



# Advancing a Framework for STEM Caring Intelligence for Academic Administrative Leadership to Broaden Participation: Perspectives of HBCU Provosts

Kenny Hendrickson\*, Karyl Askew

Center for the Advancement of STEM Leadership, University of the Virgin Islands, Saint Thomas, USA

## Email address:

khendri@uvi.edu (K. Hendrickson)

\*Corresponding author

## To cite this article:

Kenny Hendrickson, Karyl Askew. Advancing a Framework for STEM Caring Intelligence for Academic Administrative Leadership to Broaden Participation: Perspectives of HBCU Provosts. *Higher Education Research*. Vol. 7, No. 3, 2022, pp. 91-99.

doi: 10.11648/j.her.20220703.15

**Received:** June 8, 2022; **Accepted:** June 22, 2022; **Published:** June 30, 2022

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**Abstract:** Concerns over student retention and development within science, technology, engineering, and mathematics (STEM) higher education present a need for research that examines educational caring in STEM leadership. This work purports that senior academic administrative leadership's positional influence and caring intelligence are necessary to cultivate and sustain caring STEM environments. Building on cross-disciplinary scholarship on academic caring, the STEM Caring Intelligence Framework for Academic Administrative Leadership is proposed as five interrelated dimensions of caring intelligence: STEM caring, academic caring, administrative caring, leadership caring, and champion-driven caring. The proposed conceptual framework and a thematic analysis were used to examine caring intelligence within the interview transcripts of seven provosts at Historically Black Colleges and Universities (HBCUs), who were identified as STEM supportive. Atlas TI software was used for management of the data, coding, and assistance with thematic analysis. Extending previous scholarship tested with HBCU deans, the findings substantiate the relevance of the framework for understanding characteristics of STEM caring intelligence of provosts serving as chief academic officers. All seven provosts' reflections on STEM leadership promoted at least one of the five dimensions of caring intelligence that were proposed in the framework. STEM caring and champion-driven caring were found to be the most common dimensions present in the provosts' reflections on their STEM leadership and efforts to broaden participation. Thus, the reflections of the participating HBCU provosts provided a narrative for the practice and study of caring in STEM leadership. Implications for future research are discussed.

**Keywords:** STEM Leadership, Broadening Participation, Higher Education Academic Administration, Caring Intelligence, Historically Black Colleges and Universities (HBCUs)

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## 1. Introduction

Approximately two-thirds of United States undergraduate students from underrepresented minority (URM) groups who enroll in STEM programs do not achieve their goal of STEM degree attainment [1]. To counter STEM attrition, scholars argued for reforms that shift the competitive, survival-of-the-fittest culture in STEM higher education to a nurturing, caring academic culture that can cultivate diversity in STEM education [2, 3]. Historically Black Colleges and Universities (HCBUs) are widely recognized for traditions of academic caring

suggested to account for their comparatively high production of URM STEM graduates in relation to better-resourced institutions [4-6]. Examining the discourse of HBCU administrators, commonly recognized as standard-bearers in this area, can advance our understanding of the role and practice of leadership in service to broadening participation of URM in STEM.

Most of the current educational research on academic caring in STEM has focused on pedagogical caring strategies promoted by faculty, such as curriculum reform

and faculty-student mentoring [2, 3]. There is a burgeoning body of literature on academic caring by HBCU administrators [4-5, 7] that draws on cross-disciplinary scholarship on academic caring and caring in academic administration [8-12]. In particular, this paper is interested in demonstrations of STEM caring by upper-level academic administrative leadership, or chief academic officers (CAOs), who are responsible for the direction, evaluation, and resource allocation for the university's academic goals and priorities including faculty mentoring and affairs [13]. We contend that CAOs, such as provosts and vice presidents of academic affairs, are best positioned to normalize and institutionalize university-wide norms and policies in support of STEM caring by leadership at all levels (extending through faculty, students, and staff). Within their administrative capacity, these CAOs can offer necessary authoritative and structural support within universities to sustain STEM caring. Thus, this work examined the discourse of HBCU provosts as they reflected on efforts to support broadening participation in STEM. The goal is to make observations about the presence, role, and realities of STEM caring in academic administrative leadership.

Furthermore, this study builds on previous scholarship [14] that proposed a conceptual framework for STEM caring intelligence based on the analysis of narratives from HBCU STEM deans. The STEM Caring Intelligence Framework for Academic Administrative Leadership (Figure 1) positions CAOs, who demonstrate STEM caring, as essentially *STEM supportive* regardless of whether they hold a formal appointment with STEM departments. STEM-supportive CAOs also demonstrate a willingness to champion STEM initiatives. Thus, studying the caring intelligence of CAOs provides an opportunity to understand expressions of STEM caring, and advance efforts to enhance professional learning on leadership to broaden participation. Utilizing the conceptual framework, this qualitative inquiry was conducted to explore the application of the framework to HBCU provosts.

### 1.1. STEM Caring and University Academic Leadership

Critics and scholars have pointed to the fact that universities have a responsibility to care for and about the academic well-being of students [7, 10]. In fact, research suggests that academic caring enhances the overall quality of university administrative leadership [5]. Within STEM education in particular, the current research points to a vital need for high-quality leadership by mid-level and upper-level administrators, including presidents, provosts, chancellors, vice provosts, deans, chairs, and program directors to advance equity, diversity, and inclusion in STEM higher education [15]. Thus, various approaches and nuanced perspectives toward examining STEM caring in relation to the quality of academic administrative leadership deserve more attention.

Academic administrative leaders play a critical role in a university's governance. They are also responsible for (a) the sustainability, quality, and productivity of educational

programs and services, (b) the welfare and nurturing of the student body, and (c) the development and efficiency of faculty and support staff [13, 16]. The highest or senior position within the academic administrative structure is the CAO. A CAO often holds the designation of provost, chancellor, vice president of academic affairs, or vice president of student affairs [13]. The quality of leadership by CAOs and their administrative subordinates greatly impacts the university's academic function.

Academic administrative leadership faces pressure to comply with corporate bureaucratic motivations, such as fiscal, productivity, efficiency, effectiveness, rationalism, standardization, and self-preservation [17]. As a result, some CAOs operate the university's academia as disparate wastelands of siloed initiatives and marketable, revenue-accruing research ventures rooted in principles of competitiveness and indifference. Scholars have asserted a tendency for universities to be corporatized and pigeonholed as "soulless places where there is an obsession with profitability, growth and performance" [18]. Therefore, academic administrative leadership is inherently challenged to shake off these bureaucratic pressures to advance an ethic of caring that builds authentic relationships, accessibility, understanding, and engagement with and across university constituencies [12].

Hendrickson and Francis recognized that organizational transcendence within university's academic domain can only be achieved if caring is cultivated and supported by the academic administrative leadership [5]. This type of caring by administrative leadership is an amalgamation of knowledge, ethics, reflection, and relational leadership [19]. The capacity for care with academic administrative leadership holds promise for competitive STEM higher education environments [2, 3] as institutions work to broaden participation in STEM.

### 1.2. Framing STEM Caring Intelligence of Academic Administrative Leadership

To study the capacity for STEM caring in academic administrative leadership, a domain-specific framework that operationalizes caring intelligence [14]. Caring in STEM education, referred to henceforth as STEM caring, considers fidelities to knowledge and fidelities to people [20]. Fidelities to knowledge are commitments to the acquisition of STEM knowledge and disciplinary integrity; that is, attention to the STEM learners' command of STEM principles and disciplinary standards [20]. Fidelities to people are commitments to the well-being and educational growth of STEM learners through nurturing relationships [11, 12, 14, 20, 21]. Building on notions of fidelity to knowledge and people, the proposed framework for examining STEM caring intelligence of academic administrative leadership encompasses five dimensions drawn from a cross-disciplinary body of scholarship: (a) STEM caring, (b) academic caring, (c) administrative caring, (d) leadership caring, and (e) champion-driven caring (see figure 1).

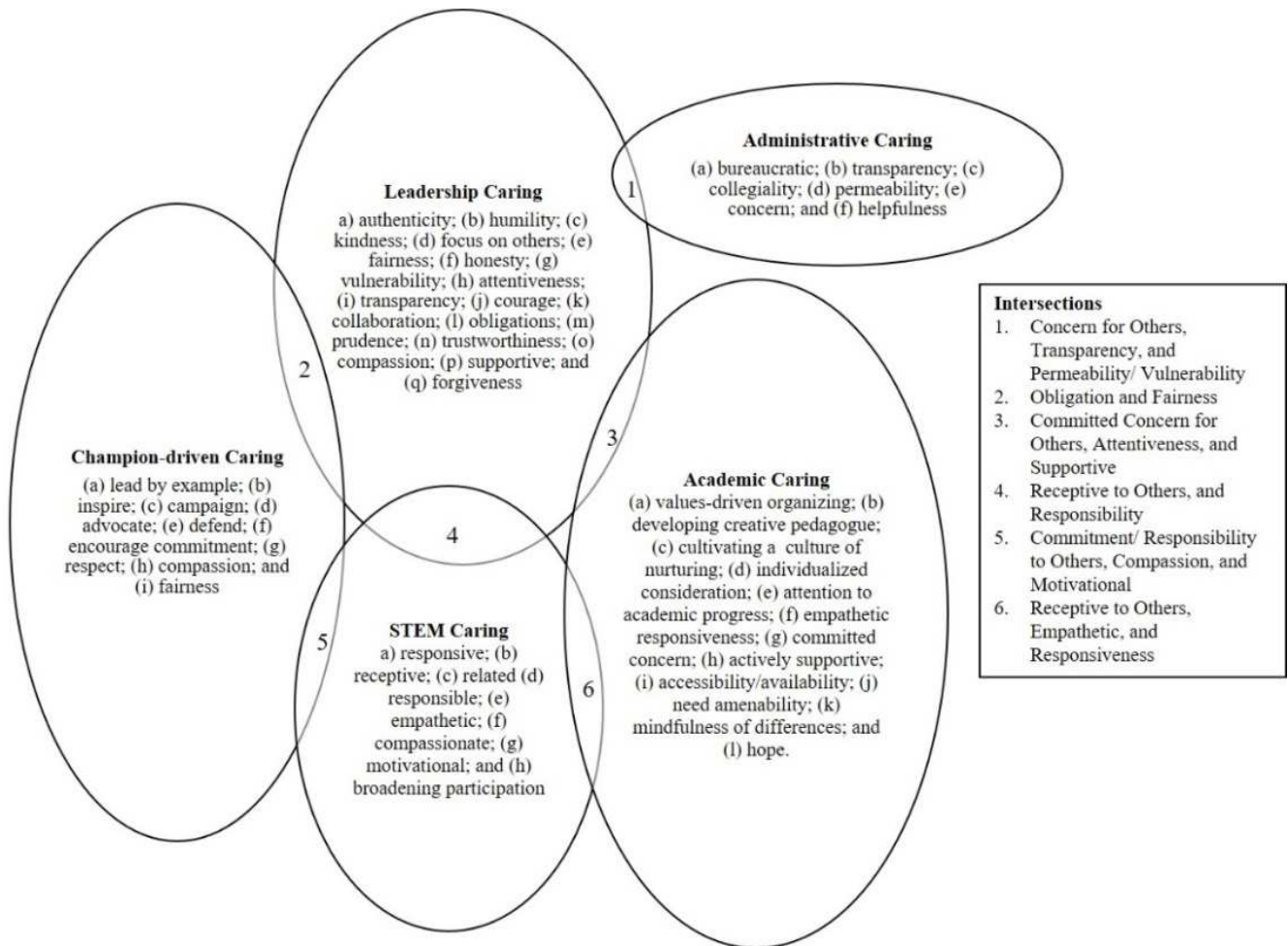


Figure 1. STEM Caring Intelligence Framework for Academic Administrative Leadership.

### 1.2.1. STEM Caring

STEM caring has been operationalized by a number of scholars. Krist and Suarez defined STEM caring as responsive, or developing collaborative relationships that value socio-cultural diversity; receptive, or showing regard for the welfare and academic achievement of learners; and related, or demonstrating a sense of connectedness [20]. Freeman and colleagues suggest that STEM caring, especially within HBCU settings, must focus on broadening participation of URM students in STEM majors [22]. Hendrickson and colleagues found that STEM caring also requires responsibility (obligation and accountability), as well as empathy and compassion [14]. Across these works, STEM caring has been operationalized as: (a) responsive, (b) receptive, (c) related, (d) responsible, (e) empathetic, (f) compassionate, (g) motivational, and (h) emphasizing broadening participation.

### 1.2.2. Academic Caring

The more generalized academic caring is characterized by “formal and informal humanizing practices of providing both caring-about (motive) and care-for (instrumental action) within all institutional levels (i.e., administrative and

frontline) and divisions of university academic services (i.e., administration/operations, schools/colleges and faculty/classrooms)” [5]. Three central characteristics of academic caring are (a) values-driven organizing, (b) developing creative pedagogy, and (c) cultivating a culture of nurturing [23]. Academic caring has been operationalized as: (a) values-driven organizing, (b) developing creative pedagogy, (c) cultivating a culture of nurturing, (d) individualized consideration, (e) attention to academic progress, (f) empathetic responsiveness, (g) committed concern, (h) active support, (i) accessibility/availability, (j) need amenability, (k) mindfulness of differences, and (l) hope. Overall, academic caring requires genuine nurturing, assistance, support, and feelings.

### 1.2.3. Administrative Caring

Administrative caring can be viewed as administrative behaviors that are inviting and as relational connections between subordinates, employees, and student-customers [24]. Hendrickson and Francis framed administrative caring as bureaucratic caring [5]. That is, “formally structured systems or processes of caring established within physical, ethical, socio-cultural, spiritual-ethical, educational, technical/technological, economic, legal and political

dimensions” [5]. Administrative caring has been operationalized as: (a) bureaucratic, (b) transparency, (c) collegiality, (d) permeability, (e) concern, and (f) helpfulness [25].

#### 1.2.4. Leadership Caring

Leadership caring can be described as manner and motivation of leaders who express care [26]. Leadership caring can be utilized to solve ethical dilemmas, in tandem with concerns for the welfare of others [8]. This type of care can also be seen as a key determinant of how leaders engage and relate to those they serve. Leadership caring has been operationalized as: (a) authenticity, (b) humility, (c) kindness, (d) focus on others, (e) fairness, (f) honesty, (g) vulnerability, (h) attentiveness, (i) transparency, (j) courage, (k) collaboration, (l) obligations, (m) prudence, (n) trustworthiness, (o) compassion, (p) support, and (q) forgiveness [12, 26].

#### 1.2.5. Champion-Driven Caring

The term *champion* has been used to describe a caring person [27]. Hendrickson and colleagues contended that champion-driven caring is a quantum-level occurrence of caring that is transpersonal, transformative, and transactional [14]. Within the bounds of champion-driven caring, academic administrative leaders help, advocate, and serve as role models who lead by example [27]. Champion-driven caring is non-directional and non-reliant on formal structure or authority, relying on caring as a universally connective and influential social principle [14]. Champion-driven caring has been operationalized as: (a) lead by example, (b) inspire, (c) campaign, (d) advocate, (e) defend, (f) encourage commitment, (g) respect, (h) compassion, and (i) fairness [14, 28].

The five dimensions of STEM caring intelligence of academic administrative leadership are not mutually exclusive. Overlap exists, with leadership caring and STEM caring sharing the most intersections with other dimensions. For example, Figure 1 illustrates that STEM caring shares conceptual overlap with three dimensions: leadership caring and reinforcing the importance of concern for others; champion-driven caring and suggesting the salience of a sense of commitment and responsibility; and academic caring and suggesting the value of empathetic responsiveness. Taken together, STEM caring intelligence of academic administrative leadership can be equated with an embodied intelligence. As an embodied intelligence, STEM caring of academic administrative leadership would require a combination of knowledge, appropriate administrative function, and particular organizational leadership styles [29].

STEM caring intelligence can be strengthened by leaders' willingness to express feelings of concern for the needs and welfare of others [30, 31], develop authentic relationships with those they serve [32], and analyze the environmental context to identify changes that are likely to be effective in achieving the desired results [33]. As such, this intelligence can be regarded as contextual, physical, entrepreneurial,

emotional, ethical, inspired, strategic and Socratic—characteristics strongly associated with the effectiveness of leadership [34]. This qualitative study aimed to test this conceptual framework of STEM caring intelligence of academic administrative leadership to determine its relevance for CAOs to inform national efforts to transform STEM higher education to broaden participation of URM in the education and career pathways.

## 2. Methodology

### 2.1. Data Collection Procedures

This qualitative research study was conducted based on an analysis of interviews conducted by the Center for the Advancement of STEM Leadership (CASL). CASL is a National Science Foundation's HBCU Undergraduate Program (HBCU-UP) collaboration among the University of the Virgin Islands, Fielding Graduate University, North Carolina A&T State University, and the Association of American Colleges and Universities. The study was approved by an Institutional Review Board prior to implementation, and all participants consented to participate in the study with the understanding that their responses would be confidential and not reported to their institutions. The investigation conducted by CASL utilized a semi-structured interview format. Each interview session, completed by a separate team from this study's research team, lasted between 60 and 90 minutes and included questions that explored participants' leadership style, leadership success related to STEM, perceived connections between their leadership and STEM success, and ideas of how participation in STEM had been broadened at their institution. The sessions were audio-recorded, and the interviewees' responses were later transcribed, with personally identifying information stripped from the transcripts by CASL. Demographic characteristics of the leaders and institutions were entered into a database and mapped to randomly assigned participant IDs to allow for the ability to contextualize the transcript data while maintaining participants' confidentiality.

### 2.2. Participants

The original study collected data from 38 leaders in roles ranging from STEM program directors to presidents and representing 13 HCBUs. The analytic sample for this current study consisted of seven provosts, four women and three men, representing seven different public and private HCBUs. Table 1 presents the demographic and institutional characteristics of the analytic sample. Provosts were assigned a numerical pseudonym, one through seven, to honor participants' confidentiality. Three of the participating provosts reported having STEM-related backgrounds. The remaining provosts reported having doctoral training in the social sciences or liberal arts. The majority of provosts, five of seven, were employed at small public or private institutions (800-2500 enrolled students), with three of them having religious affiliations.

*Table 1. Provosts' Demographic and Institutional Characteristics.*

Provost Demographics			Institutional Characteristics			
	Gender	STEM-Related Doctoral Degree <sup>1</sup>	Type	Size <sup>2</sup>	Graduate-Level Education	Religious Affiliation
1	Male	No	Public	Medium	Yes	N/A
2	Female	Yes	Private	Small	No	Yes
3	Female	Yes	Public	Large	Yes	N/A
4	Female	Yes	Public	Small	No	N/A
5	Female	No	Private	Small	No	Yes
6	Male	No	Public	Small	Yes	N/A
7	Male	No	Private	Small	Yes	Yes

<sup>1</sup> Disciplinary area self-reported by provosts.

<sup>2</sup> CASL classified institutions as small (700-2500 students), medium (2501-5000 students), and large (>5000 students; [35]).

### 2.3. Data Analysis

ATLAS.ti software (version 9) was used to aid in the analysis. After a thorough reading of all seven transcripts by the authors (Phase 1), analysis was performed by the lead author using a deductive strategy, in which passages from the interviews were assigned corresponding thematic codes guided by the proposed conceptual framework as presented in Figure 1 (Phase 2). Thematic codes based on the operational descriptors within each of the five dimensions were used to identify representative and accompanying quotes that were present in the transcripts: (a) STEM caring, (b) academic caring, (c) administrative caring, (d) champion-driven caring, and (e) leadership caring. The aim was to identify the extent to which the narratives of the HBCU provost's accounts of STEM-supportive leadership reflected or refuted the conceptual model previously devised based on the accounts of HBCU deans of STEM departments. In the final phase of analysis (Phase 3), passages associated with thematic codes within each dimension were examined by two researchers to determine how and in what ways they reflected or refuted evidence of the presence and salience of the dimensions and overall transferability of the model from HBCU deans to HBCU provosts. Noted discrepancies between researchers were resolved.

## 3. Results

Drawing from the analysis, data extrapolated from the transcribed interviews supported the relevance of the five dimensions of the conceptual framework of STEM Caring Intelligence of Academic Administrative Leadership for studying the leadership of HBCU Provosts who were identified as STEM supportive (see Figure 1). Several descriptors from the proposed thematic framework were identified within the transcripts. Additional descriptors emerged as new demonstrations of STEM caring within each theme. Overall, a dimensional narrative of HBCU Provosts' capacity for STEM caring was realized. The findings of the analysis are presented below for each of the dimensions mapped to the respective descriptors denoted in parentheses.

### 3.1. STEM Caring

STEM caring was a theme captured across provosts'

accounts of how broadening participation in STEM was enacted by themselves and their institutions. As illustrated below, their narratives encompassed multifaceted endeavors to achieve inclusivity, equality, equity, diversity, and educational accessibility in STEM higher education. Each of the eight operationalizations surfaced in the narratives of four out of seven Provosts.

Based on the accounts of participating provosts, these academic administrative leaders conveyed an institutional responsibility (d) to broadening participation in STEM (h). When describing the meaning associated with the idea of broadening participation in STEM institutionally and for them personally, Provost 1 stated the following:

Broadening participation in STEM means going outside, coloring outside of the lines...So broadening participation, for me, means that the institution is doing everything that it can to be as inclusive as possible. When we're talking about gender representation and we're talking about domestic racial and ethnic minority representation, I think all too often there is an assumption that is made that when we include internationals in our STEM discipline that we have achieved the diversity. And I would argue that is not achieving parity in any kind of way. I think it's representational diversity of a different type, but it doesn't mean that broadening participation has been broadened for the United States.

Provost 1 went on to describe leadership strategies used to broaden participation that suggest STEM caring as motivating others (g) to enact solutions that matter while signaling both empathy (e) and compassion (f) for those they serve:

And so if you are challenged with facilities from the get-go and then that is coupled with startup packages, as well as salaries, the top-flight faculty who would be role models to be able to broaden participation and to move the needle from a faculty research perspective, it becomes a challenge because you're in competition with [larger more, visible HBCUs]. And so, I think one of the things that we have been able to do in response to that is look at our faculty salary structure. And so over the past year, because we are a collective bargaining university, we have a differentiated pay structure now for STEM faculty, and that was not an easy move for a union. But to the market and [inaudible] the data, we absolutely had to make that transition.

Additionally, accounts from multiple Provosts suggested the importance of having a relatable presence (c) to build beneficial and effective connections within STEM communities. In describing leadership characteristics that have resulted in success in STEM, Provost 5 stated:

I would say, first of all, the power of presence. Let me tell you what I mean by that, and the presence of possibilities...I say the power of presence and the presence of possibility because when you come into an institution where you see people who look like you in the STEM area doing research, teaching you in the classroom, and especially when they are of age where they don't look like, maybe, some of the elders in your family, but look closer to your age. I think that makes a difference. And I think that young people have a tendency, even if they don't say it aloud, to believe, "if they can do it then surely, I can." And so I just think that's the beauty of HBCUs in general. This is a place where students can come and see people who look like them with master's degrees and doctorate degrees and in leadership positions, which is what I call the presence of possibility—that, "if you did it, then it's possible for me to do it too."

Similarly, Provost 4 highlighted the value of a relatable presence while reflecting on institutional characteristics that lead to African American STEM majors, graduates, doctoral students, and professionals:

An underlying characteristic in our mission is focusing on serving that population. There is a particular need for students to be mentored, for having role models, for being able to see themselves in the STEM workforce.

In response to the same prompt on institutional characteristics, Provost 7 made connections between ideas of STEM caring as a relatable presence (c) achieved through responsive (a) and person-centered proximal approaches in which the leader is receptive (b) to the needs of students and responsible (d) for creating opportunities to cultivate talent. Provost 7 explained:

What HBCU leaders do, through a student-centered and proximal approach, is [engage] in concerted cultivation of students' talents. We learn about them from day one, what their interests, deficiencies, and areas of development are. Then, we match that intentionally with supports on campus, whether it's academic, financial, or social support. Maybe we've got a student who's strong in science, but they're not strong in writing. We help them by building wrap-around services, and a community of care and support, that does not allow them to fall through the cracks.

### 3.2. Academic Caring

The narratives of Provosts 1 and 2 most clearly reflected the dimension of academic caring. Within the dimension of academic caring, the provosts' reflections highlighted cultivating a culture of nurturing (c) as a historical core value of HBCUs that must be reflected within leadership. The culture of nurturing conveyed by these Provosts centered on a committed concern (g) for students' learning capabilities and attention to academic progress (e). Academic caring

encompassed institutional leadership's accessibility/availability (i) for faculty, as well. Six of the twelve operationalizations surfaced in the narratives for this dimension.

The narrative of Provost 1 illustrated academic caring as nurturing (c), individualized consideration (d), committed concern (g), and active support (h) in reflection on institutional characteristics that lead to African American STEM majors, graduates, doctoral students, and professionals:

I would say nurturing as a characteristic hasn't changed. I see my faculty here on the campus, I see deans here on the campus still nurturing students. I read the emails and hear the conversations of our faculty trying to nurture those students and encourage them to not give up. They encourage students to not give up, so that they really understand that the sacrifice they are making in the short-term is going to be incredible for their family in the long term. So, I think that nurturance is still very much prevalent in the HBCU community.

Academic caring was conveyed as committed concern (g) as Provost 2 spoke to nurturing in response to an inquiry about leadership strategies used to face challenges in broadening participation:

I have been [an] aunt and mother. And most of the HBCU faculty will tell you that, that they served those roles. And you really serve them without compunction. It's just, it happens. The students need this when they are away from home. So, I won't look at that part of it as a challenge. That's just a benefit. A serendipitous benefit because I enjoy having this relationship with them as well. But the challenge is helping them build confidence.

Finally, within this dimension, the following reflection from Provost 1 on institutional leadership that results in success in STEM depicted academic caring that extends to faculty in the form of accessibility/availability (i):

I have the wherewithal and the capacity to really think with my deans and to think with the faculty what really are the distinctive and unique and relevant academic STEM kinds of programs that we need. What are the careers of the future? We are having those conversations at every level of the organization.

### 3.3. Administrative Caring

The accounts of Provosts 1 and 6 most clearly reflected the dimension of administrative caring. Administrative caring appeared as the provosts described their leadership style and its relationship to STEM success. Narratives showcased the importance of bureaucracy (a) in administrative caring. These STEM-supportive leaders conveyed an orientation towards helpfulness (f), collegiality (c), transparency (b), and concern for others (e). Five of the six operationalizations surfaced in the narratives for this dimension.

When asked to reflect on the relationship between their leadership style and STEM success, the responses of Provost 1 showcased the influences of administrative caring. In particular, leaders must act as bureaucratic

facilitators, brokers, collaborators, negotiators, and patrons (a). The following comment by Provost 1 supported these findings:

And so, we're having these broad conversations and negotiations with our faculty. For those faculty who really have strong passion about going after research dollars and building our research enterprise, we create opportunity for them through our [Office of Sponsored Research]... But all of that to say my role as [a Provost] is one of facilitator, and it's one of making sure that faculty are supported in a way that is germane and in alignment with the institutional mission.

Remarks from Provost 1 and Provost 6 also captured helpfulness (f) and academic collegiality (c) as an expression of administrative caring in STEM leadership. Provost 1 did so while describing their relationship with leadership and STEM success:

When I came on as the [Provost at this university], we [tripled our] extramural funding.

Provost 6 did so while describing their individual leadership style:

It's important for me to support the people who come under me, and they all have very complicated jobs to do. And part of what my responsibility is, is to make sure that they have the resources to be excellent at their jobs.

### 3.4. Leadership Caring

The accounts of Provosts 1 and 3 most clearly illuminated the dimension of leadership caring. Their accounts centered on collaborations (k) focused on and attentive to supporting others (d, h, and p). While providing descriptions of their leadership styles, Provosts 1 and 3 reported highly supportive collaborations (d, h, p, k) between academic administrators and the individuals they serve. Five of the 16 operationalizations surfaced in the narratives for this dimension. Specifically, Provost 1 stated:

I think for me, serving in [my leadership role], my leadership style is highly collaborative... I would also say that my leadership style is highly supportive. I think mid-level managers can't be successful if they don't have support and so in that realm of support, I have to be a good listener. I must also be pretty candid and be able to redirect where redirection is needed.

The narrative of Provost 1 also captured that the collaborative nature of leadership caring is operationalized through a sense of obligation (l) to coach and mentor subordinates (d) in developing a depth (participation and contributions within organizational hierarchy) and breadth (capacity to gain and use substantive knowledge) to their involvement in university matters. Provost 1's remarks illustrated this:

I believe that my leadership style is about coaching and mentoring individuals such that they fully understand the range of involvement and depth and breadth. Oftentimes, when we talk about leadership there is depth, but not the breadth. And what I really believe leadership is in terms of where I sit deems me to have

both depth and breadth.

Additionally, Provost 3 spoke to a sense of obligation (l) as an indicator of leadership caring. Provost 3 shared:

It's my feeling that leaders are at HBCUs because they want to be at HBCUs. They want to be a part of the solution, I guess, is the best way to say it. They're here because they want to be. And in some ways, they may be tougher on students than other leaders at other institutions. They get more engaged or involved with the students.

### 3.5. Champion-Driven Caring

The narratives of many provosts spotlighted the dimension of champion-driven caring. In particular, narratives from Provosts 2, 5, and 6 highlighted multiple aspects of this type of caring. These STEM-supportive leaders led by example (a) to inspire future leaders (b), demonstrating what it means to lead with respect, compassion, and commitment to support those they serve (f, g, h). Five of the nine operationalizations surfaced in the narratives for this dimension.

First, Provost 6 identified the need for provosts to lead by example (a) to connect with the people that they serve and to achieve their goals. Leading by example is a key identifier of champion-driven caring, especially when it is being used to model respect, compassion, and commitment (g, h, and f, respectively) to inspire (b) others to achieve their goals. Provost 6 commented, "As a leader, I try to lead by example and I [try] to work with my faculty and my direct reports to really enable their dreams. It is valuable to determine what they find is important."

Provosts 2 and 5 identified the need for academic administrator leaders to serve as champions, and to strive to be role models (a) that inspire (b) and encourage commitment (f) among the next generation of leaders. Provost 2 shared:

When I say broadening participation, I often tell my students that STEM is where a lot of things are happening. You need to be a part of it. You need to be at the administrative level, and not just at the lower entry-level.

Provost 5 commented:

The thing that excites me the most about leadership is when a student comes to my office and say[s] they want my job. Because honestly, for me it's not just a job. It is for me to really develop future leaders to continue the legacy of historically black colleges and universities. And so, it's being able to interact with our students, and then being able to say to them, "Well if that's what you want to do, I want you to [do] that. I'll hold it for you for as long as I can. But I need you to go on and be about the best at doing what you need to do to come back and take my job. And I'm all right with it."

## 4. Discussion

The findings from this study demonstrate the importance of caring for HBCU provosts who were recognized for their leadership in broadening participation of URM students and



faculty in STEM disciplines on their campus. As such, the findings substantiate the relevance of the STEM Caring Intelligence Framework for examining the influence of provosts' leadership on efforts to broaden participation in STEM. Between five and eight operational descriptors emerged during the coding process. All seven provosts' reflections on STEM leadership promoted at least one of the five dimensions of caring intelligence that were proposed in the framework. In fact, two to four caring intelligence dimensions were weaved through the narratives of four of seven provosts; two women and two men tentatively affirmed the utility of the framework for characterizing STEM intelligence regardless of the gender identity of the STEM leader. Within this group of four, Provost 1, a male leader of a public, mid-size, graduate-degree granting HBCU with liberal arts training, weaved four of five dimensions of caring intelligence including: STEM caring, academic caring, administrative caring, and leadership caring. STEM caring and champion-driven caring were most common dimensions present in provosts' reflection on their STEM leadership and efforts to broaden participation. Exemplifying notions of fidelity to knowledge and people in STEM [20], the findings amplify the intersections of concern (intersection 1), commitment (intersections 2, 3, 5), supportiveness (intersection 3), compassion (intersection 5), and empathy (intersection 6) for those served, alongside the awareness to inspire and motivate (intersection 5) as STEM Caring Intelligence of provosts in this study.

Notably, the data used in this work were originally collected to examine the overall characteristics and influence of leadership on the success of STEM programs and students at HBCUs. While the original research protocols did not explicitly probe for caring, evidence of academic administrative leaders' STEM caring intelligence was uncovered. As our sample included the perspectives of HBCU provosts only, transferability of the findings beyond the context of HBCUs and the STEM-related role of academic provosts is cautioned. Nonetheless, the aims of this study to substantiate the relevance of the framework for understanding the characteristics of STEM caring intelligence of chief academic officers were advanced.

Implications for future research include extending this exploratory study to investigate the transferability to provosts working in additional HBCU settings. There is remarkable variability among HBCUs beyond the dimensions of type, size, level of education, and religious affiliation measured in this study. For example, as HBCUs grow increasingly diverse [6, 36], researchers might explore the salience and practice of different dimensions of STEM intelligence based on alignment between the leaders' racial and ethnic identity and the composition of the students and faculty. Future researchers might consider the transferability of the framework to provosts employed in other types of minorities-serving institutions or predominantly white institutions with a demonstrated commitment to broadening the participation in STEM efforts, as well as the utility of the framework to other leadership roles.

## 5. Conclusion

The existing literatures on administrative leadership point to the challenging realities of cultivating STEM caring intelligence within university academic administration [12, 17-18]. This work purports that positional influence and caring intelligence of senior academic administrative leadership, such as provosts, are necessary to cultivate and sustain caring STEM environments through the construction of policies and practices that elevate, recognize, and reward demonstrations of STEM caring. Inherent in this stance, and the narratives of provosts in this study, is the need and invitation for leadership at all levels to practice STEM caring intelligence and support policies and practices that cultivate it. The STEM Caring Intelligence Framework for Academic Administrative Leadership and reflections of STEM-supportive HBCU provosts hold promise for a path forward to altering STEM environments for the better. Organized within the framework, the reflections of HBCU provosts provided a narrative for the practice and study of caring in STEM leadership that is noteworthy in its potential to transform STEM leadership.

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