"Si no servimos, no servimos": A Pilot Study on the Influence of Perceived Advisor Support on Graduate Student Thesis Self-Efficacy

Abimelec Mercado Rivera, Arizona State University, Polytechnic Campus

Abimelec Mercado Rivera is a Puerto Rican doctoral student and graduate research assistant in the Engineering Education Systems and Design program at Arizona State University. Abimelec received his Bachelor of Science in Mechanical Engineering at the University of Puerto Rico at Mayaguez (UPRM) in 2016. After working in the aerospace industry, he returned to the UPRM for his MS in Mechanical Engineering in 2017, where he pursued ways to tailor ideation methods to interdisciplinary teams as part of his thesis work, and had the opportunity to teach undergraduate ME courses. His previous efforts and experiences in engineering education helped shape his overall goal of fostering human-centered education systems, which led him to pursue his PhD at ASU.

Dr. Brooke Charae Coley, Arizona State University, Polytechnic Campus

Dr. Brooke Coley, an Assistant Professor of Engineering at Arizona State University, is a pioneering force in disrupting the status quo of engineering to create a more equitable and inclusive field where all individuals can thrive. As the Founding Executive Director of the Center for Research Advancing Racial Equity, Justice, and Sociotechnical Innovation Centered in Engineering (RARE JUSTICE), Dr. Coley leads transformative efforts to challenge systemic barriers and promote equity in academia. Her research focuses on amplifying the lived experiences of racially minoritized scholars, dismantling anti-Blackness in STEM, graduate student education, and fostering awareness of, and ultimately, accountability for, the lived realities of individuals navigating STEM through immersive virtual reality experiences. Collaborating with mental health experts, she also is intentional to integrate a head-on focus on the implications for wellness and wholeness in academic environments. Dr. Coley's transparent and culturally responsive approaches, coupled with her dedication and fortitude, have positioned her as a recognized leader in the field. Since 2017, she has secured millions of dollars in grant funding from the National Science Foundation, employing critical qualitative and arts-based methodologies in her work. She received the Wickenden Award and Betty Vetter Award in 2024 and was named a Virtual Visiting Scholar by the ARC Network in 2023. Launching from the Ph.D. in Bioengineering from the University of Pittsburgh oriented to the challenges of navigating STEM as an underrepresented and minoritized scholar, she continues to lead change and advocate for institutional transformation and accountability through novel applications and approaches.

Dr. Samantha Ruth Brunhaver, Arizona State University, Polytechnic Campus

Samantha Brunhaver is an Assistant Professor of Engineering in the Fulton Schools of Engineering Polytechnic School. Dr. Brunhaver recently joined Arizona State after completing her M.S. and Ph.D. in Mechanical Engineering at Stanford University. She also

"Si no servimos, no servimos": A Pilot Study on the Influence of Perceived Advisor Support on Graduate Student Thesis Self-Efficacy

Introduction

The meaning behind our title, like many phrases in the Spanish language, is better understood when examined within the context in which its native speakers use it. A direct translation would be a disservice to the witty phrase –a pun– which is often used by community leaders to describe how serving others is not only an action that points to the needs of the served but also to the mission and efficacy of those who serve. A more suitable interpretation in US English would be, "*If we are not serving, we are broken.*" Yet, this phrase is not meant to be derogatory or accusatory. Instead, it serves as an open invitation for leaders to intentionally and critically reflect upon their work of serving and how their actions and policies address the needs of their intended audience. After all, if we *are broken,* we can be restored, and thus we approach this work.

Hispanic Serving Institutions (HSIs) were established after years of advocacy from many Latin* groups across the US. However, unlike other Minority-serving Institutions (MSIs), the HSI designation is appointed at the federal level, where institutions of higher learning may apply to become HSIs once their undergraduate enrollment reaches or surpasses the 25% Hispanic/Latin* student threshold. This definition, coupled with the change in demographics across the Nation, has resulted in a deluge of newly minted HSIs in the past decade alone. Yet many of these institutions join the ranks of HSIs without having an established mission to serve the needs of underrepresented communities, and those of the Latin* community, specifically (Aguilar-Smith, 2021; Vargas & Villa-Palomino, 2019). As a result, much work has focused on conceptualizing and operationalizing "*Servingness,*" which encompasses the policies and practices aimed at positioning institutions to reflect and act in their role to ensure representation and engagement of the Latin* community (Garcia, 2020; Garcia et al., 2019; Garcia & Cuellar, 2023; Garcia & Koren, 2020).

Perhaps as an unintended side effect of their undergraduate-centered definition, current research on how policies and practices at HSIs impact Latin* student success predominantly focuses on undergraduate students. As a result, little is known about how servingness impacts the experiences of engineering graduate students and how institutional policies and practices may be aiding or barricading their path to success. As the calls to expand the post-baccalaureate opportunities of the Latin* community abound, it becomes imperative to gain a deeper understanding of the factors impacting their degree completion (Fleming et al., 2023; Garcia & Guzman-Alvarez, 2021). Therefore, this pilot study centers on one of the most influential factors in graduate students' degree completion at both the master's and doctoral levels: their faculty advising experience. We aim to examine the extent to which faculty advisors' instrumental and psychosocial support influences graduate students' self-efficacy for the tasks related to completing their terminal document. We intentionally examine the impact of institutional context to explore how institutional policies, grounded in the institution's enactment of its mission, influence the support an advisor can provide. The following questions guide our work:

RQ1: To what extent do instrumental and psychosocial advisor support influence engineering graduate students' thesis self-efficacy (TSE)?

RQ2: How does institutional context influence the types of support faculty advisors provide and its relationship to engineering graduate students' thesis self-efficacy?

Our pilot study contributes to the limited work that explores how *servingness* is being enacted at the graduate level in engineering education. We used the Advisor Support and Self-Efficacy for Thesis completion (ASSET) survey instrument to collect graduate student data across the US and Puerto Rico. While focusing on HSIs due to their potential to propel the success of the Latin* community, we compare student experiences at HSIs and non-HSIs, using non-HSIs as a baseline for our results. In exploring our research questions, we developed regression models that disaggregate between students of the Latin* community and those who belong to other groups. This approach highlights how Latin* students experience graduate advising practices in engineering programs and points to how their needs may differ from those of other groups. The insights gained from our results can aid faculty advisors enact servingness through their advising practices by strategically tailoring their support to create positive and lasting impacts on their students' self-efficacy toward completing their terminal document.

We ask the reader to note that, while we acknowledge that the term represents an inadequate attempt at generalizing the many peoples, cultures, and countries that make up the community, we chose to use the term *Latin** to refer to our participants due to its gender-inclusivity. Thus, when we use the term Latin*, we refer to students who may trace or identify their ethnicity as Hispanic, Latina/o/é/x, Chicana/o/x, or by their nationality (Ramos et al., 2023; Salinas, 2020; Villanueva Alarcón et al., 2022).

The importance of the advisor-advisee relationship

While advising practices differ greatly among institutions and disciplines, there is consensus among researchers and policymakers regarding their importance for graduate students' degree completion, particularly in relation to the advising model found in engineering education (Austin, 2009; NASEM, 2018, 2019b). Among many constructive effects, positive advising relationships can help stave off attrition (Litalien & Guay, 2015; Marshall et al., 2017; Sallai et al., 2023; Wilkins-Yel et al., 2022), become validating spaces for students (NASEM, 2019b), and help students become successfully socialized into their disciplines (Amelink & Edwards, 2020; Weidman & DeAngelo, 2020).

When considering the experience of underrepresented students in STEM, the stakes of the advising relationship quickly rise. In some cases, underrepresented students may find their success tied to an advising relationship that may not fulfill their needs and expectations for support (McCoy et al., 2015; Santa-Ramirez, 2022). In a place where they might expect validation of their identities, they can instead suffer racialized experiences through advising practices (Burt et al., 2016; Burt & McKen, 2019; Coley & Thomas, 2023). Conversely, positive advising experiences that provide active support of academic and professional goals, or instrumental support, can foster these students' academic success, satisfaction, and overall degree progression (Primé et al., 2015; Zerbe et al., 2023). Additionally, an advising relationship that offers encouragement responsive to a student's needs and individual circumstances can create a supportive environment for underrepresented students. This psychosocial support can serve as a space for healing, humanizing, and validation, ultimately influencing their progress toward graduation and career choices (Bryson & Housh, 2023; Santa-Ramirez, 2022; Wilkins-Yel et al.,

2022). Altogether, the vast and lasting effect of faculty advising on their graduate students' overall educational experience and success suggests that it is an area where *servingness* might be both cultivated and prioritized at HSIs.

While the focus on measurable performance outcomes such as persistence and graduation rates are both relevant and informative, other non-academic dimensions of the graduate student experience also deserve attention. Master's and Doctoral students' non-academic outcomes, such as their sense of belonging in their institution or discipline, have also been shown to be responsive to the types of mentorship students receive (Curtin et al., 2013; Dericks et al., 2019; Overall et al., 2011). Relevant to our own endeavor, studies have found that academic self-efficacy is influenced by the mentoring the students receive from their advisors (Fitzpatrick et al., 2022; Holloway-Friesen, 2021). However, there is a gap in the literature concerning the development of students' self-efficacy in relation to the writing of their terminal document (i.e., a thesis or dissertation) and how advising practices influence it. While contributing to address this gap, we posit that the support provided by an advisor—characterized as having the potential to become an aid or barrier to a graduate student's success—can significantly influence a graduate student's self-efficacy beliefs in areas relating to completing their terminal document.

The role played by HSIs in Latin* student success

The culturally affirming practices, student-body diversity, and faculty diversity at HSIs have greatly benefited students from the Latin* community and other traditionally underrepresented backgrounds (Fleming et al., 2023; NASEM, 2019a; Núñez et al., 2015). From influencing their sense of belonging to increasing their cultural wealth, HSIs have the potential to help students combat the traditionally exclusionary climate of the engineering discipline (Hasbún & Strong, 2020). At the graduate level, Latin* student success can have a cascading effect. As more graduate Latin* students join graduate programs at HSIs, they become both mentors and vicarious agents for undergraduate Latin* students (Mireles-Rios & Garcia, 2019), who might then join graduate programs themselves. Additionally, Latin* graduate students who choose career paths in academia go on to reduce the gap between Latin* and non-Latin* faculty in engineering education, and perhaps more importantly, they help improve the upward mobility of their communities (Garcia & Guzman-Alvarez, 2021; NASEM, 2018). Yet, there is still much work to be done to understand how current and potential servingness practices can influence the experience and success of Latin* graduate students. Our work focuses on how students experience servingness through the support they receive from their advisor, a practice that differs across disciplines, and how institutions enact their missions through policies that influence the focus of faculty advising practices. Although we might expect an HSI's servingness mission to impact faculty advising practices positively, our work interrogates this potential impact by comparing our results for engineering graduate students' TSE between HSIs and non-HSIs.

Guiding Frameworks

Our work leverages concepts from the Social Cognitive Career Theory (SCCT) (Lent, 2013; Lent et al., 1984; Sheu et al., 2018) and the Multidimensional Conceptual Framework for Servingness at HSIs (from here on, the *HSI Servingness* framework) (Garcia et al., 2019). In the academic context, SCCT offers a framework for understanding how environmental supports and barriers affect a student's self-efficacy beliefs. These beliefs, in turn, shape their career interests and

aspirations. The theory posits that a student's outcome expectations and career choices—such as whether to enroll in a graduate program, continue after enrollment, or depart—are influenced by how they perceive the supports and barriers they encounter. In STEM education research, SCCT has been leveraged to parse the barriers and supports that influence graduate student's persistence. Considering advisor support as contextual support for women of color in STEM, Wilkins-Yel et al. (2022) observed how vital this support was to their academic persistence, even as they faced personal challenges that impacted their experience. Similarly, Maher et al. (2020) found that advisor support can directly impact a student's decision to persist in a graduate program. Further, Fitzpatrick et al. (2022) noted that engineering graduate students' self-efficacy beliefs influenced their academic perseverance. In the present work, we use SCCT to hypothesize the latent relationship between students' perception of their advisor's support and their TSE.

Garcia's HSI Servingness framework proposes that servingness in an institution is an endeavor that encompasses multiple dimensions at the systems level (Garcia et al., 2019; Garcia & Koren, 2020). The framework provides a starting point from which to understand the experience of Latin* students as influenced by the various dimensions of organizational practices and structures that form an HSI. The multitude of practices and structures of an institution that can be steered towards servingness are defined as *Structures for Serving* in the framework. In turn, the measurable outcomes in the student's experiences that result from these structures, encompassing academic and non-academic outcomes, are considered *Indicators for Serving* in the framework. As a relationship has been characterized as being directly influenced by an institution's policies, practices, organizational culture, and structures (NASEM, 2018), we use the HSI Servingness framework to characterize graduate faculty advising as a potential *Structure for Serving*. In this line, we consider the students' TSE an *Indicator of Serving*.

Figure 1. A superposition of SCCT and concepts of the Servingness framework describes the cognitive connections between non-academic factors and institutional practices as experienced by the students.
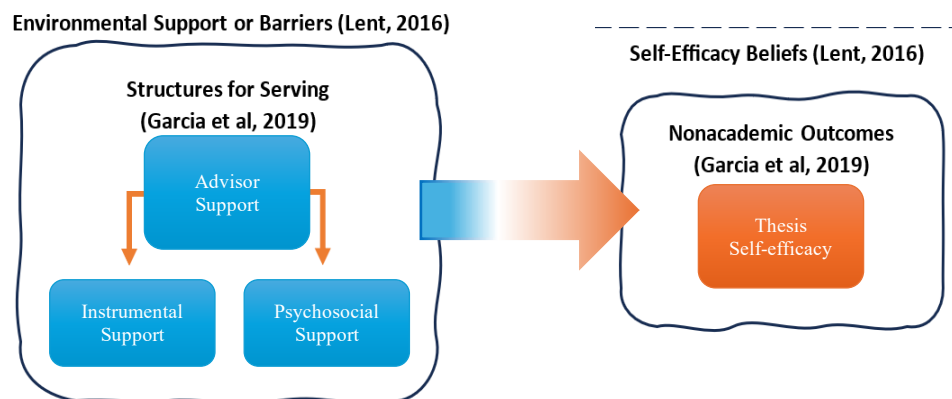
To illustrate how concepts from both frameworks are used in this study, we call the reader's attention to Figure 1. Here, we superimpose elements of both frameworks over our constructs of interest and posit that students can experience institutional *Structures for Serving* as *Environmental Supports or Barriers* that cognitively influence the development of their *TSE*. Therefore, SCCT acts as a theoretical foundation that explains the multidimensional relationships presented by the Servingness Framework, illustrating how institutional policies, culture, and

structures for serving can directly influence students' non-academic outcomes. By exploring how students' perception of support in their advising relationships influences their TSE, this work follows calls to explore the complexities of the institutional promises to serve the Latin* community at the graduate level (Garcia & Guzman-Alvarez, 2021).

Methods

Instrument and Variables

We used the Advisor Support and Self-Efficacy for Thesis completion (ASSET) survey to gather data for our study. With engineering graduate programs at HSIs as a focus and SCCT as a theoretical underpinning, ASSET was designed to explore graduate students' thesis or dissertation self-efficacy and their perceptions of advisor support. The instrument is based on Varney's Dissertation Self-Efficacy (2010) and Zhao et al.'s Advisor Behavior (2007) scales, adapted to the engineering context as the *Thesis Self-Efficacy* and *Advisor Support* constructs. Previous work, which comprised an exploratory factor analysis (EFA), provided construct validity evidence for the adapted scales in the instrument (Mercado Rivera et al., 2023).

The survey instrument allowed us to measure psychosocial advisor and instrumental support as our independent variables through the *individualized support* and *research support* subscales, respectively. Both factors are subscales of ASSET's *Advisor Support* construct, which measures the students' perceptions of the support they receive from their advisors on an agreement-anchored Likert scale. *Research support* items involve elements of advisor instrumental support in areas that directly influenced the students' research, with statements such as "My advisor teaches me the details of good research practice" and "My advisor gives me regular feedback on my research." On the other hand, items in the *individualized support* factor deal with the support related to the psychosocial needs of the students, with statements such as "My advisor takes an interest in my well-being and life-work balance," and "My advisor provides emotional support when I need it." Finally, TSE is our dependent variable and is measured by the *Thesis Self-efficacy* factor, measured on a confidence-anchored Likert scale and includes items that deal with the various skills surrounding the completion of a terminal document.

Participants and Institutions

While our focus is set on the experiences of Latin* engineering graduate students, our survey was open to students of all racial and ethnic backgrounds. The target population could be described as *engineering graduate students enrolled in master's and doctoral programs who were actively working towards their terminal document under the direction of a faculty advisor*. Seeking to reach the Latin* community, the recruitment purposefully targeted HSIs; non-HSIs included in the sample were identified and invited to participate due to their high enrollment and graduation rates of underrepresented students at the master's and PhD levels (ASEE, 2023; Santiago et al., 2024). These efforts have yielded a collaboration from a mixture of public and land-grant institutions across the continental U.S. and Puerto Rico, including historical and newly minted HSIs (n=14) and non-HSIs (n=10). All recruitment efforts followed the protocols approved by IRB.

We gathered the participation of 573 engineering graduate students from 24 institutions across the US and Puerto Rico. Importantly, our analysis included participants at the master's and PhD degree levels as a single population, i.e., *graduate students in engineering programs*. Thus, the results of subsequent analyses reflect the commonalities in these students' experiences, regardless of their degree level.

Instrument Validation

As we extended the reach of this work to a broader graduate student population, we conducted a confirmatory factor analysis (CFA) to seek further evidence of ASSET's previously hypothesized factor structure (Mercado Rivera et al., 2023). In recognizing that engineering graduate students must navigate policies that can vary greatly at the program, departmental, and institutional levels, our CFA also validates our instrument for use across an institutionally diverse population of engineering graduate programs. This further validation of our instrument was imperative to the tacit objective of providing HSIs with tools to help uncover how engineering graduate students experience servingness in their advising relationships and, in turn, how these experiences influence their non-academic outcomes. All construct validity analyses were conducted in R.

Addressing our Research Questions

All analyses related to our research questions were completed using IBM SPSS. Staying in tune with the overarching purpose of this pilot, when addressing RQ 1 and RQ 2, we created separate models for students who self-identified as Hispanic or Latina/o/é/x and those who did not identify as such. We used sequential multiple linear regression analyses to explore how individualized and research support predicted students' TSE as an exploration of RQ 1. This approach allows us to independently assess the effects of the advisor support variables; the first model includes individualized support, the second model assesses research support, and the full model includes both individualized and research support variables.

To examine how institutional context, measured by enrollment at an HSI, influenced the *individualized* and *research support* students received from their advisors and, in turn, their *thesis self-efficacy*, we followed a hierarchical linear regression approach to explore RQ 2. The first model includes *individualized, research support,* and *Institutional Designation* as variables; the latter is a categorical variable coded as 0 for non-HSIs and 1 for HSIs. In the full model, we added interaction effects between our advisor support variables and the *Institutional Designation* variable. To avoid issues of collinearity arising in linear regression when exploring interaction effects, we centered the support variables on their mean values for each group; consequently, our interaction effects are also centered, and no collinearity issues were found in the models.

Results

Instrument Validation and Construct Consistency

As the first step in our CFA, we input the factor structure obtained from the past EFA as an a priori model for testing (Mercado Rivera et al., 2023). With 573 total complete participant survey responses, our dataset passed the recommended sample-to-item ratio of at least 10 participant responses per item. An analysis of skew and kurtosis showed that our dataset met the

univariate normality assumption needed for CFA, but failed further tests for multivariate normality. To address this when running our CFA, we utilized a maximum likelihood estimation with robust standard errors (MLR), an approach that is robust to multivariate normality violations and is available in the lavaan package in R. This robust approach allowed us to continue with the CFA process as outlined by McCoach et al. (2013), where we used the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) to assess model fit. The results for the chi-squared fit statistic were also inspected; still, the chi-squared fit statistic was not considered as our primary indicator of fit because of the large size of our sample size, which could lead to an undesired statistically significant result. At our first approach, the resulting indices did not indicate a good fit for our original model, so we investigated further and re-specified our model by inspecting modification indices, residuals, factor loadings, and the wording of our survey items. Using this approach, we ensured that the model's decisions were not based solely on post hoc statistics alone, but reflected a more holistic understanding of our model (Lee et al., 2022; McCoach et al., 2013).

As an example of our process, while discussing our participants' institutional and disciplinary diversity, our examination led us to flag two items in the *Individualized Support* factor that may not reflect the general experience of all engineering graduate students. The items "Helps me secure funding for my graduate studies" and "Teaches me to write grant and contract proposals" were thus removed from the model. Additionally, items that showed residuals over 0.1 with several items, or low factor loadings (<0.70) were removed from the model. Guided by the modification indices, we used an intuitive approach to identify items that should have correlated errors; thus, we specified correlated errors on items that described different aspects of the students' experiences that could be cognitively related. For example, the items "Interpret the results obtained from a quantitative or qualitative analysis" and "Discuss your interpretation of a quantitative or qualitative analysis", which describe two different tasks related to interpreting results obtained from scientific inquiry, were correlated in the model.

Our final model is comprised of 24 items, with fit indices that showed a good fit of the model at CFI = 0.953, TFI = 0.946, RMSEA= = 0.052 ± 0.004 90% confidence interval, and SRMR = 0.042. As expected, the chi-squared statistic was found to be statistically significant (χ^2 = 621.288, p<.001), which can be explained due to its sensitivity to large sample sizes. No new factors were identified in the CFA, and our factors' overall structure and meaning remained the same. The result is an ASSET instrument refined for use in various institutions with graduate engineering programs, which can be found in the Appendix.

Understanding how advisor support influences thesis self-efficacy

We used a set of sequential multiple linear regression models to explore the extent to which *individualized support* and *research support* influence the *thesis self-efficacy* of engineering graduate students; the coefficients with their respective standard errors and other model data can be found in Table 1. For Latin* students, Models 1a and 1b show that, when considered independently, *individualized support* and *research support* were both positive and significant predictors of *thesis self-efficacy* (b = 0.36, $p < .001$; b = 0.27, p < .05). However, while Model 1a explained 13.2% of the variance in the students' *thesis self-efficacy* score, Model 1b only explained 7.2% of the variance. Concordantly, in Model 1c, which considers both advisor

support variables, *individualized support* remained a significant predictor of *thesis self-efficacy* (b = 0.36, *p* < .05). In contrast, *research support* was reduced in magnitude and no longer significant. This last model accounted for 13.2% of the variance.

Students who did not identify as Latin* saw a positive and significant boost in their *thesis self-efficacy* as they received either *individualized support* (b = 0.26, *p* < .001) or *research support* (b = 0.30, p < .05), as shown in Models 2a and 2b. Interestingly, the R^2 values for the models are somewhat flipped from those found in the Latin* student models, with Model 2a explaining 9.3% of the variance and Model 2b explaining 12.1% of the variance for students' *thesis self-efficacy*. In the same manner, *individualized support* was no longer a significant predictor in Model 2c. In contrast, *research support* remained a positive and significant predictor in the model (b = 0.25, *p* < .001), which accounted for 12.3% of the variance.

Table 1 Regression models predicting students' thesis self-efficacy based on their perceived advisor support.

	Latin* Students			Non-Latin* Students		
	Model 1a	Model 1b	Model 1c	Model 2a	Model 2b	Model 2c
Individualized Support	0.36 (0.11)***		0.36 (0.15)*	0.26 (0.04)***		0.06 (0.07)
Research Support		0.27 (0.11)*	0.01 (0.16)		0.30 (0.04)***	0.25 (0.07)***
Constant	2.48 (0.44)***	2.91 (0.44)***	2.47 (0.47)***	2.90 (0.17)***	2.77 (0.17)***	2.71 (0.18)***
R^2	0.132	0.072	0.132	0.093	0.121	0.123
Adjusted R^2	0.121	0.06	0.109	0.091	0.118	0.118

Note: Standard errors (SEs) are in parentheses.
p < .05; **p* < .01; ***p* < .001.

Exploring the effect of institutional context

Table 2 shows the models we created to explore how students' enrollment at HSIs or non-HSIs would mediate the effect of individualized support and research support on their TSE. For this purpose, we created hierarchical multiple linear models for Latin* and non-Latin* students. For Latin* students, Model 3a showed that individualized support was a significant positive predictor of thesis self-efficacy (b = 0.35, p < .05); research support and Institutional Designation were positive but non-significant predictors in this model, which accounted for 14.1% of the variation. Model 3b explored the base model and the interaction variables. Here, we found that individualized support was no longer a significant predictor; moreover, the interactions between individualized and research support and Institutional Designation were not found to be significant. This model accounted for 14.2% of the variation in TSE, with adjusted R^2 = 8.5%.

When working with students who did not identify as Latin*, Model 4a showed that research support significantly predicted TSE. Institutional Designation was also a significant predictor, although in this case, it proved to be a negative predictor of thesis self-efficacy in those students attending an HSI. On the other hand, individualized support was not a significant predictor. This first model accounted for 13.7% of the variance, with an adjusted R^2 = 13.0%. As we moved on to the full model, we found that research support and Institutional Designation were still positive and negative significant predictors, respectively, of TSE. The interaction terms, however, were

not found to be significant predictors. Model 4b accounted for 13.8% of the variance, with an adjusted R^2 = 12.7%.

Table 2 Regression models predicting students' thesis self-efficacy based on perceived advisor support and institutional designation.

	Latin* Students		Non Latin* Students	
	Model 3a	Model 3b	Model 4a	Model 4b
Individualized Support	0.35 (0.15)*	0.41 (0.25)	0.07 (0.07)	0.05 (0.10)
Research Support	0.01 (0.16)	-0.05 (0.26)	0.24 (0.27)***	0.23 (0.10)*
Institutional Designation (HSI = 1, Non-HSI = 0)	0.16 (0.18)	0.16 (0.18)	-0.19 (0.08)*	-0.19 (0.08)*
Individualized Support & Institutional Designation		-0.09 (0.32)		0.04 (0.14)
Research Support & Institutional Designation		0.08 (0.33)		0.02 (0.14)
Constant	3.89 (0.13)***	3.89 (0.14)***	4.04 (0.06)***	4.04 (0.06)***
R Squared	0.141	0.142	0.137	0.138
Adjusted R^2	0.107	0.085	0.13	0.127

Note: Individualized Support and Research Support variables and their respective interaction terms are centered on their mean values for each group. Standard errors (SEs) are in parentheses. *$p < .05$; **$p < .01$; ***$p < .001$.

Discussion and Implications

This pilot study used survey data to examine the relationship between engineering graduate students' thesis self-efficacy and the instrumental and psychosocial support they receive from their faculty advisor. To best reflect our focus on the mission of HSIs, we divided the analyses of our data into Latin* and non-Latin* groups to explore how relationships between advisor support and thesis self-efficacy might differ between these groups. Further, we sought to determine if institutional policies, as grounded in the implementation of their mission, influenced the types of support an advisor could offer their students. As an underlying goal, this work also sought to validate the ASSET instrument as a tool for researchers and practitioners interested in understanding how current practices in their institutions influence their engineering master's and doctoral students' self-efficacy beliefs toward completing their thesis or dissertation.

While exploring our first research question, our results confirmed a significant influence of instrumental and psychosocial support on the students' TSE. When examining the influence of each support factor independently, this remained true for both Latin* and non-Latin* students. However, our full model quickly presented differences in how different types of support influenced TSE for each group. The effect of psychosocial support was positive and significant for Latin* students, while the impact of *research support* was greatly diminished. The models would suggest that, as it relates to their TSE, receiving relevant and individualized support that aligns with their current and future career needs is more influential for Latin* students than support that is only related to their work in an impersonal manner. This result is consistent with prior literature that suggests the importance of positive psychosocial support for underrepresented students and confirms the connections between environmental support and self-efficacy traced by the SCCT framework (Bryson & Housh, 2023; Lent et al., 2018; Wilkins-Yel et al., 2022). In contrast, instrumental support was the only variable that remained significant in

the full non-Latin* student model, while individualized support was both reduced and non-significant. Put together, both findings show how fundamental advisor support is to students' development of self-efficacy and highlight the importance of providing faculty with the necessary tools to allow them to tailor and deliver the support their students need to succeed.

The relationships between advisor support and the students' TSE remained generally unchanged when considering *Institutional Designation* as a variable in our models. Attending an HSI did not have a statistically significant impact on Latin* students' TSE; however, a rather unexpected finding of our pilot was that non-Latin* students' TSE was negatively impacted when attending an HSI. Yet our analysis would point to other unconsidered secondary factors as the reason for this negative impact, since our full models showed that Institutional Designation did not impact the influence of instrumental and psychosocial support on TSE for either student group.

Through an HSI Servingness lens, we recognize that faculty advisors are agents who act within structures that follow institutional and departmental cultures that define what their success should entail, over which they have limited control and which remain heavily influenced by White-male-centric standards (Artiles et al., 2023; Garcia et al., 2019; Garcia & Cuellar, 2023; Garcia & Koren, 2020; NASEM, 2018). Regardless of institutional and disciplinary variations, graduate engineering programs at HSIs often adhere to deep-rooted, research-oriented, and outcome-driven advising frameworks that replicate models found in Predominantly White Institutions (PWI). Justified by aims of perceived "rigor" or the pursuit of "tier 1" status, these models are used at the expense of tailored and culturally responsive practices that would better serve their students (DeTurk & Briscoe, 2020, 2021; Hasbún & Strong, 2020). As such, our comparison of the support advisors are able to provide at HSIs and non-HSIs points to the reality that Latin* engineering graduate students face at the institutions meant to serve their needs. In short, enrollment at an HSI does not guarantee that Latin* students will receive the necessary psychosocial or instrumental support in their advising relationships, which are crucial for their degree completion. While Servingness is not limited to undergraduate students, this finding highlights the neglect of *Structures for Serving* tailored to student needs at the graduate level in engineering programs, which can be reflected in how institutions support faculty in enacting their advising practices.

Returning to our titular phrase, we might ask, "*¿servimos o no servimos?*"(are we serving, or are we broken?). Beyond the insights presented by this pilot work, we encourage the reader to engage in their own introspection and inquiry. Leaders and faculty at HSIs can enhance their support for students by intentionally addressing servingness policies and practices within graduate engineering education. Including the voices and perspectives of graduate students in policy-making processes will be essential to understand how to best serve their needs (Franco & Hernández, 2018). Grant funds from programs such as the PPOHA, a program under Title V specifically directed to help promote graduate education at HSIs, may well be utilized to promote and sustain more relevant advising practices directed not only at the Latin* community but at the entire graduate student population. After all, a rising tide lifts all boats.

Limitations and future work

The limitations of our study point towards future work to be done in this space. At the end of this pilot work, we recognize that not all HSIs are created equal. As institutions of higher learning,

there are myriad ways in which these institutions differ, with the enactment of their mission to serve not being the least of them (Aguilar-Smith, 2021; Garcia, 2018; Núñez et al., 2016; Vargas & Villa-Palomino, 2019). Future work can further interrogate the differences between engineering graduate programs at HSIs by considering other institutional descriptors and differentiators, such as length of time being an HSI or number of underrepresented faculty as factors in the data gathering and analysis. Further, this pilot only disaggregated our data by status of belonging to the *comunidad Latina*, which served the purposes of our pilot. However, a higher Latin* participation rate can allow for nuanced analysis that further disaggregates the data to explore the students' needs as informed by their intersectional identities.

Finally, while this work serves to establish the relationships between TSE and advising support, it became evident to the researchers that to better understand the enactment of servingness at HSIs, a further adaptation of the survey could target the institutional context by the addition of constructs that can more fully encompass the experience of Latin* students in these institutions. To address this need, future work necessitates a depth of understanding of the needs of Latin* students in graduate engineering programs at HSIs that may be reached through qualitative methods. In addition, a better understanding of how current institutional structures, policies, and practices at HSIs may support and allow faculty advisors to serve the needs of their students can further inform the work of servingness in engineering graduate programs.

Conclusion

This pilot study's results serve as a first step in fostering greater alignment between servingness practices and graduate students' needs for support in their advising relationships. While we cannot negate the need for instrumental support during a graduate student's research training, the results of this pilot would suggest that an intentional focus on psychosocial support for Latin* students can more significantly aid the development of their self-efficacy toward finishing their terminal document. This work also points out how policies and traditions related to advising practices in engineering education should be considered *Structures for Serving* and assessed as such when considering an HSIs capacity to serve underrepresented students and how faculty success will be defined in practice.

References

Aguilar-Smith, S. (2021). Seeking to Serve or $erve? Hispanic-Serving Institutions' Race-Evasive Pursuit of Racialized Funding. *AERA Open*, *7*, 233285842110570. https://doi.org/10.1177/23328584211057097

Amelink, C. T., & Edwards, C. D. (2020). Exploring the Socialization Experiences of Underrepresented Engineering Graduate Students. *Journal of Women and Minorities in Science and Engineering*, *26*(4), 357–379. https://doi.org/10.1615/JWomenMinorScienEng.2020032606

Artiles, M. S., Huggins, N., Matusovich, H. M., & Santiago, A. I. (2023). Exploring the Research Enterprise in a Hispanic-Serving Institution: A Systems Thinking-Informed Case Study of Graduate Advising in an Engineering College. *International Journal of Engineering Education*, *39*(4), 976–985.

ASEE. (2023). *Profiles of Engineering and Engineering Technology, 2022* (p. 94). American Society for Engineering Education.

Austin, A. E. (2009). Cognitive apprenticeship theory and its implications for doctoral education: A case example from a doctoral program in higher and adult education. *International Journal for Academic Development*, *14*(3), 173–183. https://doi.org/10.1080/13601440903106494

Bryson, T., & Housh, K. (2023). The Influence of Advisors' Advising Style on the Career Interests of Black and Latinx Students in STEM Graduate Programs. *Journal of STEM Education*, *24*(1).

Burt, B. A., & McKen, A. (2019). Black Men in Engineering Graduate Education: Experiencing Racial Microaggressions within the Advisor–Advisee Relationship. *The Journal of Negro Education*, *88*.

Burt, B. A., McKen, A., Burkhart, J., Hormell, J., & Knight, A. (2016). Racial Microaggressions within the Advisor-advisee Relationship: Implications for Engineering Research, Policy, and Practice. *2016 ASEE Annual Conference & Exposition Proceedings*, 26029. https://doi.org/10.18260/p.26029

Coley, B., & Thomas, K. (2023). "The lab isn't life": Black engineering graduate students reprioritize values at the intersection of two pandemics. *Journal of Engineering Education*, *112*(2), 542–564. https://doi.org/10.1002/jee.20518

Curtin, N., Stewart, A. J., & Ostrove, J. M. (2013). Fostering Academic Self-Concept: Advisor Support and Sense of Belonging Among International and Domestic Graduate Students. *American Educational Research Journal*, *50*(1), 108–137. https://doi.org/10.3102/0002831212446662

Dericks, G., Thompson, E., Roberts, M., & Phua, F. (2019). Determinants of PhD student satisfaction: The roles of supervisor, department, and peer qualities. *Assessment & Evaluation in Higher Education*, *44*(7), 1053–1068. https://doi.org/10.1080/02602938.2019.1570484

DeTurk, S., & Briscoe, F. (2020). From Equity and Enlightenment to Entrepreneurialism: An HSI's Pursuit of "Tier-One" Status in the Neoliberal Era. *The Review of Higher Education*, *43*(4), 967–988. https://doi.org/10.1353/rhe.2020.0027

DeTurk, S., & Briscoe, F. M. (2021). Equity versus Excellence: Is the Pursuit of "Tier-1" Status Compatible With Social Justice? *Journal of Hispanic Higher Education*, *20*(1), 112–128. https://doi.org/10.1177/1538192719836197

Fitzpatrick, M. E., Burrows, S. G., & Yonker, J. A. (2022). An Exploratory Study of Engineering Graduate Student Persistence: Self-Efficacy and Contextual Influences. *Journal of Career Development*, 089484532211237. https://doi.org/10.1177/08948453221123789

Fleming, G. C., Patrick, A. D., Grote, D., Denton, M., Knight, D., Lee, W., Borrego, M., & Murzi, H. (2023). The fallacy of "there are no candidates": Institutional pathways of Black/African American and Hispanic/Latino doctorate earners. *Journal of Engineering Education*, *112*(1), 170–194. https://doi.org/10.1002/jee.20491

Franco, M. A., & Hernández, S. (2018). Assessing the Capacity of Hispanic Serving Institutions to Serve Latinx Students: Moving Beyond Compositional Diversity. *New Directions for Institutional Research*, *2018*(177), 57–71. https://doi.org/10.1002/ir.20256

Garcia, G. A. (2018). What Does it Mean to be Latinx-serving? Testing the Utility of the Typology of HSI Organizational Identities. *Association of Mexican American Educators Journal*, *11*(3), 109. https://doi.org/10.24974/amae.11.3.363

Garcia, G. A. (2020). *Hispanic Serving Institutions (HSIs) in Practice: Defining Servingness at HSIs*. Information Age Publishing, Incorporated. http://ebookcentral.proquest.com/lib/asulib-ebooks/detail.action?docID=6166818

Garcia, G. A., & Cuellar, M. G. (2023). Advancing "Intersectional Servingness" in Research, Practice, and Policy With Hispanic-Serving Institutions. *AERA Open*, *9*, 233285842211484. https://doi.org/10.1177/23328584221148421

Garcia, G. A., & Guzman-Alvarez, A. (2021). Descriptive Analysis of Graduate Enrollment Trends at Hispanic-Serving Institutions: 2005-2015. *Journal of Hispanic Higher Education*, *20*(2), 196–212. https://doi.org/10.1177/1538192719835681

Garcia, G. A., & Koren, E. R. (2020). Connecting Research, Practice, and Policy to Define "Servingness" at Hispanic Serving Institutions. In *Hispanic serving institutions (HSIs) in practice: Defining "servingness"* (pp. 1–20). Information Age Publishing, Incorporated.

Garcia, G. A., Núñez, A.-M., & Sansone, V. A. (2019). Toward a Multidimensional Conceptual Framework for Understanding "Servingness" in Hispanic-Serving Institutions: A Synthesis of the Research. *Review of Educational Research*, *89*(5), 745–784. https://doi.org/10.3102/0034654319864591

Hasbún, I., & Strong, A. (2020). Work in Progress: Identifying Structural and Cultural Characteristics of Hispanic-serving Institutions in Engineering Education – A Morphogenetic Approach. *2020 ASEE Virtual Annual Conference Content Access Proceedings*, 35646. https://doi.org/10.18260/1-2--35646

Holloway-Friesen, H. (2021). The Role of Mentoring on Hispanic Graduate Students' Sense of Belonging and Academic Self-Efficacy. *Journal of Hispanic Higher Education*, *20*(1), 46–58. https://doi.org/10.1177/1538192718823716

Lee, W. C., Hall, J. L., Godwin, A., Knight, D. B., & Verdín, D. (2022). Operationalizing and monitoring student support in undergraduate engineering education. *Journal of Engineering Education*, *111*(1), 82–110. https://doi.org/10.1002/jee.20431

Lent, R. W. (2013). Social Cognitive Career Theory. In S. D. Brown & R. W. Lent (Eds.), *Career development and counseling: Putting theory and research to work* (2nd ed., p. 32). John Wiley & Sons, Inc.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of Self-Efficacy Expectations to Academic Achievement and Persistence. *Journal of Counseling Psycology*, *31*(3), 356–362. https://doi.org/10.1037/0022-0167.38.1.30

Lent, R. W., Sheu, H.-B., Miller, M. J., Cusick, M. E., Penn, L. T., & Truong, N. N. (2018). Predictors of science, technology, engineering, and mathematics choice options: A meta-analytic path analysis of the social–cognitive choice model by gender and race/ethnicity. *Journal of Counseling Psychology*, *65*(1), 17–35. https://doi.org/10.1037/cou0000243

Litalien, D., & Guay, F. (2015). Dropout intentions in PhD studies: A comprehensive model based on interpersonal relationships and motivational resources. *Contemporary Educational Psychology*, *41*, 218–231. https://doi.org/10.1016/j.cedpsych.2015.03.004

Maher, M. A., Wofford, A. M., Roksa, J., & Feldon, D. F. (2020). Exploring Early Exits: Doctoral Attrition in the Biomedical Sciences. *Journal of College Student Retention: Research, Theory & Practice*, *22*(2), 205–226. https://doi.org/10.1177/1521025117736871

Marshall, S. M., Klocko, B., & Davidson, J. (2017). Dissertation Completion: Higher Education's Invisible Problem. *Journal of Educational Research and Practice*, *7*(1). https://doi.org/10.5590/JERAP.2017.07.1.06

McCoach, D. B., Gable, R. K., & Madura, J. P. (2013). *Instrument Development in the Affective Domain*. Springer New York. https://doi.org/10.1007/978-1-4614-7135-6

McCoy, D. L., Winkle-Wagner, R., & Luedke, C. L. (2015). Colorblind mentoring? Exploring white faculty mentoring of students of color. *Journal of Diversity in Higher Education*, *8*(4), 225–242. https://doi.org/10.1037/a0038676

Mercado Rivera, A., Artiles, M. S., & Brunhaver, S. R. (2023). *Perceived Advisor Support and Thesis Self-Efficacy: An Instrument Development*. 16. https://peer.asee.org/43880

Mireles-Rios, R., & Garcia, N. M. (2019). What would your ideal graduate mentoring program look like?: Latina/o student success in higher education. *Journal of Latinos and Education*, *18*(4), 376–386. https://doi.org/10.1080/15348431.2018.1447937

National Academies of Sciences, Engineering, and Medicine. (2018). *Graduate STEM Education for the 21st Century* (A. Leshner & L. Scherer, Eds.; p. 25038). National Academies Press. https://doi.org/10.17226/25038

National Academies of Sciences, Engineering, and Medicine. (2019a). *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* (p. 25257). National Academies Press. https://doi.org/10.17226/25257

National Academies of Sciences, Engineering, and Medicine. (2019b). *The Science of Effective Mentorship in STEMM* (A. Byars-Winston & M. L. Dahlberg, Eds.; p. 25568). National Academies Press. https://doi.org/10.17226/25568

Núñez, A.-M., Crisp, G., & Elizondo, D. (2016). Mapping Hispanic-Serving Institutions: A Typology of Institutional Diversity. *The Journal of Higher Education*, *87*(1), 55–83. https://doi.org/10.1353/jhe.2016.0001

Núñez, A.-M., Hurtado, S., & Galdeano, E. C. (Eds.). (2015). *Hispanic-serving institutions: Advancing research and transformative practice* (First published 2015 by Routledge). Routledge.

Overall, N. C., Deane, K. L., & Peterson, E. R. (2011). Promoting doctoral students' research self-efficacy: Combining academic guidance with autonomy support. *Higher Education Research & Development*, *30*(6), 791–805. https://doi.org/10.1080/07294360.2010.535508

Primé, D. R., Bernstein, B. L., Wilkins, K. G., & Bekki, J. M. (2015). Measuring the Advising Alliance for Female Graduate Students in Science and Engineering: An Emerging

Structure. *Journal of Career Assessment*, *23*(1), 64–78. https://doi.org/10.1177/1069072714523086

Ramos, S. R., Portillo, C. J., Rodriguez, C., & Gutierrez, J. I. (2023). Latinx: Sí, Se Puede? A Reflection on the Terms Past, Present, and Future. *Journal of Urban Health*, *100*(1), 4–6. https://doi.org/10.1007/s11524-022-00690-y

Salinas, C. (2020). The Complexity of the "x" in *Latinx*: How Latinx/a/o Students Relate to, Identify With, and Understand the Term *Latinx*. *Journal of Hispanic Higher Education*, *19*(2), 149–168. https://doi.org/10.1177/1538192719900382

Sallai, G. M., Bahnson, M., Shanachilubwa, K., & Berdanier, C. G. P. (2023). Persistence at what cost? How graduate engineering students consider the costs of persistence within attrition considerations. *Journal of Engineering Education*, *112*(3), 613–633. https://doi.org/10.1002/jee.20528

Santa-Ramirez, S. (2022). Sink or swim: The mentoring experiences of Latinx PhD students with faculty of color. *Journal of Diversity in Higher Education*, *15*(1), 124–134. https://doi.org/10.1037/dhe0000335

Santiago, D., Labandera, E., Arroyo, C., & Nour, S. R. (2024). *Finding Your Workforce: Latino Talent in Science, Technology, Engineering, and Mathematics (STEM).* Exelencia in Educacion.

Sheu, H.-B., Lent, R. W., Miller, M. J., Penn, L. T., Cusick, M. E., & Truong, N. N. (2018). Sources of self-efficacy and outcome expectations in science, technology, engineering, and mathematics domains: A meta-analysis. *Journal of Vocational Behavior*, *109*, 118–136. https://doi.org/10.1016/j.jvb.2018.10.003

Vargas, N., & Villa-Palomino, J. (2019). Racing to Serve or Race-ing for Money? Hispanic-serving Institutions and the Colorblind Allocation of Racialized Federal Funding. *Sociology of Race and Ethnicity*, *5*(3), 401–415. https://doi.org/10.1177/2332649218769409

Varney, J. J. (2010). The role of dissertation self-efficacy in increasing dissertation completion: Sources, effects and viability of a new self-efficacy construct. *College Student Journal*, *44*(4), 932–947.

Villanueva Alarcón, I., Mejia, J. A., Mejia, J., & Revelo, R. (2022). Latiné, Latinx, Latina, Latino, or Hispanic: Problematizing terms often used in engineering education. *Journal of Engineering Education*, *111*(4), 735–739. https://doi.org/10.1002/jee.20486

Weidman, J. C., & DeAngelo, L. (Eds.). (2020). *Socialization in Higher Education and the Early Career: Theory, Research and Application* (Vol. 7). Springer International Publishing. https://doi.org/10.1007/978-3-030-33350-8

Wilkins-Yel, K. G., Bekki, J., Arnold, A., Bernstein, B., Okwu, C., Natarajan, M., & Randall, A. K. (2022). Understanding the impact of personal challenges and advisor support on stem persistence among graduate women of color. *Journal of Diversity in Higher Education*, *15*(1), 97–110. https://doi.org/10.1037/dhe0000236

Zerbe, E., Sallai, G., & Berdanier, C. G. P. (2023). Surviving, thriving, departing, and the hidden competencies of engineering graduate school. *Journal of Engineering Education*, *112*(1), 147–169. https://doi.org/10.1002/jee.20498

Zhao, C., Golde, C. M., & McCormick, A. C. (2007). More than a signature: How advisor choice and advisor behaviour affect doctoral student satisfaction. *Journal of Further and Higher Education*, *31*(3), 263–281. https://doi.org/10.1080/03098770701424983

Appendix
Confirmatory Analysis Results: Finalized ASSET Instrument

Latent Variables	Survey item	Standardized factor loading	Construct Reliability	Average variance extracted
Individualized Support	Gives me regular feedback on my research	0.880	0.93	0.67
	Is available when I need help with my research	0.895		
	Gives me constructive feedback on my progress toward degree completion	0.912		
	Is available when I need to talk about my progress in my program	0.897		
	Teaches me the details of good research practice	0.887		
	Provides information about ongoing relevant research	0.843		
Research Support	Takes an interest in my well-being and life-work balance	0.924	0.91	0.57
	Provides emotional support when I need it	0.929		
	Has my best interests at heart	0.815		
	Would support me in any career path I might choose	0.745		
	Helps me develop professional relationships with others in the field	0.857		
	Assists me in writing presentations or publications	0.832		
	Advocates for me with others when necessary	0.839		
Thesis Self-efficacy	Select a suitable research topic for study	0.679	0.95	0.60
	Formulate a research question(s) or problem statement(s) for study	0.699		
	Describe the purpose and importance of a study	0.705		
	Collect data or field notes for a study	0.768		
	Review and synthesize the scholarly literature in your area of study to write a Literature Review	0.735		
	Select the appropriate quantitative or qualitative analysis methodology to address a research question(s)	0.788		
	Clearly explain the methods you used to address a research question	0.782		
	Run or apply the appropriate quantitative or qualitative analysis to address a research question	0.847		
	Interpret the results obtained from a quantitative or qualitative analysis (whichever you apply in relation to a research question)	0.838		
	Discuss your interpretation of a quantitative or qualitative analysis (whichever you apply in relation to a research question)	0.824		
	Clearly present the results obtained in a study	0.797		