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# Advising in science education: Critiquing where we have been, moving toward an equitable and holistic advising approach

Enrique Suárez

Cameron C. Beatty

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Enrique Suárez
Assistant Professor
University of Massachusetts, Amherst
easuarez@umass.edu

Cameron C. Beatty
Assistant Professor
Florida State University
cbeatty@fsu.edu

**Abstract**

This article explores and wrestles with the various discourses that arise when considering why it is important to advise students from an assets-based and holistic approach into science-related majors and careers. Our hope is to inform how and why it is important to advise students into science-related careers, specifically, and STEM fields, more generally, from an ethical and justice-oriented approach. We begin with a review of empirical literature that highlights the different approaches to advising and the challenges racially and gender minoritized students often face in STEM fields. We then review contemporary research from science education that document the hostility that racially and gender minoritized students experience in undergraduate and graduate science programs. We find the intersection of these two subfields to be productive for elucidating multi-level, context-dependent strategies that can redress the inexcusable and alarming under-representation and exclusion of racially minoritized peoples in science programs and careers in the US. We end by contemplating the ethical question of how science programs, careers, and the broader field would need to change in order to keep historically minoritized students from experiencing further material and epistemological violence. We argue that, without this reimagination, even the most effective advising models will only ensure that more racially and gender minoritized students are sacrificed on the altar of "equality" for the sake of the economic and geopolitical needs of the state.

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## Introduction

There is, undoubtedly, an inexcusable and alarming under-representation and exclusion of racially minoritized peoples in the Science, Technology, Engineering and Mathematics (STEM) fields in the United States (Fry et al., 2021; Rivers, 2017). For some, there is an economic need to address this injustice, as the US was projected to need approximately one million more professionals in science, technology, engineering and mathematics (STEM) fields by the year 2022 (Long & Henderson 2022; U.S. Department of Education, 2016). For others, the remedy to this systematic exclusion cannot be framed in the service of the geopolitical and socioeconomic needs of the US, and instead appeal to the moral failure these gaps represent and the need to reimagine the STEM fields (Basile & López, 2015; Calabrese Barton & Tan, 2020; Vossoughi & Vakil, 2018). Regardless of the framing, everyone who is committed to redressing the widespread and intentional under-representation and exclusion of racially and gender minoritized peoples from STEM fields – especially Black, Indigenous, and Latinx folks – turn towards P-20 STEM education as the site were solutions and reimagining's must take place; their approaches vary widely, from new curricula, to liberatory pedagogies, to engaging out-of-school time programs. Irrespective of their ultimate goal, however, those who want to make a difference in the inclusion and transformation of STEM disciplines agree on one important feature: youth from historically marginalized groups benefit from intentional policies and practices that disrupt the systemic oppression, while also encouraging and guiding them to pursue STEM degrees.

Through this three-article series (this article; Morton & McKinney de Royston, 2022; Dodo Seriki & McDonald, 2022) we will explore and wrestle with the various discourses that arise when considering why it is important to advise students from an assets-based and holistic approach into science-related careers, specifically, and science, technology, engineering (STEM) fields, more generally. This, of course, is a complex landscape where multiple – and often – competing visions intersect from workforce training, to improving what and how we know about the natural world, to sustaining imperialistic projects, to opening a space for the rightful presence of those who have been kept out, to science as a tool for liberation and well-being. This is the first article in a three-article series, where we present a review of literature that highlights the different approaches to advising and the challenges racially minoritized students often face in STEM fields. Our hope is to inform how and why it is important to advise students into science-related careers, specifically, and STEM fields, more generally, from an equity and justice advising approach. Equity, for the purpose of this article, refers to fairness and justice for all students, taking into account context and students' unique situations and experiences (Holcomb-McCoy et al., 2008). This paper will engage with broader discourses about increasing the representation of historically minoritized students in science, but it will primarily focus on efforts that take place in secondary schools and institutions of higher education.

## School Counseling and Academic Advising: What's the Difference?

Before unpacking what we mean by school counseling and academic advising, we begin by acknowledging that we see ourselves and coauthors and co-conspirators, who have supported each other through many challenges that arose while writing this article, rather than "first" and "second" authors. As such, we would like to share what identities and experiences we each bring to this endeavor, and how our positionalities shape our scholarship.

As the first listed author (Suárez), I am a multiethnic, heterosexual, cisgender, able-bodied Latino and grew up with a modicum of socioeconomic privilege in Venezuela, a country with deep racial and class stratification. Before becoming a science education researcher in 2010, I spent the prior 10 years studying and researching cosmology across three continents, specifically *dark energy* – the driver of the accelerated expansion of the Universe. I became interested in science when I was nine years old through the work of Carl Sagan, particularly his book and TV series "Cosmos," and decide to become an astronomer midway through high school. Even though some in my family had STEM-related degrees, there was no clear pathway, counseling, or advising on what pursuing a career in astronomy entailed, especially since no university in Venezuela offered that major. I began my physics career at Universidad Simón Bolívar, but the challenges of being a non-white (under)grad student in science did not arise until I moved to the US to pursue my BS and a PhD in (astro)physics. Faculty and advisors at my universities were stupefied that having a scholarship almost taken away for being Venezuelan, having your family kidnapped, being reprimanded for "TAing too much", or even having your spouse hospitalized would affect my academic performance. Meanwhile, these programs were constantly puzzled by why the grand majority of their students were white, East Asian, and/or South Asian men, and were unable to attract racially and/or gender minoritized students. Those experiences pushed me to leave (astro)physics and, instead, dedicate my professional life to researching and dismantling the narratives, institutional barriers, and epistemological stances that make it nearly impossible for historically marginalized folks to become scientists.

As the second listed author (Beatty), I am a Black gay cisgender man who is able-bodied and grew up relatively working class within a deeply Catholic family. I attended a private parochial Catholic high school in Indianapolis, IN. Through my experiences learning in predominately white and economically privileged environments, I have seen and experienced how science education rooted in whiteness and hegemonic ideologies can be demoralizing and not represent my identities and lived experiences. I worked professionally as an academic mentoring program coordinator for first-generation college students at Indiana University. While

I do not have K-12 teaching experience, I have taught and conducted research at the postsecondary level for over eight years. As a faculty in higher education and student affairs, I regularly teach graduate level preparation courses for students interested in working as higher education professionals in academic affairs, college counseling, STEM student support services, and academic advising. I have also cultivated learning spaces where education can be a transformative space for learners to want to enact change. I feel strongly that STEM educators have the capacity to create more culturally relevant spaces for learners if they have the tools and resources. This article is part of my effort to move science education and advising forward by creating more socially just and equitable learning environments in and out of the classroom. Our actions as educators and researchers must match our values of social justice and equity.

While school counselors and academic advisors perform similar functions – guide students through academic and professional decisions – there are important differences in their histories, contexts, and roles. In the PK-12 grade bans, *School Counselors* are charged with providing effective and appropriate services to the schools' student body, with a special focus on students from historically underserved communities (Holcomb-McCoy, 2007). The rapidly changing demographics of schools has spurred ongoing discussions about the cultural competencies that professional school counselors need to serve racially minoritized student populations (Erford, 2014; Hines et al., 2014; Hines et al., 2015; Holcomb-McCoy, 2007; Holcomb-McCoy et al., 2008). *Academic Advisors*, on the other hand, are charged with supporting higher education students' educational pathways and career plans that will help students complete their degree or certificate programs in a timely and efficient manner (College Board, 2010). Academic advisors suggest course sequences, provide one-on-one advising, and support students curricular and co-curricular involvement and learning (College Board, 2010).

As the demographics of higher education continue to shift, as more racially minoritized students enter colleges and universities, research on academic advising has also pointed to the need for approaches that are rooted in multicultural competence (Harper, 2012; Harper, 2019). In this section we highlight further the importance of distinguishing the role that school counselors and higher education academic advisors play in the education trajectory of students in PK-20 education pathways and beyond.

*School Counseling in K-12*

School counselors play a significant role in students' postsecondary planning (ASCA, 2019; College Board, 2010). For example, school counselors in PK-12 can assist in a variety of ways such as providing students in the development of educational goals, providing students with information and knowledge about high school classes that can help them prepare for college or career choices, identification of current and postsecondary opportunities (e.g., college, vocational school, workforce, apprenticeships, scholarships), and relaying information to parents about postsecondary opportunities (ASCA, 2019; College Board, 2010). Moreover, school counselors foster college and career readiness by encouraging students to think about people, traits, friends, sources of information and other natural and available resources in their lives that might help them in their career or college decision-making situations (Erford, 2014). For example, school counselors use career assessments to help students consider and/or decide on which postsecondary pathways would be the most appropriate and fulfilling. School counselors also contribute to increased number of college enrollment and persistence rates by developing programs and services to support all students via "individual planning," as well as addressing inequities that prevent certain students from successfully transitioning through high school into college (Holcomb-McCoy, 2007). Finally, school counselors are expected to provide counseling, consultation, and support to students and their families to ensure that they are properly prepared for the college planning and acceptance process, based on each student's college and career aspirations and goals (ASCA, 2019). For many students, the influence of the school counselor plays a critical role in the college predisposition among students (Muhammad, 2008), especially when parental educational experiences are limited and counselors can help families understand the how's, why's, costs, and benefits of postsecondary education (McDonough, 1997).

*Academic Advising in Higher Education*

The distinct perspectives and contributions of academic advising have been examined and evolved over time through both professional development and scholarly inquiry (Schulenberg & Lindhorst, 2008). Broadly speaking, academic advising involves engaging students to think critically about their academic choices and make effective plans for their education (Council for the Advancement of Standards in Higher Education [CAS], 2005). Academic advising at the higher education level requires an advisor's interdisciplinary knowledge about student development, communication theory, academic disciplines, and more. Most colleges and universities in the United States offer academic advising to help undergraduate students set and achieve their educational and professional goals. In general, an advisor's duties include monitoring students' academic progress, provide personalized assistance with selecting courses and developing a plan of study, give information on academic programs and majors, and offer academic and career mentoring. Additionally, first-year or pre-major academic advisors in higher education help students select an appropriate field of study (Carlstrom & Miller, 2013). For some students, a "high-touch" model of academic advising is particularly beneficial, as students interact closely with their advisors throughout the academic year to receive supports (Canaan & Mouganie, 2019).

For several decades, the field of academic advising has outlined three distinct approaches that yield different results related to student outcomes are: *prescriptive*, *developmental*, and *intrusive* advising (see Table 1). Prescriptive advising seeks to prescribe an academic plan for students to follow closely that comprises curriculum requirements, rules, and regulations, which is meant to address the student's expectations and goals (Earl, 1987). However, given the rigidity of these plans, prescriptive advising often ignores the sociocultural, sociohistorical, and socioemotional factors that drive academic motivation and success. Developmental advising, on the other hand, is framed from a collaborative perspective that creates a process-oriented relationship between advisor and student, where the student's total educational, personal, and career goals are the main focus (Winston, Ender, Miller, 1982). While taking the student's whole person into account is productive, developmental approaches tend to focus on long-term, sustained strategies for addressing (struggling) students' goals and needs, which can leave students unsupported during sudden crises. Moreover, recognizing the multiple dimensions along which students benefit from advising does not always lead to advisors and students developing in-depth relationships, which research has shown to be crucial for succeeding in STEM programs (see below). Finally, intrusive advising approaches take an action-oriented stance that involves motivating students to seek help when needed, rather than waiting until the situation is dire. Bringing together the good benefits of prescriptive advising (expertise, awareness of students' needs, structured programs) and of development advising (relationship to a student's needs), intrusive advising is a direct response to an identified academic crisis with a specific course of action to support the student (Upcraft & Kramer, 1995). However, advisors who follow an intrusive approach can also keep students at arm's length, avoiding developing deep knowledge of who students are outside of academic contexts or relationships, as the advising is solely focused on addressing academic issues.

*Table 1: Academic Advising Approach Summary*

| **Advising Approach** | **Focus** | **Less Emphasized** |
|---|---|---|
| *Prescriptive Advising* | Quick Solutions; impersonal; efficient | Feelings; Thoughts of the student |
| *Developmental Advising* | Discussions on Academic goals, plans, and actions between advisor and student | Quick solutions, in-depth relationship building; |
| *Intrusive Advising* | Ongoing relationship building between advisor and student; Focus on issues that may impact academic performance | Focusing on only academic issues; impersonal |

*Successes and Challenges of Advising Models in STEM Education*

The concerns for how to best advise high school and higher education students into and through STEM fields is as old as the push for bringing "producing" more STEM professionals that came after Sputnik in the late 1950s, if not older. Many have dedicated their careers for understanding what it means both to attract and support students into undergraduate and graduate STEM programs, with the need for short-term and/or sustained (often informal) advising coming to the fore. And yet, after conducting a literature search through multiple scholarly databases (e.g., ERIC's ProQuest), we were unable to find many peer-reviewed studies that build on the widely accepted models of advising mentioned above. Still, we thought it would be useful to outline the contributions from some of them as a way of getting a sense of where the field's thinking has been.

First, we were not able to find any studies that explicitly built upon *prescriptive* approaches for advising students in or into Science, Technology, Engineering, and/or Math in high school or higher education. We were able to find only one study that focused on the outcomes of developmental advising for STEM students. Specifically, Coronella (2018) found that developmental approaches did not promote persistence for first-generation Latinas in a university-based Engineering program, partly because these strategies did not account for or validated the students' lived experiences. Coronella's study is consonant with other research from STEM education that argues that racially and gender minoritized students have different needs and experiences with advising, contributing to the exclusion of these groups.

We did find three research articles (Carter et al., 2020; Rodgers, Blunt, Trible, 2014; Smith et al., 2019) that studied the effects of intrusive advising in higher education STEM programs. Carter and his colleagues (2020) studied the efficacy of the "Guided Pathways" model, which built on intrusive approaches to advising and centered on four key principles: (1) colleges need to have a clear map of required courses; (2) colleges need to provide guidance and counseling that allows incoming students select the best-fitting program of studies; (3) college advisors need to closely monitor and encourage students to keep up with the required courses; and (4) colleges need to work closely with students to monitor and ensure their progress and success in required courses, and plan interventions when needed. After following around 25 students through four academic years, results from this initial study suggest that the success of these students could be attributed to the full-tuition scholarship these students received and/or the high school preparation these students brought to their program, but it could not be attributed to the intrusive advising they received. Specifically, these students were successfully achieving their academic goals well before they began receiving advising support from their Success

Coach. Rodgers, Blunt, and Trible (2014) also studied the implementation of a program based on intrusive advising meant to address the low graduation and high attrition rates of STEM majors – the PLUSS Initiative. Specifically, the PLUSS Initiative placed what they considered “under-prepared” students in remedial college Algebra courses to prevent them from failing later STEM courses, as part of a comprehensive strategy that included: developing profiles to identify at-risk student, formal and informal student advising sessions, student support to aid in the transition to college, and a first-year seminar course about strategies for successful completing their STEM degrees (2014, p. 37). The authors employed a quasi-experimental design and found that, for the 281 students they included in their analyses, the PLUSS Initiative had effectively increased the 1-year, 2-year, and 3-year retention rates for under-prepared students in STEM majors (from 32% to 53%); the program also changed how advising was done at the institution, transferring the advising responsibilities to PLUSS advisors and away from STEM faculty. The last study we found was from Smith and her collaborators (2019), who studied the effects of an intrusive advising program on the retention and persistence rates of undergraduate students majoring in Biology, within the contexts of the largest historically Black university, North Carolina A&T State University (78% of the student-body identified as Black). Their Life Mapping and Advising Model comprises six key features: (1) dedicated advising space, the Life Mapping and Advising Center (LMAC), (2) effective advisors, (3) integrated peer mentor and peer tutoring programs, (4) an intrusive advising strategy, (5) integration with first-year student success courses, and (6) life coaching (2019, p. 291). Though the program is still getting off the ground, the authors found that this structured intervention was already showing promising impacts: from advisors including interweaving discussing academic performance with students career goals and family relationships, to seeing how Biology faculty were developing deep relationships and having authentic interactions with students, to cementing a department-wide stance towards seeing "students as individuals with the potential to be successful" (2019, p. 310).

Overall, all three studies converged on the position that, rather than trying to figure out why traditionally under-represented students leave STEM programs in colleges and universities at higher rates than their white counterparts, researchers should focus on identifying productive strategies for increasing retention and persistence. Through structured programs and interventions, these authors aimed to understand how to best support struggling students succeed academically once they had been admitted to their STEM majors, although the effectiveness of these interventions was mixed – some groups achieved their goals, others did not. Ultimately, while all programs aimed to find the potential in individual students and create tailor-made plans, only some focused on who students were and could become outside of the classroom. Moreover, all these studies framed their advising approaches in STEM education around neoliberal and capitalistic goals, taking at face value that unproblematically increasing the number of historically minoritized who enter and persist in STEM fields is valuable in and of itself. For these reasons, in this series of articles, we collectively argue that a new approach to advising is needed, especially one that understands and acts on the lives and resources and goals and needs of historically minoritized students, especially in relation to the purpose of STEM in society.

## The Sociopolitical Realities of Science Education in Secondary and Higher Education

In the previous sections we considered the different models that have guided approaches to advising students and how these models have shaped advising of racially and gender minoritized students in(to) STEM fields. The research we reviewed focused primarily on outlining and investigating the impact of advising interventions with the goal of increasing students' academic success, which in some cases included retention. One common feature across these different advising (and counseling) models is the focus on the individual student and creating all kinds of scaffolds that would allow them to succeed academically. From structured and required programs, to developing deep relationships between advisors and students, these advising models have created robust systems to support students through crises and adversities. Specifically for racially, economically, and gender minoritized youth, some have developed sophisticated intrusive advising programs (e.g., Rodgers, Blunt, Trible, 2014) as a way to mitigate the risks that these students experience as they move into and through STEM majors.

While this work is crucial for understanding the benefits of certain advising approaches, these models' focus on approaches at the micro (e.g., students) and meso (e.g., institutional programs) levels left us wondering how these individual-oriented strategies engage with minoritized students' experiences with macro systems. For instance, a successful advising model should address the experiences that minoritized students report with departmental cultures, particularly whether students see their respective STEM department as a welcoming space. To address those wonderings, we draw on existing research in science education that leverages critical racial and gender theories, as well as ethnographic methods, on the opportunities and challenges that racially and gender minoritized students experience in STEM majors and fields. Thus, in this section we focus on the studies in science education that have investigated in greater depth: (1) the assets and interests that historically minoritized students bring to STEM education; and (2) the existing deficit-based models of advising that frame minoritized students as needing remediation and do not attend to the sociopolitical dynamics that surround students' choices to join STEM. Through reviewing this literature, we aim to provide further insight into what structural features of those experiences allow BIPOC folks to be successful and/or what structural features are significant impediments.

One prominent study in this area was conducted by Ong and her colleagues (Ong et al., 2011), who focused on the experiences of undergraduate and graduate racially minoritized women in STEM programs. Specifically, Ong and her co-authors used the theoretical lens of the double bind -- " the way in which race/ethnicity and gender function simultaneously to produce distinct experiences for Women of Color in STEM" (2011, p. 176) -- to investigate the experiences of Women of Color in STEM programs. The authors conducted an extensive literature review of STEM education and careers at different levels (e.g., undergraduate, graduate, career pathways) and classified the empirical studies according to the race and ethnicity of the undergraduate and/or graduate students, as well as the specific fields within STEM that the programs were associated with.

Based on their analyses, Ong et al. debunked the persistent myth that Women of Color do not succeed academically in STEM programs because of their lack of interest. Building on multiple empirical studies, the authors concluded that "the social and structural environment of college as the main source of Women of Color's attrition" (2011, p. 181); this is especially the case in Predominantly White Institutions (PWIs). For instance, Ong and co-authors found that racially minoritized women occupy a unique position in STEM departments and are at the receiving end of compounded negative racialized and gendered experiences, (micro)aggressions that leave them feeling unwelcome and unrecognized by the institution. Repeatedly, the students in these studies referenced the cultural disconnect and hostility that exist within PWIs, where most of the high-ranking STEM graduate programs are located. Specifically, PWIs often lack infrastructures designed to recruit into and retain racially minoritized women in their undergraduate STEM programs, which tend to include supportive faculty and community-oriented programs that promote students' academic success. Moreover, PWIs tend to perceive

Minority-Serving Institutions (such as HBCUs) as being less academic rigorous and, therefore, their graduates being less academically prepared; these deficit-based perceptions are compounded with the (societal) stereotypes about Women of Color that these graduate students are constantly confronted with.

Ong and her co-authors also found that these women have to make an extra effort in order to: fit within meritocratic expectations of success that do not acknowledge the social and historical realities of systemic sexism and racism; actively push back against negative stereotypes their peers, faculty, and/or advisors may hold of them; and build support networks that will validate their identities as emergent STEM professionals. And while these racially minoritized women can find support and benefit from the mentoring relationships they develop with faculty members in their departments, these students also report that these relationships can be counterproductive and frustrating, especially when the faculty do not understand the racialized and gendered experiences of these students and/or are interested in developing relationships that center only on academics. Similar trends were reported by Hazari and her co-authors (Hazari, Chari, Potvin, Brewe, 2020), who found that culture and community in undergraduate physics programs have a deep impact on the identity work of racially and gender minoritized students, while simultaneously then the ways that these students constructed their identity affect the culture and community of their programs. Ong et al. concluded that strong mentoring relationships between Women of Color and faculty are rare, especially due to the over-representation of white men in these kinds of positions, as well as a significant cultural change within STEM departments.

These findings were corroborated in a follow-up qualitative study that Ong, Smith, and Ko (2017) conducted where they interviewed 39 Women of Color in STEM fields, at different stages of their careers. Building on theoretical frameworks like *Critical Race Theory*, *Intersectionality*, and *Counterspaces* the authors developed an analytical approach for making sense of the interviews they recorded with each participant, focusing on the adversities and challenges that these Women of Color had faced in their STEM-related trajectories, as well as the actions they had taken to mitigate those adversities. First, it was clear that most of these women felt isolated in their classes, departments, and places of work, as they were on the receiving end of race- and gender-based (micro)aggressions. For instance, some students were excluded from fully participating in their STEM courses because they were perceived to be less capable to engage with the material, while others avoided interacting with peers and/or instructors out of fear of being perceived as unprepared and, thusly, confirming their stereotypes (2017, p. 216-219). In all, these Women of Color found that the prevailing culture and structures of their STEM programs, which have traditionally defined academic and professional success from the perspective of white men scientists (e.g., competition, individualism), to be unwelcoming.

In order to cope with this violence, the Women of Color interviewed by Ong and her colleagues created counterspaces:

> academic and social safe spaces that allow underrepresented students to: promote their own learning wherein their experiences are validated and viewed as critical knowledge; vent frustrations by sharing stories of isolation, microaggressions, and/or overt discrimination; and challenge deficit notions of people of color (and other marginalized groups) and establish and maintain a positive collegiate racial climate for themselves. (2017, p. 209)

Specifically, Ong and her co-authors identified five main types of counterspaces that Women of Color created and sustained throughout their whole STEM careers (i.e., from undergraduate to professional spaces): Peer-to-Peer Relationships; Mentoring Relationships; National STEM Diversity Conferences; STEM/Non-STEM Campus Groups; STEM Departments. When *relating to other peers*, the authors found that both undergraduate and graduate Women of Color sought safe havens in study groups within and across classes, where they could share resources and support each other, upending the traditional competitiveness of STEM programs. Relatedly, advanced undergraduate and graduate students would reflect on their own experiences to sympathize with junior peers, as well as support them in navigating the institutional politics. Rosa and Mensah (2016) found a similar theme in their analyses of the experiences of Black women physicists, who reported intentionally seeking out study groups with other students in their undergraduate and graduate programs to fend off isolation, even if they were only minortized student in the group. Specific to *mentoring relationships*, Ong et al. found that both undergraduate and graduate Women of Color sought out mentors who recognized their skills, held high academic expectations for them, created a safe space for venting and/or making mistakes, and supported them in navigating the transition towards the next steps in their careers, may it be graduate school or a professional position. Particular to graduate programs, Ong and her co-authors also found that Women of Color sought advanced peer mentors who encouraged them "to defend against sexual harassment by male student, reported issue to HR" (2017, p. 221). Finally, the study participants thought that STEM departments also shared a responsibility in making them feel welcomed, safe, and intellectually engaged through enacting policies and practices like: offering tuition-free programs to support them develop relationships on campus; PWIs celebrated the accomplishments and research of Women of Color at internal conferences;

having anti-racist missions and policies; and created opportunities for students of color to interact and develop relationships with faculty.

Building on their analyses, Ong and her colleagues concluded that isolation and (micro)agressions are central to the “negative social experiences contribute to social discomfort and a sense of not belonging, that in turn lead to a lower persistence rate in STEM education than their White female or male counterparts” (2017, p. 229). Moreover, the authors highlighted the importance of institutions being aware of and working actively to counteract *institutional microaggression*: the actions, inertia, structures, and practices of institutions that create a hostile campus climate for minoritized groups (Yosso et al., 2009, as cited in Ong et al., 2017). A clear example of these institutional microaggressions is the kind of advisor who actively (or inadvertently) allow for race- and/or gender-based violence against Women of Color within their science department, which would negatively impact the standing and collaboration of students of color. Finally, Ong and her co-authors urge STEM departments to foster “counterspaces as locations of activity or thought that counter the dominant culture in STEM, offering the potential to disrupt historical power structures of STEM culture” (2017, p. 232). Within these spaces, Women of Color can connect with peers and/or mentors to counter personal attacks, to undo feelings of isolation, to a strong sense of self in a culture that seldom includes them, and to find ways of navigating institutions and organizations to achieve academic and professional success.

Similarly, Long and Henderson (2018) found that Black and Latino college men in engineering and related STEM fields revealed institutional barriers to their success that university administrators, faculty and staff can work to remove. Four major themes emerged from this study involving: (a) inadequate academic advising, (b) poor quality teaching, (c) limited course offerings, and (d) insufficient financial aid. They called for future research to apply intersectionality theory with Black and Latino males majoring in engineering and related STEM fields to challenge broad stereotypes that are placed on men of color. Future work can also use an anti-deficit perspective to further highlight the positive traits and strategies that Black and Latino men in STEM use to overcome institutional racism and systematic oppression.

Finally, White, DeCuir-Gunby, and Kim (2019) employed a mixed methods approach that was informed by Critical Race Theory when studying the relationship between racial identity, science identity, science self efficacy beliefs, and science achievement for 347 African American students enrolled in Historically Black Colleges and Universities (HBCUs). White and her co-authors used a series of instruments for assessing all participating students' Black identity (i.e., the MIBI), their science identity (i.e., the science identity scale), and their science self-efficacy (i.e., science self-efficacy inventory), as well as a semi-structured interview protocol with 14 of them (one for each of the five HBCUs represented in the sample). Through analyzing their quantitative data, White et al. observed that there did not seem to be a relationship between racial identity and science identity in students' responses, although some respondents who exhibited high science identity were also more likely to see their Black identity as part of a broader assimilationist project into mainstream society and institutions. The authors' analyses also yielded that, in their sample, there did not appear to be a correlation between science identity and college science achievement; they did identify a direct relationship between students' racial identity and their college science achievement.

From their qualitative data, White and her co-authors found that the interviewed participants "expressed the strong sense of belonging that they experienced on their campus that not only shaped their racial identity, but also provoked them to use their skills and talents to help advance the Black community" (2019, p. 65). Relatedly, interviewed students were able to successfully intertwine their science identity, racial identity, relationships, interests, priorities, and their sense of agency to benefit African American peoples in the US through science. Specifically, through “the social relations that students were able to engage in with African American faculty and peers resulted in the development of their science identity, as well as a greater cohesiveness with the science community” (2019, p. 65). Finally, White et al. found that each Black student they interviewed expressed a strong appreciation for their science discipline and subject matter, suggesting that, through being supported by Black faculty and mentors, these students developed strong scientific dispositions that, in and of themselves, related to how they saw themselves in relationship to science within institutions, organizations, and companies. These results contrast tremendously with the kinds of experiences reported by Black students, and students of color more generally, in PWIs, where whiteness tends to have an oppressive effect and exercise its “right to exclude” African American students from educational settings (Harris, 1993, as cited in White et al., 2019). In HBCUs, on the other hand, Black and African American science students were made to feel welcomed and valued, rather than like intruders who constantly have to prove their qualifications and their worth to receive a quality education.

The trends and experiences reported by racially and gender minoritized undergraduate and graduate students in science-related institutional spaces are, unfortunately, consonant with how high school students of color in the US relate to science as a field. Across multiple research studies, Black and Brown students report that science is boring, disconnected from their lives, excluding and exclusive learning spaces, and even spaces where they experience racialized harm (e.g., Atwater, 2000; Barton and Tan, 2010; Basu, 2008a, 2008b, 2008c; Bullock, 2017; Mutegi, 2011). Science educators tend to hold and act upon negative stereotypes about the motivations, abilities, and needs of Black and Brown students (Pringle et al., 2012). For instance, science teachers and school counselors tend to hold and enact deficit-based views of high-achieving Black girls and young women, truncating these students' academic success and potential for self-determination (King & Pringle, 2019). Moreover, the PK-12 science curriculum tends to define science as the domain and contributions of European white men, sending the clear message that racially minoritized peoples have not and cannot build knowledge of and relationships with the natural world (Mensah et al., 2018). Finally, high schools where the majority of the student body is racially minoritized lack opportunities for accessing high-quality courses, as well as structures that would support students who enter STEM careers (Bullock, 2017; Eisenhart et al., 2015; Means et al., 2017). In a way, high schools can become sieves that filter Black and Brown students out of science, even before they get to college.

A recent study by King and Pringle (2019) that tries to understand and disrupt the negative experiences of high school Black girls in science learning spaces. Specifically, acknowledging the prevalence and prominence of racialized and gendered interactions that Black girls and young women experience in science classrooms, King and Pringle design a counterspace that would create opportunities for challenging deficit-based notions and develop positive adaptive responses. Within this new learning environment, King and Pringle sought to create an out-of-school science learning program where Black girls and young women could "problematize deficit notions, establish and maintain relationships, and validate each other's experiences as important knowledge" (2019, p. 542). Building on critical race methodology, the authors observed and interviewed six Black girls (grades 4-7) who participated in the "I AM STEM" out-of-school program, in order to understand how these students accessed, engaged in, and responded to the program's STEM learning activities; the girls also generated narratives of their own experiences learning STEM in both K-12 and informal spaces. King and Pringle found that, as early as 4th grade, Black girls and young women become aware of the differential treatment they receive in science class, especially by white teachers, which made them feel excluded, disconnected, and marginalized. For instance, a 7th grader stated, "me being Black impacts me more as a science learner", after seeing her white teacher treating a white girl better than her (2019, p. 560). To counter these kinds of experiences, the authors and designers of the learning environment made efforts that fostered participating Black girls and young women's interests in STEM through field trips and engaging in authentic investigation of phenomena, as well as supporting the girls become more agentic in how they continued to engage in STEM learning activities outside of the out-of-school program (especially back in their K-12 schools). Based on their findings, King and Pringle emphasize the importance of creating counterspaces where Black girls and young women not only see themselves as capable of engaging meaningfully with science, but also spaces where they can receive the support for and support each other to reject the racialized and gendered (micro)aggressions they experience within traditional science spaces that uphold white men and their practices as the norm.

Similar kinds of harm are experienced by racially minoritized young women in high school science learning spaces, just as the one that Dr. Miles witnessed in a chemistry lab as the white teacher expelled from the classroom a Black young woman for giggling (Morton et al., 2022). Drawing on prior literature on STEM education, Morton, Miles, Roby, and Ortzin (2022) argue that "Black students contend with deficit-oriented, negative stereotypes regarding their perspectives and engagements" (2022, p. 132), often met with harsh punishments and chastisements from white science teachers. Add to these interpersonal trends the fact that Black and Brown students seldom have access to high-quality science courses in high schools and the mixture results in K-12 science learning environments that very loudly and explicitly tell racially and gender minoritized students that they do not belong. To counteract and disrupt the structural racism, Morton and his co-authors (2022) propose the *Black Liberatory K-12 Science Education* (BLKSE) call to action as a mechanism for both naming the anti-Blackness that has characterized most high school science classrooms and root out anti-Blackness in science epistemologies. Specifically, the authors propose these seven guiding concepts that aim to stop the violence in science classrooms, begin to repair relationships, and redress historic harms: (1) Start with Black Students are Brilliant; (2) Disrupt Existing Anti-Black Biases; (3) Value Black Student Contributions; (4) (Re)insert Black Perspectives and Histories; (5) Embrace Black Engagement Critically; (6) Center Black Girl Magic and Black Boy Joy; and (7) Acknowledge the Diversity of Blackness (2022, p. 142). Ultimately, BLKSE works towards and advocates for Black liberation in science classrooms, reminding researchers, teachers, teacher educators, and policy makers that Black youths deserve to be "loved, appreciated, valued, and fully embraced by all, individually and structurally" (2022, p. 147).

In no uncertain terms, the studies we have included here (and many others that we did not include due to space considerations) point to a shared reality: university-based STEM programs, especially those in PWIs, are often unwelcoming and violent towards racially and gender minoritized students. As students and graduates have reported, this hostility due to the differences in lived experiences between the faculty (who primarily are white men) and students, the rejection of the ways of knowing and valuing that students bring to the science programs, the lack of infrastructures that can support students in navigating financial challenges or opportunities, or a combination of these and many more factors. What this literature makes clear is that there is a deeper layer of racial and/or gendered experiences, contradictions, and animosity that most of the research on the traditional advising models (i.e., prescriptive, developmental, and intrusive) ignore altogether. Thus, as we consider what kinds of advising strategies and infrastructures undergraduate and graduate students would benefit from, we argue that it is paramount to better understand the micro- and meso-level injustices that fuel the rejection of and attrition from university-based science programs. Before delving into that conversation in this paper and its companions (Morton & McKinney de Royston, 2022; Dodo Seriki & McDonald, 2022), we stop and reflect on how solely increasing the presence of racialized and gender minoritized students in science programs and careers may not be enough.

## Advising in STEM and Sociopolitical Projects

Central to how to advise students into and through science majors and careers, especially historically minoritized students, lies the sometimes uncomfortable question of how and why we should aim to do so. Advocates of Diversity, Equity, and Inclusions (DEI) in science throughout P-20 have rallied around the need to fix all kinds of issues that are associated with the Science/STEM "pipeline," from trying to add more water/bodies to it, to understanding were the so-called leaks are located, and sometimes even worrying about where the water will end up at the end of it. We worry, however, as some have before us (e.g., Basile & López, 2015; Calabrese Barton & Tan, 2020; Vakil & Ayers, 2019; Vossoughi & Vakil, 2018), about the underlying -- and often unquestioned -- assumptions about the learning spaces and cultures we are thinking of bringing more racially and gender minoritized students into. To be clear, this worry should not be interpreted as us resisting the need and commitment to do so -- we wholeheartedly recognize the need to address the historical and contemporary injustices in education and opportunities towards liberation and self-determination that close doors for minoritized peoples, as well as the limits these injustices and narrow set of worldviews place on our understanding of the natural world. Instead, as we work towards a vision of what a healthy and productive advising framework that takes the whole student into account, we want to make sure that we do not inadvertently uphold and recreate the same conditions that undergird the power structures that continue to subjugate minoritized peoples in the US (and abroad).

Without delving into the socio-epistemic debate on how and why knowledge about the natural world is constructed, we do think it is important to recognize that the stance towards the epistemology of science shapes the how and why we should advise minoritized folks into the discipline. For too long, science has been framed as holding a privileged place that transcends any kind of human positionality (e.g., values, goals, fears) -- what Sandra Harding called a "view from nowhere" (Harding, 1993, 2015). For some, Science exists in a rarefied place where human beings distantly observe the natural world and, using their inductive and deductive strategies, they are able to construct laws that explain the how and why of phenomena; this happens devoid of any kind of "subjectivity" or "interpretation." From this perspective, who the scientists are, what their experiences in the natural and social world are, what they care about, what they value, what they fear, what they reject, have no place neither in their observations of natural phenomena nor in explaining the phenomena they observe (Harding, 2006, 2015). On these "cold, hard facts," scientists built an academic space where the truth comes from this view from nowhere and is impervious to the power dynamics of the social world. In other words, the ills that brought us Jim Crow, a crisis of murdered and missing Indigenous women, nuclear devastation, and the mass incarceration of racialized folks have no effect on how scientists make sense of the world.

But the science can no longer cover the Sun with a finger and, for the past few decades, has been grappling with the reality that the obscene majority of the STEM (tenured) faculty are white, cis, well-to-do men; a composition that flies in the face of the actual demographic make-up of the US. Guided by policy documents to departmental initiatives, the sciences have been pursuing DEI efforts to make significant changes to what students are in their courses, labs, and in science-adjacent careers. Within a model of knowledge-construction that favors a "view from nowhere," the most obvious approach to countering centuries of injustices and, in turn, changing the academy involves increasing the number of minoritized students (this is the Inclusion part of the strategy). This strategy assumes that inviting the "other" into an existing disciplinary and academic structure, Diversifying the faces in the hallways. One motivating factor is the very real under-/over-representation in the demographics of a department, which often come with the recognition that Black, LatinX, and Indigenous folks of all genders are barred from these institutional spaces. Additionally, advocates of this approach often refer to the possibilities and benefits that come with "seeing faces like yours," building on the experiences and goals of mentors who can counsel and advise minoritized students in ways that are culturally relevant and sustaining. In no way do we discount the merits of these two goals of the efforts to increase DEI in science departments. The under-representation of certain groups of people in science is concerning, as well as the lack of mentors and role models who can help students navigate institutions of higher education. However, stopping at "equity as access" (Vossoughi & Vakil, 2018) creates two tensions for us that we think the field should consider as we engage in advising and counseling minoritized students into science majors and careers.

An important tension that arises from these "equity as access" models is the lack of explicit reflection on how reform efforts in Science and STEM education can be "implicated in the advance of neoliberal multiculturalism, anti-Blackness, colonialism, white supremacy, and militarism in this unique historical moment?" (Vakil & Ayers, 2019, p. 450). The reasons, values, and/or ethics of bringing more racially and minoritized peoples into and through science never address how and why to implement these efforts. This lack of self-awareness leaves the door open for DEI efforts to reproduce and reify the same power structures that contributed to the exclusion of minoritized folks in the first place, domestically and internationally. For instance, education policy documents since the 1980s have framed the rationale and need for increasing the number of youth of color in STEM careers as a geopolitical matter. Most of these documents frame the need to increase the number of racially minoritized youth in STEM disciplines as tapping into a potential labor force that has been unexplored and unexploited until now and, without it, the US cannot remain competitive in the global stage (Basile & López, 2015). Specifically, Basile and López analyzed 17 recent policy documents and reports and found that efforts to diversify STEM have taken a color-evasive approach and erased the shared and unique needs of youth of color. This stance was further reflected in the finding that these policy documents and reports virtually never center the goals, needs, and/or humanities of youth of color, and instead privilege a "one-sided economic perspective, favoring the owners and operators of the STEM enterprise" (2015, p. 540). Basile and López also point to the inconsistencies with which the need to diversify STEM is framed across these documents as further evidence of how these purposeful inclusions and exclusions are connected to the economic, political, and militaristic agendas of the times when these documents were written.

Another area where a model of advising that foregrounds "equity as access" can lead to trouble is the deep connections between STEM fields and the US's militaristic goals. Since its founding, the US military has relied on scientists and engineers to create and refine the weapons and means for the country to forcefully dominate peoples within and beyond its borders. Through efforts like the militarization of the academy, the US and its military has funded, recruited, and partnered with STEM scholars in colleges and universities to maintain the military-industrial complex; in some cases creating whole new fields of science/STEM were developed through and for militaristic purposes, such as material sciences (Vossoughi & Vakil, 2018). The most clear example of how militaristic and imperialistic goals can drive changes in STEM education is the launch of Sputnik in 1957, which sent the US public and policymakers into a panic. For some, that the Soviet Union was able to launch a probe into space before the US represented a massive failure of our education system, a geopolitical defeat that could only be explained and solved by increasing the quantity and quality of science and math courses available to P-20 students, as well as the number of students who would eventually become the STEM professionals who would bring the US back to its rightful place in the geopolitical landscape (Rudolph, 2002). That year, congress passed the National Defense Act of 1957 and made it to where "federal funding for mathematics and science education increased by an order of magnitude in less than three years" (Meltzer & Otero, 2015; p. 451). Some of those funds went directly to funding scholarships, career fairs, and even "a series of professional development workshops and summer institutes to assist K–12 science teachers in reorganizing their curricula and teaching" (Vossoughi & Vakil, 2018; p. 125). More recently, the US Department of Defense funded the StarBase program that intends to "expose our nation's youth to the technological environments and positive civilian and military role models ... nurture a winning network of collaborators, and build mutual loyalty within our communities" (DoDStarBase, n.d.; dodstarbase.org). Through initiatives like Lockheed Martin's "Engineers in the Classroom," which places Lockheed engineers in schools to act as mentors and advisors, the DoD is aiming to increase the number and kinds of peoples that pursue STEM-field careers within the military-industrial complex (Vossoughi & Vakil, 2018).

Given these complicated intertwinements, we argue that efforts to diversify science must be rooted in a critical analysis of how Eurocentric ways of knowing, being, and valuing have created the conditions for scientists to (inadvertently) contribute to the ideologies and structures that harm students. Simply approaching the task of advising more historically minoritized students to join science from an "equity as access" model will guarantee that we maintain, and even strengthen, the connections between science and the capitalism and imperialism that oppresses those students and their communities. Moreover, we need advising approaches that favor a situated view of science, which includes analyses of power as scientists continue to wrestle with the questions of the Universe and eschews the "view from nowhere" (Harding, 1993, 2015). Thus, we argue that we need an approach to advising that: (1) refuses the current epistemological and axiological status quo of science; (2) reimagines a new way of becoming and being a STEM professional that embodies a liberatory praxis; and (3) is always willing to ask how and why bringing more minoritized students into science majors is an ethical effort.

As we reimagine what is possible, we draw on Calabrese Barton and Tan's (2020) argument that most efforts to diversifying STEM education are rooted in a host/guest model, where the current STEM majors and fields act as "hosts" that invite "newcomers" into the space. While this invitation grants rights to those who are invited in, the host institutions/fields have power to choose who is a suitable guest and what kinds of meaning-making practices are deemed respectable and productive. Some of the DEI efforts that we outlined above fall under this dynamic: despite trying to diversify STEM fields, the interests and goals of governmental and educational institutions are privileged over the knowledge, goals, and needs of historically minoritized students and communities. What remain are the oppressive structures that shaped the institutions and fields to begin with, such as white supremacy and cis-heteropatriarchy. Rather than playing the inclusion game, Calabrese Barton and Tan urge us to consider a framework of Rightful Presence, a justice-oriented political project that asserts the legitimate belonging of minoritized youth in STEM fields and institutions through making present the political struggles they experience. To kickstart a process of reauthoring minoritized students' rights within STEM fields and institutions, the authors argue that "allied political struggle is integral to disciplinary learning," especially when institutions work with youths "to challenge and transform what participation in the disciplines entails or what meaningful representations of learning look like" (2020, p. 436). Additionally, Calabrese Barton and Tan propose that rightfulness is claimed through making justice and injustices in STEM and the world visible, particularly through orienting towards more just futures that bring together youths' lives and disciplinary learning. Third, and finally, the authors argue that it will take collective disruption of the guest/host relationalities that characterize STEM fields and institutions, paying particular attention to the normative knowledge/power relationalities that are grounded in traditional forms of asymmetry and oppression. Working towards a Rightful Presence, and away from simple Inclusion, asks us to refuse efforts to assimilate minoritized youths into the culture of power of STEM and, instead, reimagine how making present the lived experiences and political struggles of minoritized youths can both create more meaningful disciplinary learning and more just futures.

Similarly, Vossoughi and Vakil (2018) acknowledge that minoritized youths should be able to access and thrive within STEM fields and institutions, but warn DEI initiatives that prioritize the geopolitical agendas of the US are self-interested and disregard the needs of the students and their communities. Instead, STEM education should be rooted in moral concerns for justice that "begins with and organizes learning around the needs, capacities, values, identities, and possible futures of underrepresented students and communities" (2018, p. 135). This shift towards attending to the needs and goals of minoritized youths builds on the work by Danny Martin (2009, 2013, 2019) and is an intentional strategy for disrupting how the domestic and global interests of the state are often misaligned from what youth and communities want and need. From this stance, Vossoughi and Vakil argue that Diversity in STEM through attending to moral concerns should prioritize the democratization and expansion of the “meaning, values, and purposes of STEM education” (2018, p. 134). Additionally, the authors call for a kind of Representation that focus on the struggle for justice in STEM education and the redistribution of power, particularly around who is included, highlighted, and deemed knowledgeable. Vossoughi and Vakil also acknowledge the need to expand the number of Black, Latinx, and Indigenous folks who work in STEM fields, understanding that this presence can promote economic mobility, community development, and upending racial hierarchies and economic exploitations. Finally, rather than focusing on achievement gaps, Vossoughi and Vakil propose a reimagination of education, where students within and beyond the US can have “intellectually respectful learning experiences and the resources to fulfill their individual and collective potential” (2018, p. 134). As we move forward as a field, we must examine and reject how hierarchies and competition have shaped youth’s educational experiences, and how “belonging in STEM” has been part of assimilationist and dehumanizing projects.

## Opportunities for Becoming, Challenges for Becoming, Structures for Becoming

In this final section, we leverage the concept of *becoming* in order to make connections rooted in equity and justice across the literature on counseling and advising students in STEM education. Similar to emerge, becoming is to move out of the way of something, to become visible, important, and prominent (Harris & Njoku, 2017). In alignment with Harris and Njoku (2017), for us, the term *becoming* is applicable to students at the margins in STEM education, who are attempting to emerge from an education system that is steeped in white supremacist ideologieaAhmed, 2012; Patton, et al. 2015; Patton, 2016). Through an equity and justice analysis of the literature highlighted in this article (and the two articles that follow), we aim to support the holistic development of minoritized learners and the beautiful intellect that surrounds them toward visibility and pathways in STEM education and *becoming* more liberated to learn and grow in less oppressive learning environments. Thus, we offer opportunities for becoming, challenges for becoming, and structures for becoming more equitable and just in the approaches of school counseling and academic advising for minoritized students.

As we continue to consider how the narratives of racially and gendered minoritized students in STEM inform and challenge the holistic approach to both the individual learner and the system, we consider opportunities for becoming, challenges for becoming, and structures for becoming. As mentioned earlier, Morton & McKinney de Royston (2022) offer deeper explanations for a more critical ecological approach for academic advising that builds on four main tenets: (1) disrupting harmful institutional practices and STEM learning spaces; (2) maintaining a holistic approach that fosters learning as becoming; (3) maintaining a holistic approach that fosters learning as belonging; (4) enacting advising that works toward collective social-cultural-structural transformative action and change andassesses learners' outcomes in relation to this process (Morton & McKinney de Royston, 2022).

Specific literature on pathway programs for STEM education situate advising as coupled with career development and mentoring; very rarely is it explicitly pulled out in its own individual entity, as the literature in this article aimed to do. For example programs like McNair, Meyerhoff, IMSD, MARC, and LSAMP have a career-line trajectory and the aims of the programs are about supporting identity development and matriculation. The programs in some ways debunk the persistent myth mentioned earlier that racially minoritized and women students do not succeed academically in STEM programs because of their lack of interest. The literature we reviewed here earlier also highlights the gap in the scholarship regarding a conceptualization of what advising might look like institutionally rather than at the programmatic level. Further research that offers examples of how students are being supported/advised/mentored within science departments and research opportunities through the education life span (P-20+) could offer key implications and inform the structures of advising

## Conclusion

In this article we set out to understand the various approaches to counseling and advising that have been devised to address issues related to retention and persistence of racially and gender minoritized students in science. We began with a review of the different models to advising in higher education, how they had been applied to support Black, Indigenous, and/or Latinx students in science majors and careers. This review helped us realize that, despite the programmatic and structural strategies meant to support students, most of these programs had not been accounted for an important feature of minoritized students' experiences: the destructive racialized and gendered interactions and cultures within certain science departments that bar and/or drive away these students. For further clarity on the kinds of experiences of racially and gender minoritized in science programs, we turned to contemporary empirical work from science education that documents the challenges and opportunities that drive retention and persistence in science(-related) careers. This literature allowed us to fill in some of the gaps at the departmental and interactional levels that can both explain the hostility minoritized students face and elucidate potential levers to enact justice-oriented changes; most did not connect their findings to broader programmatic efforts that institutions of higher education could device and enact in order to prevent and/or ameliorate these injustices in science departments. We find the intersection of these two subfields to be a productive in-between space from which a multi-level, context-dependent strategy can arise to redress the inexcusable and alarming under-representation and exclusion of racially minoritized peoples in science programs and careers in the US. From here, we can imagine a set of action items that science departments, especially in Predominantly White Institutions of higher education, need to put in place, such as: create a formal mentoring program for faculty and students to actively identify, process, and counter the academic norms of dominant groups; create departmental anti-discrimination policies, consequences, and working groups to guard against race- and gender-based violence; and increase the visibility of racial and gender diversity in science, and STEM more generally.

As we focused on the reasons for why racially and gender minoritized students find science undergraduate and graduate programs hostile, we also sat on the ethical question of why we would want to bring more folks into spaces that would also enact material and epistemological violence on them. We do not intend for our question to be paternalistic in nature, or mean to discourage Black, Indigenous, and/or Latinx peoples from joining science, but rather to reflect on what needs to change at the field and institutional levels in order to avoid further injury and dehumanization. As Basile and López (2015) clearly articulate, efforts to increase the diversity of STEM fields must "see the faces, not just the lines and statistics, of the many different Peoples of Color in our country who have the humanitarian right to experience the wonder of a STEM education and the power of owning scientific knowledge" (2015, p. 542). This ethical exploration led us to consider how the field of science, and its related P-20 science education spaces, need to move towards a framing of Rightful Presence, democratization, and transformation that eschew “equity as access” tropes. Without this reimagination, even the most effective advising models will only ensure that more racially and gender minoritized students are sacrificed on the altar of “equality.” Counseling and advising students into and through science careers must explicitly address the democratic, moral, and ethical dimensions of being a scientist, rather than focusing solely on retention and academic success.

The next two articles in this series delve deeper into these considerations, offering recommendations of retheorizing the process of advising and introducing an ecological and holistic approach to advising (Dodo Seriki & McDonald, 2022& Morton & McKinney de Royston, 2022). Specifically, the second article (Morton & McKinney de Royston, 2022) will explore the conceptual fuzziness between advising and mentoring and career, as well as what the learning and advising ecosystems would look like and the roles advising plays in addressing inequities in science education. The authors conceptualize a critical-ecological approach to academic advising in P-20+ STEM education that responds to this article’s literature and critiques of STEM advising and schooling. Morton & McKinney de Royston also draw on Phenomenological Variant Ecological Systems Theory (PVEST; Spencer, 2006) to illustrate the broader advising ecosystem and its key constructs that center learners in the decision-making process regarding their academic pursuit of and continued engagement with STEM.

The third and final article in this series (Dodo Seriki & McDonald, 2022) offers recommendations on how to engage learners in critical thinking about their academic and career choices, and aid their science identity development. Through real-life vignettes of important moments of counseling and advising, the authors propose several dimensions (e.g., cultural competency, critical consciousness) through which advisors can advise Students of Color pursuing science degrees and careers; the authors provide practical examples of how they have seen this work take place to illustrate their arguments. Dodo Sireki and McDonald end their article by calling for more interconnectedness between the identifiable niches in this ecosystem (e.g, elementary schools, out-of-school programs) and the actors within them (e.g., teachers, advisors, parents), in order to establish coherence and provide timely resources across the institutions and spaces where advising youth takes place.

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Data sharing not applicable to this article as no datasets were generated or analyzed, given that the findings presented here come from reviewing peer-reviewed, empirical literature that has already been published and is widely available.

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