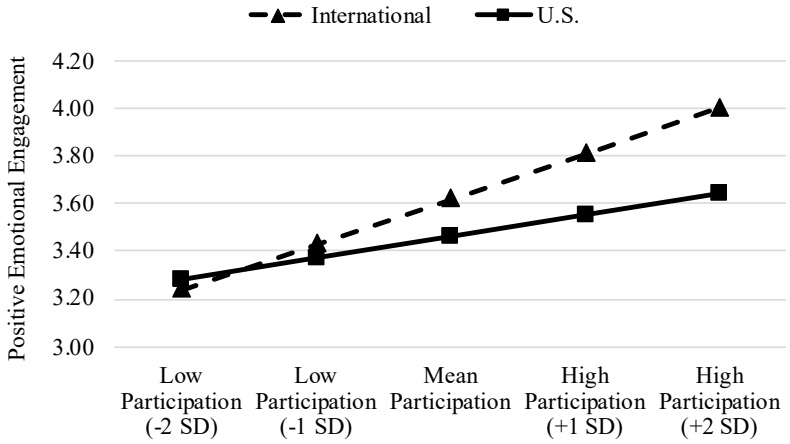

Figure 3: Positive Emotional Engagement vs. Participation for U.S. and International Students

Discussion

According to the results of the HLM models in this study, remote learning did not impact international students' perceptions of faculty or TA support, nor did it impact positive emotional engagement. This finding is consistent with recent COVID era research that concluded students' experiences were not negatively impacted by remote instruction [21]. This could be due to the fact that many institutions increased administrative support for international students [20], so their overall experience was not negatively impacted in a significant way. Another plausible explanation is that faculty and TAs encouraged students to make the most of the new teaching and learning modality to preserve their health and well-being, considering moving to remote instruction was not by choice.

With regard to faculty support, the HLM models also indicated that international students' perceptions of that support were more sensitive to student's level of self-efficacy. International students with a lower level of self-efficacy appeared to appreciate faculty support less than their U.S. peers while international students with a higher level of self-efficacy seemed to perceive faculty support more strongly than their U.S. peers with the same level of self-efficacy. Individuals with higher levels of self-efficacy are more willing to take actions towards their desired outcomes [37]. Previous research has also shown that greater self-efficacy among international students was associated with perceptions of higher levels of community acceptance and academic ability [38], and international students with a higher level of self-efficacy are more likely to engage in academic help-seeking behaviors that further contribute to their academic success [39], such as reaching out to faculty for support. It is reasonable to claim that international students with higher levels of self-efficacy were more proactive in reaching out to faculty and receiving the faculty support they needed. To international students, receiving academic support, including connecting with faculty and TAs, also positively contributes to their satisfaction with academic, and social and cultural adjustment [39].

With regard to TA support, international students' perceptions of TA support were significantly higher than U.S. students overall. This result reinforces previous research findings that international students value and appreciate instructional support from home institutions [14], [15]. Regardless of remote or in-person learning environments, international students regarded instructional support they received from TAs as very important. Beyond instructional support, TAs can also offer guidance on other matters as peer mentors. Previous research has indicated that international students rely heavily on peers for academic support [10]. Thus, the peer support that TAs provide is likely to have a stronger effect on international students than their U.S. peers. To conclude on students' perceptions of instructional support, international students' perceptions of TA support were significantly higher than U.S. students whereas their perceptions of faculty support were not significantly different from those of U.S. peers. This result could potentially be due to the added influence of peer support that TAs could provide while faculty could not.

With regard to positive emotional engagement, international students' positive emotional engagement was significantly higher than U.S. students overall. This is consistent with earlier research findings where in traditional learning environments, being an international student consistently, positively, and significantly predicted the student's level of positive emotional

engagement [19]. Moving classes online did not negatively impact international students' positive emotional engagement. A possible explanation is that despite the challenges they face, international students had strong motivations to come to the U.S. in pursuing higher education, including avoiding fierce competition in their home country [40], developing social and cultural capital in a foreign country [41], and using English as a second language in academic and professional worlds [42]. It is also plausible that moving classes online decreased international students' exposure to bias and hostility that might otherwise be found on campus.

For international students, positive emotional engagement was also sensitive to students' level of participation. The higher the level of participation, the higher the positive emotional engagement scores were for international students and disproportionately so compared to U.S. students. This is consistent with earlier research findings on the positive association between international students' participation in curriculum activities, such as classroom discussions and their level of engagement [25], [39]. Interestingly, international students' positive emotional engagement did not vary much due to different levels of TA support, but U.S. students' positive emotional engagement was more sensitive to variations in TA support. This suggests that positive emotional engagement is more stable for international students than U.S. students. When examining the difference in perceptions of TA support among international and U.S. students, the overall perception of the level of TA support among international students was much higher. When revisiting descriptive statistics, the mean TA support reported by international students was higher in remote learning than in traditional learning. This is consistent with recent survey results that international students' academic level of satisfaction has been higher than that of U.S. peers during COVID-19 [21].

Although international students' positive emotional engagement was not sensitive to their perceptions of TA support, their overall positive emotional engagement was very high. This result suggests that for international students, active participation was more important than the TA support they received in determining their level of positive emotional engagement.

Limitations

This study was limited to a single institution and a limited number of majors (primarily electrical and mechanical engineering). Thus, the results may not be generalizable to other engineering majors or other institutions. Further, the remote learning data were collected in the first full term of remote learning and do not reflect longer term adjustments that students may have made as remote learning extended into the 2020-2021 academic year. And, TA personalities and mentorship styles may have played a role in perceptions of TA support that were not captured in the survey used in this study. This analysis also did not take into account different countries of origin which may have further influenced the results. Nevertheless, the HLM analyses provide a rich picture of how what students bring into the classroom (e.g., self-efficacy) affects their ability to take advantage of faculty and TA support and to different degrees depending on the students' immigration status. And this study has also highlighted the importance of participation in influencing positive student affect which in turn impacts so many other aspects of the college experience, including persistence.

Implications

Based on the findings of the study, higher education institutions should be more sensitive to international students' instructional needs beyond just administrative support during the pandemic. Administrators, advisors, and instructors alike should strive to create opportunities to enhance the engagement of international students in course-based activities. Considering how much international students rely on faculty and peers for academic support, faculty are encouraged to learn more about international students' needs and stress factors, and identify and utilize inclusive teaching pedagogy.

Faculty and TAs are well-positioned to facilitate communication with international students, including clarifying expectations, providing visual and oral support and written notes, trying to get to know the students, and offering constructive feedback. For example, faculty and TAs should make an effort to know the international students in their classrooms and personally reach out to students who are not actively participating in classroom activities. Encouraging participation is key to international student engagement. To facilitate participation, faculty and TAs can consider giving more time for students to prepare before a discussion, listen actively, and provide opportunities for students to understand the purpose of tasks and assignments. Further, faculty and TAs are encouraged to familiarize themselves with community resources and opportunities for international students to engage outside of classrooms [17], considering that social connections with the host country increases these students' overall confidence [38].

Conclusions

This study has underscored the fact that faculty support and TA support are important for student success regardless of whether students are engaged in traditional or remote learning. For international students in particular, students' perceived level of faculty support is more sensitive to their level of self-efficacy than U.S. peers. International students' perceptions of TA support are generally higher than that of U.S. students. Finally, international students' positive emotional engagement is higher than that of U.S. peers and is more sensitive to participation but less sensitive to perceptions of TA support. Faculty and TAs are encouraged to more actively engage international students in the classroom, virtual or in-person, and leverage pedagogical tools to increase their participation. Institutions should also provide additional support and resources to faculty and TAs during the pandemic, increasing their capacities to innovate in teaching and learning for student success.

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