

## **Are Future Constructors Experiencing a Warm Climate? An Initial Study of Citizenship Status and Affective Engagement**

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# **Are Future Constructors Experiencing a Warm Climate? An Initial Study of Citizenship Status and Affective Engagement**

## **Abstract**

This study explores the differences in student perceptions of academic discipline belonging (ADB) and peer interactions (PI) for students from different citizenship backgrounds and who are also majoring in Civil Engineering and Building Construction programs. A quantitative, causal-comparative study (n = 397) was conducted using the Postsecondary Student Engagement (PosSE) Survey. The survey included participants from sophomore to senior levels. Analysis of the survey data includes two-way ANOVAs. ANOVA results indicated that student citizenship status is a significant factor for ADB and PI. Further, results indicated that permanent residents had significantly more positive perceptions of academic discipline belonging and peer interactions than other groups, while naturalized citizens had significantly lower perceptions. The significance of this study lays on it being one of the few quantitative studies focusing on civil engineering and building construction students' affective engagement.

**Keywords:** persistence, peer interaction, belonging, international students

## **Introduction**

The United States (U.S.) faces an urgent national need to increase both the diversity and number of graduates to meet science, technology, engineering and mathematics (STEM) workforce demands and address societal problems [1], [2], [3], [4], [5], [6]. The need for more constructors is timely due to the role of these professionals in repairing and rebuilding national infrastructure—an enormous U.S. challenge given the number of infrastructure systems rated below a C grade on the ASCE Infrastructure Report Card [7]. One way to increase the numbers of constructors is by improving the quality of their educational experiences.

While there are a multitude of ways to frame quality of educational experiences, we focus this study on two measures of quality, academic disciplinary belongingness (ADB) and peer interactions (PI). We frame this study around these measures as students who are positively engaged in educational activities develop lifelong learning skills that ensure personal development [8]. Further, lacking a sense of academic discipline belonging often indicates disaffection or disengagement with school, resulting in emotionally detached students who may show signs of cognitive and behavioral disengagement with learning activities, which eventually results in student attrition [9], [10], [11]. Based on this existing work, we seek to provide guidance to faculty and administrators so that they can increase the engagement and sense of belonging of future constructors.

While belongingness and social interactions have been previously studied in engineering environments [12], [13], [14], [15], little work has examined the intersection of students in constructing majors and their citizenship status. Given the increase in international student

enrollment at U.S. universities [16], the present study uses citizenship status as criteria to better understand if affective engagement difference exists between U.S. and international undergraduate students. Specifically, research has found that international students struggle to adjust to U.S. campuses, particularly those lacking guidance from their parents who did not attend college [17]. Given the role of international undergraduate students at taxpayer-supported universities bringing in much needed revenue to support university missions [18] focusing on how we can support this population serves to benefit the undergraduate population as a whole.

To begin understanding how we can produce more constructors we examined how citizenship status influenced students' sense of academic disciplinary belonging (ADB) and quality of peer interactions (PI). The following research question is addressed: How do academic discipline belonging and affective engagement with peers for future constructors differ by citizenship status? For this study constructors are defined as undergraduate students majoring in Civil Engineering (CE), Building Construction (BC), Construction Science (CS), or Construction Management (CM). Through the explicit examination of the experiences of undergraduate constructors of different citizenship categories, educators can begin to better design programs to benefit all students and work to remove educational practices that serve to decrease the retention of diverse students [19], [20], [21]. The paper defines and underscores the importance of belongingness and engagement; outlines the methodological and analytic approach; and discusses the results of this work within the context of the broader literature. Finally, the paper concludes with implications for educators and administrators.

## **Background**

The culture within engineering has been described as a “chilly climate,” which refers to the negative, unfavorable educational atmosphere that surrounds students’ interaction with faculty and peers [22]. Academic departments that express these unfavorable environments have been shown to decrease student engagement and increase student attrition [22], [23]. To add another layer to this unfavorable climate, students with different citizenship status can experience a chillier climate than others. Obtaining a degree from a U.S. institution has become a prominent academic goal that is influenced by interpersonal relationships in and outside of the classroom. Research on student engagement has focused primarily on U.S. citizens, less is known about the motivational point of view of students based on citizenship status. This study takes a quantitative approach to discover how students perceive their educational program in their sense of belonging.

Student engagement is broadly categorized into cognitive, behavioral, and affective engagement [24]. The present study focuses on affective engagement, which denotes students’ emotional response to learning, which can include anxiety, interest, boredom, and belonging [25], [26], [27], [28]. Specifically, affective engagement has been shown to be expressed in two distinct ways. First, affective engagement is described with respect to the relationship with academic pursuits. For example, it is measured as the level of student interest in, anxiety about, or boredom with academic activities [29], [30]. Second, affective engagement is also seen as an indicator of a student’s sense of belonging and affective connectedness with their learning community [31], [32]. Lawson and Lawson [28] argued that students who feel attached to the people within their learning communities have greater motivation to pursue academic tasks than those who have less

attachment. Further, students who demonstrate less affective engagement with learning also display dysfunctional learning behaviors [11]. In engineering, student engagement is suggested to be a precursor of persistence [33]. While engagement and workforce preparation of civil engineering students has been studied (e.g., [34], [35], [36]), more research is needed to examine influential agents in these students' higher education experience: faculty and peers. Therefore, ADB and PI are used in this study as measures of affective engagement.

Scholars have also pointed out that persistence is related to student demographics, parental influence, and student engagement [37] and not capacity, innate ability, or grades [38]. A wide body of literature indicates that students' demographic identifiers serve to dictate how they are perceived [40], act in an environment [39], and develop affective engagement characteristics such as belongingness [41]. As such, examining citizenship status in relation to discipline belongingness and peer interactions contribute new insights to positively influence persistence. By promoting student engagement both in- and out-of-class through interaction with faculty and peers, educators may be able to improve the academic experiences of all students. Improving student experiences will not only ensure degree attainment and learning but has also been shown to promote persistence within the profession [42]. However, the literature does not offer a clear understanding of undergraduate constructors' affective engagement or examine the influence of citizenship status. To create or modify department-level support structures so that programs can respond to national needs, how constructors from the US and abroad develop affective engagement within their disciplines needs to be addressed.

## Methods

This initial study is part of a larger research program on the postsecondary educational outcomes of historically underrepresented groups in engineering. To begin addressing the highlighted needs for research that examines the development of affective engagement of future constructors. This study examines how students' affective engagement outcomes differ by citizenship status.

Data were drawn from an administration of the Postsecondary Student Engagement (PosSE) Survey, which measured the quality and quantity of students' engagement in out-of-class activities [43], [44]. The administration included students enrolled at three research institutions. The institutions are public, Carnegie classified R1, and located in the United States.

Additionally, the institutions had student-faculty ratios ranging from 16:1 to 19:1, and total enrollments of over 25,000 students. The institutions selected for sampling are ones that graduated a significant number of women and underrepresented ethnic groups in STEM disciplines. This ensured the sample included underrepresented groups. This purposeful sampling method would serve the goal of exploring affective engagement for science, technology, mathematics and especially engineering undergraduates. Moreover, the large potential sample ( $N > 1,000$ ) and high subject to item ratios ( $> 20:1$  ratio) ensured the stability of estimates with a power of 0.80 or greater [45], [46]. The data from the PosSE survey ( $N = 1,897$ ) were subset to focus on the experiences of future constructors ( $n = 397$ ; male=228, female=165, unknown =4; civil=343, 54=building construction, construction science, and construction management). While the program of studies differs across these majors, the researchers assumed that these students share similarities in the affective effective engagement due to their major choice.

Two scales of affective engagement, academic discipline belonging (ADB) and peer interactions (PI), were measured. These differences in outcome measures were then compared across different groups. Participants were asked to indicate the extent to which they agree with survey items for each of these scales. Responses to each item were placed on a 4-point scale ranging from 1 (“strongly disagree”) to 4 (“strongly agree”). A 4-point scale was used to avoid respondents who are not willing to answer a particular question. The PosSE survey has been shown to be consistently reliable and valid (Simmons et al, 2017).

ADB and PI, as used in this study, have psychometric properties consistent with the definition of each scale. Our measure of ADB is derived from three survey items (Cronbach's  $\alpha = 0.901$ ) accounting for 71% of the inter-item variance. One measure of ADB was, “I do not feel like ‘part of the family’ in my academic discipline.” Mean scores for ADB ranged from 2.94 to 3.03 with higher scores indicating greater levels of belongingness. Similarly, peer interaction (PI) is derived from four survey items (Cronbach's  $\alpha = 0.856$ ) accounting for 62% of the inter-item variance, and mean scores ranged from 3.02 to 3.24. Higher scores indicate increased levels of PI. PI was measure through items similar to, “I discuss career issues with peers.”

## **Analysis**

After the creation of factor averages for ADB and PI, results were checked for normality. All item responses met normality assumptions, using the requirements of skewness  $\leq |2|$  and kurtosis  $\leq |7|$ . These levels of normality are appropriate for exploratory psychological studies [47]. Two-way ANOVA and post hoc analysis of variance was conducted to determine if differences exist for multiple groups. For the ANOVA, we sought to understand how differences in the two



affective engagement constructs of interest were influenced by citizenship status.

Citizenship status was separated into four categories: Permanent Resident (P.R.;  $n = 16$ ), U.S. Citizen born in the U.S. (Born;  $n = 317$ ), Naturalized U.S. Citizen (Nat.;  $n = 14$ ), and International Student on F-1 or J-1 visa (Inter.;  $n = 47$ ). A permanent resident is defined as someone that has been granted the ability to remain in the U.S. indefinitely but is still not considered a citizen of the U.S. This status is usually obtained along the path to becoming a naturalized citizen. Permanent residents are typically people that themselves or their parent/guardian are in the process of immigrating to the U.S. A naturalized citizen is someone who has taken all of the steps to become a U.S. citizen including passing a citizenship test.

The significant difference between groups from the two-way ANOVA does not distinguish which groups were significantly different from one another. To determine group differences, post hoc testing was conducted. Tukey's Honest Significant Difference (Tukey's HSD) is a multi-step procedure used to determine which sets of means are significantly different from each other [48]. Tukey's HSD compares all possible pairs of means to identify any differences. For all tests, a significance level of 95% was used due to the preliminary nature of the work.

## **Results and Discussion**

### *Citizenship Status*

Results of the two-way ANOVA analysis indicated that students with different levels of citizenship status had statistically different academic discipline belonging (ADB) ( $p = .00287$ ) and peer interactions (PI) ( $p = .0163$ ). A summary of these results can be found in Table 1.

**Table 1.** Affective Engagement: Differences by Citizenship Status,  $\alpha=.05$ .

			Mean		
Test	<i>df</i>	Sum sq.	SQE	<i>F value</i>	Pr(>F)
ADB ~					
Citizenship	4	16.80	4.20	4.10	.00287**
residuals	392	401.50	1.02		
PI ~ Citizenship					
	4	8.57	2.14	3.08	.0163*
residuals	392	273.06	0.70		

Significance Codes: \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$

Results of Tukey’s HSD post hoc testing indicated significant differences between permanent residents, international students, U.S. Citizen born in the U.S., and naturalized U.S. Citizen. All had significant differences for ADB and there is a significant difference between permanent residents and naturalized citizens for PI (Table 2).

**Table 2.** Tukey's-HSD Post Hoc Testing for Differences in ADB and PI ( $\alpha=0.05$ ), only significant differences are shown.

		Confidence Interval <sup>1</sup>			
		p adj.	delta	lower	upper
Academic Discipline Belonging (ADB)	P.R. & Inter	0.009**	0.97	0.17	1.78
Peer Interactions (PI)	Nat. & P.R.	0.002**	-1.39	-2.41	-0.37
	Nat. & P.R.	0.013*	-0.98	-1.82	-0.14

<sup>1</sup> 95% confidence interval

P.R. - Permanent Resident, Born - U.S. Citizen Born in the U.S. Nat. - a U.S. Citizen: naturalized, Inter. - an International Student (on F-1 or J-1 visa)

Significance Codes: \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$

The data highlights that student citizenship status interacted with student affective engagement characteristics in their academic programs. The data indicates that in all cases permanent residents perceived higher levels of academic discipline belongingness than their counterparts. This can be attributed to the process of becoming a naturalized citizen, such that the students feel invested in the country and these feelings are manifesting in students' feelings of belongingness within U.S. based engineering and building construction program environments. The greatest difference in mean scores occurs between permanent residents and naturalized citizens. Students who have become citizens through naturalization may struggle with merging their identities from

their previous communities and their identities as a U.S. citizen when being asked to practice engineering in an American context. This interpretation mirrors previous trends in the identity literature that show students who struggle to merge their identity within their context struggle to engage with course material [39]. When permanent residents are compared with U.S. citizens that were born in the U.S. they displayed an increased academic discipline belonging, suggesting that U.S. citizens may be taking their residency for granted whereas the permanent residents were still trying to achieve citizenship.

Testing revealed that citizenship status only has a significant relationship for peer interactions (PI) between permanent residents and naturalized citizens as shown in Table 2. When examined alongside the other results of this study, this result indicated that the gateway for belonging in CE, BC, CS, and CM programs may be controlled by students, which aligns with previous findings comparing domestic and international student belongingness [49]. While further exploration is needed to understand the reasons for these results.

### *Limitations*

The analysis in this study is limited to the following fronts. First, the students in this study represent the populations of institutions that have generated higher graduation rates for women and underrepresented students than the national average. As such, the generalizability of this study is limited to the institutions studied and other institutions with similar graduation metrics (e.g., community colleges and two-year colleges). As such, the positive results seen here may not be seen in other CE, BC, CS, and CM programs. Second, the theoretical model used to build the ABD and PI factors, while statistically appropriate and strong, needs to be examined with a

larger population. A couple of the items had low uniqueness values for the sample in this study indicating that they may not capture enough of the variability within each of the affective engagement measures [50]. Third, this work only explores affective components of student engagement and does not explore other aspects of engagement: cognitive and behavioral engagement. While affective engagement has been connected to persistence and retention, cognitive engagement may also connect to student performance on day-to-day tasks such as problem-solving.

### **Conclusions and Future Work**

The goals of this study were to gain a better understanding of student affective engagement among future constructors. Affective engagement was measured using two scales: academic discipline belonging (ADB) and peer interactions (PI). The analyses provide both encouraging results and areas to further explore concerning how to improve the current climate in engineering.

We found a “chilly climate” trend based on self-identified citizenship category. In general, permanent residents feel that they have a higher level of ADB than their counterparts. Additionally, the findings indicated that citizenship status influences student’s perceptions of PI. This result might reflect an aversion of students to interact with peers due to perceived power status or cultural practices of interacting with others. The researchers acknowledge that the present results are based on a relatively small sample size of international students, but this work provides an indication that these views should be further investigated. The results are strengthened by the convergence of the data from three different institutions as well as reliable

scales of affective engagement.

Practitioners need to understand how students learn and how they experience their educational environments. By understanding students' experiences and their resulting attitudes, practitioners can improve the ways in which they teach and how they construct learning environments to promote engagement and persistence in CE, BC, CS, and CM programs. By making faculty members aware of these findings and encouraging them to foster positive interaction between students, common goals of increasing and retaining a diverse group of CE, BC, CS, and CM students can be achieved.

These preliminary results can be used in future studies to gain a deeper understanding of the complexity of students from different citizenship categories in CE, BC, CS, and CM programs through qualitative techniques such as narrative analysis. For instance, studies can explore how and through what mechanisms are students come to perceive their belongingness and which techniques faculty are using to develop positive relationships between students.

In addition, the future survey can include questions about the place of origin and gather data from leading institutions hosting international students. Other variables to include in future studies include social support outside of school, English language proficiency, region/country of origin, length of residence in the United States, social interaction with U.S. Citizens, and self-efficacy.

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