An NSF-Funded Professional Development Series for Advancing Inclusion at a Hispanic-Serving Institution

Dr. Pheather R. Harris, University of California Irvine

Dr. Harris has worked in postsecondary education for over two decades in various capacities. She began her career at Santa Monica College as a counseling aid at the Extended Opportunities Programs and Services office prior to her role as an Assistant Director of Admissions at the University of Southern California. She then moved to Cambridge, MA to pursue her Master's Degree in Higher Education, with a focus on Risk and Prevention, and began working at Tenacity, a non-profit organization focused on social-emotional learning and literacy development for middle school youth, as a Prevention Specialist. Dr. Harris formally moved to the east coast when she began her work at the Gates Millennium Scholars Program as a Senior Program Manager – managing the Academic Empowerment Program across partner organizations: the United Negro College Fund, The Asian Pacific Islander American Scholarship Fund, The Hispanic Scholarship Fund, and the American Indian Graduate Center Scholars. Dr. Harris received her Bachelor of Arts degree in Communication from the University of Southern California, a Master of Arts degree from Harvard University, and a Doctorate in Higher Education Administration from The George Washington University. She is also an NSF IASPIRE Fellow and the Principal Investigator on a nearly $3-million dollar grant aimed at advancing access, diversity, equity, and inclusion in STEM . Her research interest includes exploring the relationship between faculty mentor engagement and minoritized student STEM persistence. She is a critical methodologist who uses both post positivism and postmodernism to guide her inquiries.

Dr. Dianne G. Delima, University of California, Irvine

Dr. Dianne G. Delima is the Project Policy Analyst for The Institute for Meaningful Engagement (TIME). Dr. Delima received her doctorate in Higher and Postsecondary Education at Teachers College, Columbia University, where she focused on the learning experiences of first-generation college-going students of color and faculty members' use of a funds of knowledge approach for teaching in college classrooms. Her research has been published in College Teaching and in two edited volumes. Dr. Delima's work and research interests are informed by her prior roles in elementary schools in Southern California, as a Research Assistant for the Department of Mexican American Studies at the University of Arizona, and her involvement with Professor Anna Neumann on Metropolitan Colleges Institute for Teaching Improvement at Columbia University. Her research interests in higher education are supplemented by her prior work as a student affairs administrator at Barnard College and as a Researcher and Administrative Coordinator for the Center for Understanding Race Education, under the direction of Professor Amy Stuart Wells.

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INTRODUCTION

Higher education scholars have extensively detailed the factors that contribute to the withdrawal of racially minoritized Black and Hispanic college students from the STEM (Science, Technology, Engineering, and Mathematics) field (see [1]-[3] for examples). These factors include unwelcoming and exclusionary learning environments and curricula, lack of faculty mentorship and role models, and lack of a supportive peer group (see [4]-[6] research findings on these topics). For these reasons, there is a steep decline in the number of Black and Hispanic students graduating with a STEM degree from Baccalaureate institutions [7].

Classroom culture is shown to have a significant impact on the success of Black and Hispanic students in higher education and in STEM in particular. Specifically, when Black and Hispanic students feel like they have learning and supportive spaces to develop their STEM identities, they are more likely than their peers who do not have access to such spaces to academic persist in the STEM field [8]. However, Black and Hispanic students often encounter a STEM culture that is dominated by European, White-centric knowledge; thus privileging a viewpoint that isolates the backgrounds and identities of students of color [9]. A recent study by Hatfield, Brown, and Topaz [10] emphasizes the impact of this classroom culture by finding that STEM classrooms and programs systemically push Black and Hispanic students out of the STEM major, despite these students' preparation for and prior academic achievements (i.e. in high school). These scholars thus point to a pervasive issue in STEM culture that postsecondary institutions must intentionally address to ensure that all students, of any racial or ethnic background, can realize their full academic potential in STEM. To address ways to improve the outcomes of Black and Hispanic college students in STEM, scholars point to the important role that STEM faculty play in the academic persistence of these students in the major (see [11]-[12] for scholars' findings on this topic).

The particular focus on the role of STEM faculty has led to a re-evaluation of their teaching practices and the ways in which these may exclude the valuable identities and prior knowledge that Black and Hispanic students bring with them into the classroom setting [13]. According to a 2014 survey of STEM faculty in over 200 public and private Baccalaureate granting institutions, more than half reported using lectures as their predominant method of teaching; thus, leaving no room for students to interact along with their peers and the faculty on the subject matter [14]. However, an increasing number of STEM faculty have become aware of the importance of integrating student-centered and active teaching and learning approaches into their classroom practices, like incorporating group projects and small-group discussions [15]. Researchers have found these types of active teaching and learning approaches have proven to be effective in the enhanced classroom experiences of students of color in STEM; thus, increasing

these students' sense of belonging as they engage with STEM subject matter in the classroom and with their peers (see [16]-[18] for examples of research findings).

The increased diversity of the student population in the STEM field has led many higher education institutions to think about ways they can offer STEM faculty with professional development experiences that would help them create accessible, inclusive, and equitable teaching and learning environments [19]. Many of these professional development experiences, however, focus on the perceived deficits of STEM students of color, where faculty in turn provide them with external resources that can aid in their learning (e.g., tutoring and writing centers on campus, affinity groups, etc.; see [20]-[21] for examples). Thus, STEM faculty often fail to consider how *their own* racial identities and exclusionary practices in STEM collectively play a role in the disparity concerning persistence and retention of students of color in their major. By not interrogating their biases and viewpoints on student success and the ways institutional and departmental culture can inhibit the academic persistence of students of color, faculty cannot make significant strides toward changing their curriculum and classroom environment to be inclusive and equitable (see [22]-[23] for examples of these points).

Professional development opportunities that have pushed STEM faculty to interrogate their biases have been found to be effective in intentionally addressing the learning barriers students of color face in STEM classrooms and in creating inclusive and equitable learning opportunities for these students (see [24]-[25] for examples of research findings on this point). For example, Sanders O'Leary and others [23] found that, after having had the opportunity to interrogate their own social identities and the barriers that shape students' learning, STEM faculty then became intentional in changing their pedagogical practices to be inclusive of the knowledge and experiences of diverse students. In another example, Macaluso and company [26] found that, after taking part in a multi-session professional development program, STEM faculty showed greater interest than before their participation in the program in understanding the backgrounds and unique needs and concerns of their students, particularly those who were first-generation college-going students of color. Thus, STEM faculty who participate in professional development experiences that explicitly interrogate their personal biases and the social and cultural systems that inhibit the academic success of students of color in STEM can shift the culture and content in their classroom and their curriculum to address ways to support these students along in their STEM journey.

The impact of STEM faculty's use of inclusive and equitable teaching practices pays significant dividends toward the academic achievement of students of color as well. Good and others [27] highlight this point in their study of over 200 STEM students of color from various colleges and universities in the U.S. The authors find that students of color who had STEM faculty that incorporated a multicultural and inclusive philosophy to their curriculum and pedagogical practice were more likely than their peers who had faculty with different approaches to have increased comprehension of STEM subject matter and to feel a sense of belonging in the classroom and STEM field. A recent case study by Goering and company [28] further emphasizes the benefits that get passed on to students when STEM faculty utilize an inclusive curriculum. In their study of STEM faculty in a diverse community college, the authors find that, in comparison to the students they had prior to incorporating an inclusive curriculum, these faculty had students of color score higher in their exams and had earned "A" final grades (90%

or better). Thus, when STEM faculty develop a curriculum and classroom environment where students of color feel that they are valued learners, these students will academically succeed and persist in the field.

Extant literature shows us that professional development opportunities that interrogate STEM faculty's biases and understanding of the lived experiences of students of color are better able to develop an inclusive curriculum and classroom. The students of color in these classrooms also tend to do better academically in the field, in comparison to their peers who do not have such an opportunity to learn in this manner. Thus, it is imperative to examine how professional development experiences can be transformative learning experiences for STEM faculty, and what viewpoints, if any, these faculty bring into their learning of topics related to access, diversity, equity, and inclusion for students of color.

With the goal of further uncovering the ways in which inclusive teaching and learning practices can become an integral part of STEM classrooms, this paper presentation provides a framework for exploring how STEM faculty can enhance inclusive academic spaces through a professional development experience. Specifically, this paper discusses the content of a STEM faculty professional development experience that focuses on uncovering faculty's personal biases, their social and cultural locations, their understanding of systems of inequity, and the pedagogical frameworks that drive their teaching, and how such perspectives may shape their classroom environment and curriculum. Moreover, this paper details an NSF funded research project focused on providing professional development experiences that can lead to institutional transformation at a Hispanic-Serving Institution (HSI). In doing so, this paper hopes to provide a framework that may be utilized on other campuses, STEM colleges, and departments.

This paper, thus, emphasizes the importance of STEM faculty teaching towards the engagement and persistence of minoritized students (MS) on campus. For the purposes of this paper, we define minoritized students (MS) as Hispanic and Black students whose identities are socially constructed within their specific social and political contexts (see [29]-[30] for detailed explanation of this definition).

NSF-FUNDED PROFESSIONAL DEVELOPMENT PROJECT

The NSF-funded professional development project is designed to facilitate institutional transformation by addressing environmental factors that negatively influence STEM degree completion for MS. The STEM faculty that participate in this professional development experience have been nominated by the deans of their college. The PI for this project met with each STEM dean individually (six in total) and discussed in detail the goals and expected outcomes of the project. The PI emphasized the importance of a diverse faculty composition (Assistant Professors, Full Professors, etc.) of each cohort, to ensure that the discussions were robust, and the content could be experienced, from various perspectives. Each dean expressed their desire to partner and nominated two faculty members to participate. The nominated faculty represented a diversity in racial and gender identities, as well as rank and experience. The participating faculty will receive research funding for their involvement and have agreed to take part in the two-year experience which includes discussions that interrogate systemic inequity in STEM,their social positionality, biases, and pedagogical frameworks. In doing so, faculty are to

explore how the aforementioned factors influence their students, particularly those who identify as MS. Faculty are also able to list the experience under "Professional Development Activities Related to Teaching", or "Diversity Activities Related to Teaching," or "Teaching Innovations and Curriculum Development" for their tenure review.

This project consists of five overarching goals:

1. To lay a solid foundation of local and national **data** related to STEM persistence and retention to inform instructor practices and behaviors in the classroom.
    a. Participating faculty are exposed to data that will encompass both national and HSI-campus specific information.
2. To provide participants with **a core curriculum** (which entails a particular sequence of workshops for completion) that is focused on the social and cultural locations of MS in STEM and best practices related to culturally responsive pedagogy.
    a. Participating faculty are provided with inclusive language, activities, and diverse perspectives that address the science classroom climate to create a culture of inclusion, and engagement, from a strengths-based perspective. They are also provided opportunities to share their voice related to the material and its influence on their lived experience.
    b. Participating faculty learn about the importance of building STEM identity and its associated factors, which includes contributing to STEM knowledge, being recognized as a scientist or engineer, and receiving social and cultural capital
3. To engage with extant **campus programming** that allows participants to reflect, and meaningfully address, factors that contribute to STEM persistence across STEM disciplines.
    a. Participating faculty have opportunities to participate in campus-wide programming, based on their individual interest, to gain a stronger understanding about the experience of students from minoritized populations to enhance their understanding, and utility, of the content they learn in the professional development experience, and to satisfy their elective requirement.
    b. To create a **sustainable structure** to continually engage in the activity of reflection, introspection and action concerning inclusive academic spaces.
4. To **meaningfully partner** with a local community college to maximize the lessons learned and best practices that emerge in the professional development experience.
    a. This professional development experience will facilitate remote engagement opportunities, on-site workshops, and a dissemination strategy for our off-campus partners to assist them with creating similar programming on their campus which will address our shared interest of graduating well-prepared underrepresented students in STEM across disciplines.

With these goals in mind, this professional development experience seeks to provide STEM faculty with the resources that can enhance inclusion and equity in their teaching and learning spaces. To do this, the professional development curriculum purposefully draws from ideas and experiences that can speak directly to how STEM faculty can support MS. For example, the first session introduces faculty to ideas of epistemological frameworks–or how faculty frame their discipline and the knowledge produced from their field [31]–and implicit

bias–or the unintentional biases that people hold that shape their behavior, actions, and judgements [32]. These two particular lessons introduce ways for faculty to begin to examine and reflect on their own experiences and identities and how these have shaped their work, particularly as they teach MS in STEM. The next two sessions look at national and institutional data as a way to set the macro and micro contexts for understanding the classroom experiences of MS in STEM. The next three sessions, then, explore in-depth a few theories and frameworks that explore ways STEM faculty can re-examine their engagement with MS. These theories include "Othermothering" [33], fixed versus growth mindset [34], culturally sustaining pedagogies [35], and STEM students' intersectional identities [36]. The last three sessions, the faculty explore ways they can draw from data and the frameworks they learned to create inclusive and equitable curriculum; thus, the faculty are asked to re-examine and re-evaluate the current framework of their curriculum and shift it to think about how MS are reflected and valued in the subject matter teaching and learning.

In order to examine the faculty's initial starting points before participating in the professional development lessons and to monitor their progress throughout the year, this professional development project has included a research component to its work. The research is driven by three primary questions:

1) What social and cultural factors do students at an HSI believe need to be considered in the classroom to improve the classroom climate?
2) What is the impact of participation on faculty conceptions of diversity and inclusion in the classroom?
3) How does faculty participation lead to increased implementation of evidence-based inclusive teaching practices?

To answer the first question, data was collected in Spring 2022. For this particular data collection, MS in STEM volunteered to take part in a focus group where they were asked about their classroom experiences and their interactions with faculty and non-MS peers. To answer the second question, multiple rounds of surveys will be taken to understand how the faculty understand their positionality, what they have learned during their participation in the professional development experience, and how they plan to continue the work beyond the professional development experience. A few faculty will also take part in an interview where they will be asked in greater detail about their experiences in the professional development experience and their viewpoints on the teaching and learning experiences of MS in STEM. To answer the third question, the students of the participating faculty will be asked to complete their course evaluations which will include questions that inform the work of the grant to measure the extent to which their faculty's approaches to teaching are inclusive and supportive of STEM identity development. Currently, the questions to the student course evaluations are undergoing review from the faculty senate. The questions will gauge whether the pedagogy was inclusive, whether the methods utilized in the course maintained or decreased their interest in STEM, and a question about the uniqueness of the teaching methods employed. The faculty will also be observed as they teach their classes, and researchers will measure the extent to which their pedagogical approaches reflect any of the ideas and theories learned during the professional development experience. To help triangulate faculty's shift in their teaching approaches, their syllabus will also be collected and examined for inclusive practices.

It is important to note that the timing and process for data collection did not allow for a pre-design whereby we could gather information about the participating faculty members' approaches to teaching and learning, especially geared towards minoritized students. However, the first survey that was disseminated during the first few weeks of the professional development experience, asked faculty's perspectives on and experiences with addressing on diversity, equity, and inclusion in their classroom; thus, we were able to get some insight into how the participating faculty approach their work with these issues in mind.

With the data collected from this work, the research team hopes to understand the extent to which the tangible resources provided to faculty–through the frameworks, activities, and discussion groups–have been helpful to their growth and development in understanding inclusive and equitable practices for MS in STEM. In doing so, this particular professional development experience can be a model by which other institutions can develop a professional development experience that delves deeply into how STEM faculty can interrogate their identities and experiences, and the ways in which these parts of themselves frame how they teach and interact with MS. One way by which this work will be disseminated to other higher education institutions is having a partnership with a local community college in order to better understand how to successfully export this programming to other two- and four-year institutions. Thus, it is our hope to transform the STEM classroom environment for MS to be inclusive and supportive of STEM identity development and persistence.

CONCLUSION

Faculty play a significant role in the development of positive (or negative) classroom culture. Due to the increasing numbers of minoritized students (MS) in STEM, faculty need to think of ways to engage meaningfully with these students' learning of the subject matter. To directly address the importance of culture in the classroom for MS success, we presented ways in which higher education institutions can develop, implement, and assess professional development programs for STEM faculty. In particular, this paper highlighted our own multi-session faculty professional development series designed to provide STEM faculty with a curriculum and resources that will enhance inclusion and equity in their teaching and learning spaces. More specifically, the multi-session series raises faculty awareness of the classroom and campus culture, environmental factors that influence the experience of MS in STEM, practices that perpetuate disparities in STEM degree completion for MS, and ways to combat those practices to create inclusive and equitable learning environments in STEM.

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