Noncognitive and Affective Attributes of Caregivers Enrolled in Engineering and Computing Programs

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***Abstract* — Historically, student caregivers have been described as parents over the age of 25. However, the role of a caregiver may extend beyond a parental responsibility to include caring for other family members and may include students who are of "traditional college age." Failing to acknowledge and provide appropriate support for student caregivers can be particularly problematic for students in engineering and computing. Engineering and Computing programs often require extensive work that must be completed outside of class. Meeting these demands is particularly challenging for students with caregiving responsibilities. However, there are significant gaps in our understanding of college experiences and college outcomes of student caregivers enrolled in engineering and computing programs. To understand the experiences of undergraduate student caregivers in engineering and computing fields, this study explored the differences in non-cognitive and affective factors between students who have caregiving responsibilities and those who do not have responsibilities during college. We particularly focused on student caregivers in the College of Engineering at an R1 Hispanic-Serving Institution (HSI). The context of HSIs is important given that these institutions enroll a large number of post-traditional college students, students who have significant life responsibilities that are often at odds with the demands of college. Additionally, this study incorporates a Hispanic-servingness approach, a framework centered on institutions acknowledging the realities and needs of the students they serve. Using data from a single institution, we asked the following research question: To what extent are caregiving responsibilities related to undergraduate engineering and computing students' non-cognitive and affective factors? Our findings indicate that the experiences of students with caregiving responsibilities differ on five non-cognitive and affective factors: open-mindedness, engineering/computer science identity, help-seeking, motivation, and time management. Taken together, these findings draw attention to the importance of universities taking a holistic approach to developing student support services for Engineering/Computing student caregivers.**

Keywords— Caregivers, Engineering & Computing Education, Family responsibility, Hispanic servingness, Non-Cognitive & Affective Factors, Post-traditional students

I. INTRODUCTION

Higher education institutions are becoming increasingly diverse; however, students from diverse backgrounds are often concentrated in certain institution types, such as community colleges or Minority Serving Institutions (MSIs). For example, Hispanic-Serving Institutions (HSIs) enroll the majority (62%) of all Latinx undergraduate students in the United States [1]. Additionally, HSIs enroll larger proportions of African American students than Historically Black Colleges and Universities and more Native American students than Tribal Colleges and Universities [2]. Along with enrolling students from diverse ethnic and racial backgrounds, HSIs also enroll large numbers of first-generation college students and students from low-income backgrounds [2]. In some cases, HSIs have better outcomes (i.e., graduation rates, individual income mobility) for students, even though these institutions have less resources [3]. These improved outcomes might be due to more positive campus climates for students from minoritized backgrounds; however, HSIs are often still critiqued for not living up to their serving title [4]. As a result, researchers have developed a servingness framework [4] that urges institutions to consider an organizational approach to serving students from minoritized communities by promoting structural change within the organization; this approach is focused on producing equitable outcomes for the largely diverse students the institutions serve [5]. Taking an organizational approach, emphasizes that the organization needs to change rather than placing the onus of change on students [4], [5]. Adopting this orientation is particularly important at HSIs who serve large numbers of post-traditional students but often operate in ways that cater to traditional college students [5]. The term *post-traditional student* refers to those students who have significantly different life characteristics and responsibilities compared to “traditional” college students.

Within the category of post-traditional college students, there is often an overlooked group: those who hold caregiving responsibilities but are not necessarily parents. Most of the research on student caregivers has focused on the experiences of student parents and often assumes them to be age 25 or older. However, student caregivers can also include students under 25 years old who care for parents, siblings, or extended family

members. An extended definition of caregiving is particularly relevant for students pursuing engineering or computing degrees. These disciplines tend to require extensive work outside of the classroom, lab equipment, and team projects, all of which might conflict with students' caregiving responsibilities.

In light of the reality that HSIs enroll large numbers of post-traditional college students [2], [6], this paper will report the findings of a study of undergraduate student caregivers enrolled in engineering and computing degrees at a large HSI in the south region of the United States. In particular, this study reports findings beyond commonly discussed academic factors, focusing instead on non-cognitive measures (e.g., mindsets, attitudes, belongingness).

II. Background

A. Diversity in Computing and Engineering

There remains an increasing demand for STEM talent in today's world as the number of jobs requiring STEM skills continues to climb [7]. The National Science Foundation recognizes that while there have been significant advances in STEM over the last several decades, the composition of faculty, staff, and students engaged in STEM still does not reflect the demographics in our society [8]. Fields like computer science and engineering have some of the lowest numbers of women, Hispanics, and Blacks represented [9]. Native Americans are rarely included in these figures because their representation in STEM fields is often at zero percent [10]. While there has been an increase in students from minoritized communities graduating with degrees in engineering and computer science, those numbers are far from reaching parity with the overall U.S. population. For example, data from the National Center for Science and Engineering Statistics (2021) [11] found that while the Black population makes up over 13 percent of the total U.S. population, Blacks only make up 3.9 percent of bachelor's degree recipients in engineering and 8.2 percent of bachelor's degree earners in Computer Science. The Latinx population makes up close to 19 percent of the total U.S. population, however, only 10.9 percent of bachelor's degree earners in engineering are Latinx, and only 10.4 percent of computer science bachelor's degree earners are Latinx. While Native Americans make up 1.3 percent of the U.S. population, numbers for bachelor's degree earners in engineering and computer science total less than half of one percent. Low numbers of diverse groups within fields like engineering and computer science are due to many factors. However, these low numbers of students from minoritized communities represented in fields like engineering and computer science often exacerbate the hostile environments students encounter within these disciplines [12].

Within engineering fields, diverse communities often encounter biases along gender, race, and other identity-related categories as they navigate professional and academic settings [13]. In computer science, women, and students from minoritized racial and ethnic communities often perceive the climate in computer science programs to be both racist and sexist [14], and they are often negatively stereotyped as not having the abilities to succeed in computer science [15], [16]. While efforts have been made to address the lack of diversity in STEM, this work has often focused on programming and practices that aim to remediate or compensate for inferior educational experiences for minoritized communities, and many of these approaches have seen little success [17], [18]. Therefore, if we aspire to improve success for students from minoritized communities in STEM majors, research must move beyond promising classroom practices and consider the role institutions play in contributing to the lack of diversity in STEM [18]. Presently, many institutions still operate in ways that promote the success of traditional college students and often inhibit the success of post-traditional college students [6].

B. Post-traditional college students

With the growing need for higher education credentials, more people are entering colleges and universities with diverse backgrounds and experiences. Post-traditional college students are a growing population at higher education institutions in the United States. However, most higher education institutions are not designed to meet the needs of students who fall outside of the traditional college student scope. As a result, post-traditional college students often face issues navigating institutions that do not take their life experiences into consideration [19]. Post-traditional college students who hold responsibilities beyond academics often experience inter-role conflict, conflict arising when one role hinders their ability to fulfill their other roles [20]. These students are often balancing additional responsibilities such as caring for family members or working full-time jobs while attending college. Often these conflicting responsibilities make it difficult for post-traditional college students to earn credentials, and as a result they are more likely to leave college without a credential [6].

C. Caregivers

Research on student caregivers is growing; however, much of this work has focused on the experiences of students at the K-12 school level [21], [22]. In 2020 the National Alliance for Caregiving (NAC) [23] conducted a study of caregivers in the United States and estimated that at least 3.4 million youth under the age of 18 provide care to an adult recipient. Caregiving refers to caring for a parent or grandparent who has a long-term physical condition or an emotional mental health problem [23], or caring for younger siblings [21]. Student caregivers often come from Black or Latinx communities compared to White or Asian groups [24], [25] and from single-parent or low-income households [26]. Caregiving students on average often spend more than 30 hours a week providing care for their families [23]. Managing these multiple responsibilities can be time-consuming for students and can affect their academic outcomes. If these caregiving youth subsequently enroll in a post-secondary degree program, there is no reason to assume that their caregiving responsibilities will suddenly cease.

According to research on caregiving, K-12 students, Black, Latinx, and low-income students [24], [25] are more likely to be caregivers. Therefore, it is important to consider why caregiving might be more prevalent in these communities. Caregiving can be tied to cultural values. For example, in communities of color, such as Black and Latinx communities, students tend to have more collectivist perspectives [27]. These collectivist

perspectives promote working as a group versus as an individual, and hold families and communities as central in the lives of individuals. These collectivist values are often at odds with the competitive and individualistic nature of the higher education context, especially in STEM fields where White individualistic and competitive cultures thrive [28]. Additionally, for low-income communities, there has been an upturn in caregiving. The increase over the past decade is due to rising healthcare costs that have been driving an increase in the need for informal caregiving. More family members in low-income communities participate in providing care for individuals with chronic illness and disabilities [29].

Although there is growing awareness of college students who hold caregiving roles, there is limited research to describe caregivers' experiences within STEM contexts. One exception is a recent study that examined the impact of providing emergency funding for low-income undergraduate women enrolled in computing programs. The study explored the financial struggles of these women, describing the social and economic factors that impacted their persistence and degree completion. The study's findings included stories of students with family caregiving and financial obligations who struggled to focus on academics. Participants described how familial responsibilities influenced their ability to be successful economically and in school [30]. For example, one participant explained that when her father lost his job, she had to take time off work to care for her younger siblings. Not being able to work interfered with her ability to stay enrolled in school. Other examples included a student who shared that she was unable to stay focused on school because she lost her father due to COVID-19, and then had to take on additional financial responsibilities to help her family. Emergency funding provided by the organization that sponsored the study was critical to help these students persist in computing. These stories reflect that students with caregiving responsibilities might have overlapping challenges and multiple intersectional identities which can hinder college success. External organizations that step in to assist computing students who risk non-degree completion at the last stage of their college career for non-academic reasons point to the need for larger systemic reforms at the university level that acknowledge and support these students from Day 1.

D. The Impact of Noncognitive and Affective Factors and Caregiving Responsibilities

Researchers have used several terms to define "noncognitive factors" (e.g., noncognitive attributes, noncognitive skills, noncognitive factors, character skills, social-emotional learning, soft skills, personality traits) [31], [32], describing separate constructs from cognitive skills (e.g., acquiring knowledge, manipulating information, reasoning). Likewise, in education research, "affective factors (e.g., emotions, feelings, values, beliefs)" are also studied as separate from cognitive attributes [33]. NCA factors consist of a wide range of constructs and, more importantly, each construct may overlap with one another conceptually and empirically [31], [34]. Therefore, we broadly use the term "NCA factors" to describe various psychosocial factors that may holistically contribute to student success [33]. NCA factors have been shown to be significant predictors of college GPA and retention [31], [35], [36], [37], students' perception of satisfaction and sense of belonging [31], [36], and wages and career promotions [38].

NCA factors are closely related to life circumstances and social background characteristics [39], [40]. In secondary education, caregiving is a life circumstance that has been significantly associated with more emotional challenges, reduced academic performance [24], and lower school engagement and belonging levels [25]. In postsecondary education, family obligations, including caregiving responsibilities, contribute to college choice (e.g., attending a 2-year college), enrollment status (e.g., part-time), and high attrition rates [41]. For students who had caregiving responsibilities in their secondary education period, their caregiving responsibilities often do not go away even after they transition to higher education. As higher education institutions are often designed around "traditional" college students, students who hold caregiving responsibilities often find it difficult to balance these responsibilities in addition to their academic expectations [42]. To improve these students' learning and college outcomes, it is important to better understand to what extent student background characteristics contribute to NCA factors because NCA factors have considerable malleability depending upon context and environment [33]. Therefore, research that deepens our understanding of students' lived contexts and their NCA factors can provide universities and colleges with insights into which interventions and programmatic efforts are more effective in changing students' NCA factors, which in turn can better support their success in college.

In summary, NCA factors are significant predictors of engineering and computing student success. In addition, caregiving responsibility, as an important part of students' social demographic backgrounds and identities, relates significantly to NCA factors. However, there is a dearth of research investigating the relationships among NCA factors, caregiving responsibilities, engineering, and computing student success. Prior research has primarily paid attention to the impact of NCA factors on various outcomes, while understanding student characteristics shaping NCA factors remains unstudied.

In order to better support caregiving students' success, it is essential to have a more holistic and comprehensive understanding of the relationship between caregiving responsibilities and NCA factors and college outcomes [43]. The study reported in this paper aims to provide deeper understanding of these relationships.

E. Theoretical Framework

Hispanic-Serving Institutions are a critical site for examining the experiences of student caregivers, given that these institutions enroll large numbers of post-traditional college students [2]. Conflicting findings about the environment for Latinx students at HSIs [3], [44] might be due to the nature of HSIs as enrollment-defined institutions, that is institutions that became minority serving institutions following demographic shifts [3]. While HSIs serve large numbers of diverse students, these institutions were historically once Predominately White

Institutions (PWIs). Therefore, researchers argue that the policies and practices at HSIs often reflect those of their historical contexts [45]. As a result, HSIs have been critiqued for not living up to their "serving" title; in response, a framework of servingness has been developed to engage institutions in thinking of ways to promote student success beyond traditional measures [4].

A servingness framework [4] takes an organizational approach that puts the onus on colleges and universities to structurally and systematically change the organization. These efforts are aimed towards producing equitable outcomes for students from minoritized backgrounds who are typically underserved by higher education institutions [5]. Additionally, a servingness framework examines academic outcomes (i.e., graduation rates), non-academic outcomes (i.e., sense of belonging) and the structural components (i.e., equity-minded efforts) in higher education institutions that contribute to student success. In a servingness framework, nonacademic outcomes are one of the significant indicators to examine HSI's servingness. Measuring NCA factors can be critical to understand what factors contribute to nonacademic outcomes. Therefore, our study contributes to understanding Hispanic students' noncognitive and affective factors in order to contribute to the development of strategies for serving HSI students.

III. The Current Study: Methods

Given the need to better support and empower a growing population of post-traditional computing and engineering students, there is much to be gained from a study of student caregivers. Our study examines the relationship between HSI engineering and computing students who have caregiving responsibilities and their NCA factors. The following research question guided our study:

> *To what extent are caregiving responsibilities related to undergraduate engineering and computing students' non-cognitive and affective factors?*

The study used the SUCCESS (Studying Underlying Characteristics of Computing and Engineering Student Success) survey that a multi-institutional research team developed to examine the effect of NCA factors on academic performance in engineering and computing fields [46], [47]. Based on the results of their confirmatory factor analysis, the SUCCESS research team presented measures of 28 NCA factors that may contribute to engineering and computing student success, including personality, grit, identity, mindset, motivation, and belongingness [46], [47] with strong validity and reliability evidence. To understand caregiver's NCA factors more comprehensively, the analysis for this paper examined the relationship between being a caregiver and the 28 NCA factors.

A. Participants

Data for this study were collected from one doctoral-granting Hispanic-Serving Institution from 2018 through 2021. A total of 930 undergraduate students enrolled in introductory courses in the institution's School of Engineering completed the survey. (i.e., the 2018 sample consisted of 304 students, n = 259 in 2019, n=129 in 2020, and n=238 in 2021). Some of the students participated in the survey for more than one year (n=33), and five respondents did not provide their information, so we could not find out if the respondent participated in the survey for more than one year. Therefore, we deleted these 38 responses. Responses from students who were not undergraduate students (n=32), or who pursued non-STEM-related degrees (n=4) were also deleted. As a result, the sample size decreased to 856.

TABLE 1: Demographic information from the analytical sample

Category	Frequency	
	Count	***Percentage***
Race/Ethnicity		
Latinx	367	81.74
Multiracial	50	11.14
White	16	3.56
Other racial minorities and Write-In	16	3.56
Gender		
Male	305	67.93
Female	131	29.18
Non-Binary	13	2.90
First-Generation College Status		
Continuing-Generation	355	79.06
First-Generation	94	20.94
Sexual minority background		
Sexual minority students	36	8.02
Non-sexual minority students	413	91.98

Note. Research participants were able to select multiple responses to a race/ethnic question; the percentages may not total 100%.

After using listwise deletion to account for missing data, the final analytical sample was 449 (i.e., the 2018 final sample consisted of 162 students, n=137 in 2019, n=46 in 2020, and n=104 in 2021). Although the analytical sample decreased in size, the listwise deletion method is commonly used since it results in unbiased parameter estimates in regression analysis, even if data are not missing at random [48].

The final analytical sample consisted of 449 students, and approximately 55% of the final analytical sample spent at least one hour per week providing care for dependents living with them (e.g., parents, children, spouse, etc.). Approximately 82 percent of the final sample self-identified as Latinx; 29 percent were self-reported female; 21 percent were first-generation college students; 8 percent were sexual minority students (see Table 1 for more information). The average respondent age was 20 years. Approximately 14 percent were transfer students; pursued degrees in computing and engineering fields; 58 percent spent at least one hour per week working for pay either on-campus or off-campus.

B. Measures

Our dependent variables are a total of twenty-eight NCA factors under the following 14 composite constructs: (1) Big Five personality, (2) Grit, (3) Engineering identity, (4) Mindset, (5) Mindfulness, (6) Meaning and purpose in life, (7)

Belongingness, (8) Gratitude, (9) Future time perspective, (10) Test anxiety, (11) Time and study environment, (12) Perceptions of faculty caring, (13) self-control, and (14) Stress. These data were treated as continuous variables [32]. This study used the same survey items that the multi-institution research team presented [46], [47], [49] in order to create a scaled measure of the twenty-eight NCA factors. The primary independent variable is family care responsibility. To create a binary variable, one survey item was used: "How many hours per week do you spend on providing care for dependents living with you (parents, children, spouse, etc.)?" A block of hours was measured on a scale (ranging from 0, 1-5, 6-10, 11-15, 16-20, 21-25, 25-30, and more than 30 hours). The respondents who provided care for their family members for at least one hour per week were identified as caregivers.

The student-level demographic control variables were race/ethnicity, age, gender, first-generation college status, sexual minority status, and pre-college academic achievement using SAT scores. Some of the race/ethnicity categories were too small for analyses (Asian, Black/African American, Native American/Alaska Native, Native Hawaiian/Pacific Islander), so other students from racially and ethnically minoritized backgrounds were grouped together due to small sample sizes. We acknowledge that aggregating race/ethnicity brings limitations; we provide a discussion of this decision later in this paper. College-related control variables included: transfer status, work for pay either on or off campus, class level, disciplines (computer science, engineering, other STEM), hours spent preparing for class (e.g., studying, reading, writing, and other academic activities), participation in academic co-curricular activities (e.g., engineering/computing competitions), participation in non-academic co-curricular activities (organizations, campus publications, student government, etc.) (interval variables treated as continuous variables).

C. Analysis

We performed ANOVA (analysis of variance) analyses with the twenty-eight NCA factors to test significant differences between years at the institution. We found statistically significant differences in the mean of some NCA factors by year. Therefore, we fixed year effects in the analytical models. Next, we conducted ordinary least-squares (OLS) regression analyses with robust standard errors in STATA. Each model predicted the twenty-eight continuous NCA factors, and analyses were conducted separately for each NCA factor. The control variables noted above were entered in every model.

IV. RESULTS

Out of the 28 factors examined, having caregiving responsibilities predicted five out of the 28 NCA factors (see Table 2). First, after controlling for other factors (age, gender, race/ethnicity, first-generation college status, sexual minority status, SAT scores, transfer status, class level, the field of study, working either on-campus or off-campus, hours spent to prepare for class, hours spent to participate in academic co-curricular activities, and hours spent to participate in non-academic co-curricular activities, and year), having caregiving responsibilities was positively associated with the openness factor within the Big Five personality construct (b = .233, p = .032, R^2 = .09). This finding means that students with caregiving responsibilities were more likely than non-caregivers to be open-minded and creative.

TABLE 2: RESULTS FOR REGRESSION ANALYSES PREDICTING NCA FACTORS

Outcomes	Analyses with Control Variables Included	
	b	SE
Big Five Personality - Openness BIG5	0.233*	.108
Engineering Identity - Recognition	0.298*	.131
Motivation (Future time perspective) - Value	-0.341*	.147
Time and Study Environment	-0.274*	.114
Stress – Family and Peer Support	0.444**	.168

Note. Ordinary least-squares (OLS) regression analyses with robust standard errors were used to predict the 28 NCA factors. Control variables were race, age, gender, first-generation college status, sexual minority status, SAT scores, transfer status, employment status, class level, the field of study, hours spent preparing class, and participating in academic co-curricular and non-academic co-curricular activities.
*p < .05. **p < .01. ***p < .001.

Second, having caregiving responsibilities was positively associated with the recognition factor within the engineering identity construct (b = .298, p = .023, R^2 = .15). This finding means that caregivers viewed themselves as engineers through external recognition from parents, instructors, and peers.

Third, caregivers reported seeking family and peer support in stressful situations more than their non-caregiver peers. Examples of this support included talking to their parents, siblings, friends, and classmates (b = .444, p = .008, R^2 = .15).

However, when taking the covariates into account, being a college-enrolled caregiver was significantly and negatively associated both with students' value motivation (b = -.341, p = .020, R^2 = 0.09) and students' perception of time and study environment (b = -.274, p = .017, R^2 = 0.14). These last two results reveal that college-enrolled caregivers prioritized long-range goals less than their non-caregiver peers. The time and study environment factor assessed how students perceived time management for academic work, revealing that caregiving responsibilities were negatively associated with students' time perception.

V. DISCUSSSION & IMPLICATIONS

The demographics of students entering higher education institutions in the United States are becoming increasingly diverse. For example, HSIs serve a large portion of students who are considered post-traditional college students. These include students who are the first in their families to attend college, students who work full-time, students who enter college later in life, and in the case of this study, student caregivers. As the demographics of students change at higher education institutions, institutions must work to understand how to best promote the success of the students they serve [5]. Therefore, this research centers on examining the non-cognitive and affective aspects of student caregivers' experiences to understand how to create better academic outcomes. In order to understand the experiences of student caregivers in engineering and computer science, we asked the following research question: *To what extent are caregiving responsibilities related to*

undergraduate engineering and computing students' non-cognitive and affective factors? Findings from this study revealed five areas in which being a caregiver predicts aspects of students' noncognitive factors. These five results have important implications for universities that wish to better serve their post-traditional students.

The first finding suggests that student caregivers majoring in engineering and computing tend to be more open-minded and creative than their non-caregiving peers. Within the higher education context, openness is a quality that has been found as a significant predictor of college GPA [50], [51] and final course grades [52]. Additionally, creativity is an important skill for computer science and engineering students given that creativity can generate effective and innovative solutions to problems [53]. While caregiving responsibilities might be viewed as interfering with students' academic responsibilities, this role provides students with critical skills needed in engineering and computer science.

The second finding reveals that engineering and computing student caregivers view themselves as engineers through external recognition, which can come from parents, instructors, and peers. Research on identity development underscores the significance of recognition as an integral aspect of shaping one's science identity [54]. Notably, a study on science identity development has revealed that women of color are more likely to perceive themselves as scientists if they themselves, or science faculty, view them as science people [54]. Our discovery expands upon existing research by emphasizing the significant influence that caregivers' peers and families can exert in facilitating the development of students' science identities. As a result, educational institutions should acknowledge the valuable contributions that families and peers make in molding students' scientific self-concepts and should actively explore strategies to foster family and peer support systems.

The third finding underscores that caregivers in engineering and computing tend to seek family and peer support during stressful situations more frequently than their non-caregiver counterparts. This further reinforces the second finding that emphasizes the significant roles families play in shaping students experiences. Additionally, this result aligns with recent research [55] that highlights the importance of leveraging social and familiar capital in order to foster the development of students' computer science identities. Collectively, the second and third findings demonstrate the need for university policy makers and decision-makers in student support services to reimagine how to support student caregivers and consider integrating students' families and peers into the framework of institutional support networks.

The fourth finding indicates that being a college-enrolled caregiver was significantly and negatively associated with students' value motivation. The added demands and time commitments of being a caregiver on top of a demanding engineering or computing curriculum might interfere with developing long-term goals. This finding aligns with earlier research that indicates how familial responsibilities can have an influence on student caregivers' ability to be successful economically and in school [30]. Additionally, it is worth noting that instructors can provide guidance on developing skills to cope with stress stemming from diverse life circumstances, equipping students with tools to navigate these challenges and progress through their college journey [56].

Finally, the last finding suggests that the more tasks and activities a student has to juggle, the more difficult time management can become. Among self-regulation strategies, time management is strongly related to college student academic achievement [57], [58]. In the field of computing, possessing effective time management skills is an integral aspect of project management competence. These skills significantly impact students' perseverance in the computing major, given that computing, in contrast to other disciplines, demands a substantial amount of time and effort [59]. Considering the multifaceted roles and responsibilities that caregivers in engineering and computing undertake, in addition to their status as college students, they may encounter dual challenges in effectively managing their time and securing their study environments. Consequently, it becomes crucial to implement targeted interventions early on to enhance the time management skills of student caregivers.

VI. LIMITATIONS AND FUTURE WORK

While the caregiving and NCA factors study reported in this paper contributes to the literature, there are limitations that need to be addressed. First, this study used survey datasets from a single institution; thus, this study has limitations in generalizability. Second, using a dichotomous variable to create a group of students who have caregiving responsibility has some limitations: the student's experiences and perceptions may vary depending on for whom they provide care and whether they live at home together. For instance, the experiences and perceptions of a student who provides care for their elderly parent(s) may differ from those who provide care for their children. Also, the impact of having caregiving responsibilities during college could be closely related to family structure. However, family structure-related factors were not included because the SUCCESS survey used in this analysis was not developed for that purpose. Therefore, future work should develop and refine the measures to examine the caregiving responsibilities of college-enrolled students. Lastly, we combined other racial/ethnic minority groups and self-reported race/ethnicity groups. We acknowledge that there is a diverse student body even within HSIs, and different groups of racial/ethnic minority groups may assess their experiences and outcomes differently. Although race/ethnicity characteristic is not a key variable in our analysis, the findings in regard to race/ethnicity should be considered with caution.

Future research must maintain a student asset-based orientation in alignment with the goals of a Servingness framework. In other words, in order for institutions to develop structural changes that center caregiving students' lived experiences, future research must embody a stance of using findings towards providing systematic support rather than efforts to change students. To obtain a deeper understanding of the lived experiences of student caregivers such as those who took part in this study, we are conducting a qualitative study of current undergraduate computing and engineering student caregivers at the same university where the current study took place. The interviews include an exploration of family structure

and details about the nature and frequency of each student's caregiving responsibilities and activities. The study will also address the limitations of the current study. The follow-up study will build upon the findings from the current study, working towards a holistic understanding of the day-to-day experiences of engineering and computing student caregivers.

VII. CONCLUSION

This work contributes to the relative dearth of research on post-traditional computing and engineering student caregivers who have often been omitted from investigation. We highlight the source of this research deficit as originating in common misunderstandings of caregivers and caregiving and limited, traditional definitions of caregivers' lives outside of the classroom. Using a Hispanic-Servingness framework to understand the experiences of students, we provide new insights into the relationships between computing and engineering caregivers and their noncognitive and affective factors, thus contributing to a more holistic understanding of the factors that contribute to students' academic success. Researchers and policy makers can use our findings to begin asking their own questions about how they can get to know their students better, which is a key component of a Servingness framework. Our findings have revealed new topics for interested researchers. Although there is more to explore, we hope that the findings spur conversation among university decision-makers on the topic of how to actively embrace and serve post-traditional students and create inclusive institutional environments, resulting in new contributions to the body of work on caregivers. Ultimately, our work intends to shift the discussion around student caregivers from a deficit- to an asset-based narrative and provide a foundation for student-centered institutional change.

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