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Mentoring across differences in science education: Applying a brokering framework

Christa Haverly¹  | Bryan A. Brown² 

¹Human Development and Social Policy, School of Education and Social Policy, Northwestern University, Evanston, Illinois, USA

²Curriculum and Teacher Education, Graduate School of Education, Stanford University, Stanford, California, USA

Correspondence Christa Haverly, Human Development and Social Policy, School of Education and Social Policy, Northwestern University, 2120 Campus Dr, Room 208, Evanston, IL 60208, USA.
Email: christa.haverly@northwestern.edu

Abstract

Mentoring relationships in academia have traditionally been described as a dyad between a mentor and a mentee. The mentor provides the mentee with both technical and psychosocial support to move toward obtaining their Ph.D. or gaining tenure and promotion. While there is an embedded assumption that mentoring is best suited when people of common background support each other, scholars must consider the impact of mentoring across differences. Given the lack of diversity among senior faculty members in science education, and given the increasing diversity represented among graduate students and early career scholars in science education, inevitably mentoring relationships will be formed across differences in identities (race, ethnicity, gender, sexuality, ability). In our essay, we focus on two focal points: we explore those aspects of mentoring relationships that research suggests are critical to the success of relationships built across differences, foregrounding lessons science education researchers can take from this literature and arguing that it is too much to expect one individual mentor to provide to any given mentee. Next, we propose a brokering framework, leveraging technological advances, to work toward more transformative mentoring outcomes at scale, particularly when mentoring across differences.

KEYWORDS

equity, mentoring

1 | INTRODUCTION

Nearly all faculty are mentors. While mentoring is vital to shaping science education as a field, it is not commonly studied or written about within our community. For generations, mentors played a vital role in helping to translate tacit aspects of the professoriate to a new generation of scholars. Although mentoring is critical to sustaining high-quality scholarship, we allow mentorship to remain a subtle or even unstated component of what we do. In our modern era of virtual meetings and hybrid spaces, we must carefully consider our assumptions about mentoring.

Our approach to mentoring is deeply connected to who is doing the mentoring. Given the increasing diversity among science education graduate students and early career scholars, both challenges and opportunities arise when mentoring across differences. These differences present a critical focal point for consideration. In this essay, we argue that assumptions about the expectations embedded in a traditional apprenticeship framework of mentoring are complex and too much for individual mentors to manage. These expectations are particularly challenging when mentoring relationships are built across differences of race, culture, gender, sexuality, or ability. Adopting perspectives from other disciplines points us to reconsider our apprenticeship approach to mentoring. We propose a *brokering* framework of mentoring for the science education field, in which mentors facilitate connections for their mentees into networks, with current technological advances, that broaden the ecosystem of support for mentees to more successfully usher mentees through academic and career benchmarks.

2 | APPROACHES TO MENTORING

Left unchallenged many may assume mentorship is a catch-all term for the transmission of generic expertise from a mentor to a mentee. However, based on our analysis of the mentoring literature, there are two central functions of mentoring: technical functions and psychosocial functions (Ragins & Kram, 2007; Sands et al., 1991; Zellers et al., 2008). Technical functions include advising, coaching, networking, challenging, and offering feedback to promote professional advancement, tenure and promotion, doctoral benchmarks, and other measures of success (Behar-Horenstein et al., 2012; Cowin et al., 2012; Davis et al., 2011; Evans & Cokley, 2008; Fries-Britt & Kelly, 2005; Holmes et al., 2007; Jones & Osborne-Lampkin, 2013; Shollen et al., 2008). Psychosocial functions include friendship, counseling, advising, and offering coping strategies that promote individual well-being, socialization, and professional identity development (Behar-Horenstein et al., 2012; Chesney-Lind et al., 2006; Diggs et al., 2009; Edmonson, 2012; Fries-Britt & Kelly, 2005; Holmes et al., 2007; Johnson, 2017; Jones & Osborne-Lampkin, 2013; Shollen et al., 2008; Simon et al., 2008). Though there may well be other dimensions of mentoring that mentors include in their practice, in our essay, we will focus on these two categories that emerged from our search (technical and psychosocial) given that they are critical for graduate students to move through their doctoral benchmarks and for early career scholars to gain tenure and promotion, and as such, these functions are central aspects of a mentor's role.

Mentoring can also be framed in terms of mentoring types. Sands et al. (1991) provided a vision of the array of support provided by mentors by describing four types of mentors:

The *friend* socializes, provides advice, and helps with personal problems; the *career guide* promotes the mentee's research and his or her professional visibility; the *information source* provides practical information about promotion and tenure, publication outlets, and committee work; and the *intellectual guide* promotes an equal relationship, collaborates, and provides constructive criticism and feedback. (Zellers et al., 2008, p. 555)

Sands et al.'s (1991) framework for the diverse tasks of mentoring highlights the duality and complication associated with academic mentoring. The framing of mentoring approaches as *Career*, *Information*, *Intellectual*, and

Friend foregrounds the many ways mentors operate as professional support. Furthermore, who is being mentored, who is doing the mentoring, and what the mentoring is intended for (be it institutional promotion or humanitarian service) will likely influence the approach or function of a mentor-mentee relationship.

In this essay, we first consider the benefits of successful mentoring relationships to argue for their importance to the field. We next explore what research suggests is important for sustaining successful mentoring relationships across differences. Taking these characteristics into account, we develop an argument that it is unreasonable to expect any one individual in a mentoring role to fulfill all of the roles and characteristics needed for successful mentoring relationships for their mentees—the apprenticeship model. We believe that a move away from a sole apprenticeship framework of mentoring toward a brokering framework which leverages technological advances to connect mentees to networks across the globe can better meet the needs and demands of a mentoring relationship formed across differences. While not explicitly critiquing the apprenticeship model as deficient, we instead recognize how reframing the expectations of mentoring and employing modern technology moves the difficulty of the task of excellent mentoring in important ways. Said differently, asking the modern mentor to do what they can to broker their mentee into meaningful supportive relationships expands the possibilities of mentorship. We conclude by describing networks and opportunities for brokering that already exist within and outside the field of science education, and we make suggestions for where there may be a need for additional networks.

3 | THE NEED FOR GOOD MENTORING

As scholars in science education consider the value of mentoring in academia, we must move from a belief about mentoring as a passive support system toward an approach that explicitly values mentoring as a critical component of academic structure. Structured mentoring has meaningful impacts on a number of aspects of the lived realities for both mentors and mentees. Emergent research from the business sector suggests mentors benefit from a sense of purpose and community connectedness (T. D. Allen et al., 2006; Hundey et al., 2020; Nowell et al., 2017), while mentees gain access to meaningful knowledge to support their career aspirations. Years of research on mentoring offers compelling evidence about the benefits of consistent mentoring (Ehrich et al., 2004; Hundey et al., 2020; Zellers et al., 2008).

There is a large body of evidence associated with the benefits of mentoring that offer insight into how we might conceptualize “successful” mentoring (Zellers et al., 2008). For example, there is evidence that having a mentor improves retention and increases social communication (Buchanan et al., 2008; Lorenzetti et al., 2019). Regardless of academic discipline, research also suggests that individuals with mentors adapt to the academic environment with greater ease than those without mentoring support (T. D. Allen et al., 2006; Ehrich et al., 2004; Zellers et al., 2008). The benefits are mutual, as Luna and Cullen (1995) documented how mentors experienced the intrinsic benefits of mentor–mentee relationships. Other studies demonstrate how mentoring produced a mutual sense of connection and reduction of isolation when involved in mentoring activities (Buchanan et al., 2008; Zellers et al., 2008). Ultimately, the body of scholarship exploring mentoring pinpoints the benefits on retention, academic progress, and social experiences (Acevedo-Gil & Madrigal-Garcia, 2018; T. A. Allen & Eby, 2007). What is successful mentoring, then? Retention, institutional progress, and social connections seem like three excellent indicators to consider that are supported by our review of the literature. Additional metrics of success could be an interrogation of institutional racism, sexism, ableism, and so on; considerations of ways to work within the institution's -isms and/or disrupt and transform them; and a development of collective awareness and action in the process. Ultimately, what counts as successful mentoring may be negotiated between the mentor and mentee, based on the particular needs of the mentee. Does the mentee feel supported? Is the mentee developing the requisite skills to perform proficiently and/or transform systems capably? Is the mentee's mental health being cared for?



4 | MENTORING ACROSS DIFFERENCES

Mentoring relationships are traditionally conceptualized as dyads between a mentor and a mentee. One might assume that mentoring relationships formed between a mentor and mentee who share particular identities with regard to race, culture, gender, sexuality, or ability would be most successful. These shared identities may come along with shared experiences or shared communities, the absence of which may appear to be a barrier to successfully mentoring someone. There is some research that supports this assumption. For example, a shared racial identity is highly predictive of trust between a mentor and mentee (Smith, 2010). This may be in part due to inherent challenges in mentoring across differences. These challenges include unconscious bias, microaggressions, cultural anxiety (wherein a mentor is so concerned that feedback may be interpreted as racist, sexist, or otherwise biased that they provide less feedback to the mentee), immunity (that of being “immune” to the experiences that the mentee may face in academia), and courtesy stigma (when a mentor is perceived to be LGBTQ+ by association with a mentee who identifies as LGBTQ+ and thus faces a stigma in the workplace) (Barker, 2021; Dominguez & Sears, 2017). Left unchecked, these challenges can result in mentees with marginalized identities seeking mentorship outside of their formal mentoring relationships (Zambrana et al., 2015).

However, other research shows that mixed race and gender dyads can be just as effective and beneficial as same race and gender dyads (Johnson, 2015; Noe, 1988; Ragins & Cotton, 1999; Schunk & Mullen, 2013). For example, Ragins (2002, 2010) suggests that having shared values and attitudes, such as being on time, maybe more important than shared identities. To that end, significant consideration has been paid to mentoring across differences in the mentoring literature, describing the characteristics of practices of mentors who do this study well.

Mentors who are successful in mentoring across differences exhibit strong interpersonal skills. These may include charisma, friendliness, self-confidence, humility, humor, and being approachable (Chan, 2018; Elzubeir & Rizk, 2001; Gray & Smith, 2000; Haddock-Millar & Sanyal, 2015; Li et al., 2018; McDowall-Long, 2004; Murray, 2002; Wright & Carrese, 2002). Successful mentors are also knowledgeable about their organization or institution (Haddock-Millar & Sanyal, 2015; Murray, 2002). When mentoring across differences, it is especially important that mentors are knowledgeable about societal and institutional structures that produce inequities, in particular with regard to their mentee's trust concerns, and mentors should be prepared to speak out against said structures, inequities, or trust barriers (Chan, 2018; Li et al., 2018).

Every mentor–mentee relationship is positioned within a broader social context. The society we live in sets norms for social expectations and beliefs (Hall & Burns, 2009; Muir, 2014). While mentors may intend to support mentees in meaningful ways, they are always operating as individuals who are informed by complex social realities. Without explicit training on mentoring, the mentor relies on a set of lived experiences as the foundation of their mentoring. As such, the positionalities of individuals and their mentoring experiences become a subtle, yet powerful subtext to mentoring. In this way, mentoring is more than simply having valuable information; it becomes sharing personal and professional skills within the context of individual social positionalities. Said differently, everyone mentors within a broader social context and operates from their individual biases. Thus, mentors need a sense of self-awareness and knowledge to support their mentees.

Along with interpersonal skills, institutional knowledge, and self-awareness, mentors must have strong communication skills. They need to be good listeners who can pick up on their mentees' emotions while managing their own emotions (Chan, 2018; Sanyal, 2017; Shea, 2001). They need to provide honest feedback while being affirming (Gray & Smith, 2000; Li et al., 2018; Sanyal, 2017; Wright & Carrese, 2002). Effective mentors must also be willing to self-disclose about their own personal and professional trials and errors and be vulnerable to their mentee to promote learning and trust (Chan, 2018; Johnson, 2014; Li et al., 2018). Finally, mentors must validate mentees' experiences rather than question them and be willing to talk about race and culture (Barker, 2021; Chan, 2018).

In addition to describing successful mentoring relationships across differences, researchers also describe alternative mentoring structures that may support nontraditional academics. These alternative mentoring structures

are offered as part of a constellation of mentoring experiences a mentee might have rather than as an alternative to the traditional dyad. For example, sponsorships are described in the literature as a pairing of someone in a more advanced professional position with a protege (Hewlett, 2013; Swart et al., 2015). According to Hewlett (2013), a sponsor acts on behalf of the protege, putting their own reputation on the line to advocate for the protege's professional advancement. The sponsor also provides cover for the protege to take risks and makes it safe to fail (Hewlett, 2013). Another example is the role of networks (Jonsen et al., 2010; Reddick & Young, 2012). Nontraditional academics are less well-networked (Dominguez & Sears, 2017), yet building relationships with peers and more advanced scholars in professional networks is critical to one's personal and professional development.

As described above, the required expertise, types of support, knowledge, and skills to successfully mentor across differences is wide-ranging. Yet, our assumptions about mentoring predominantly rest on one-to-one models of mentoring. For the purposes of this essay, we refer to these one-to-one models of mentoring as an *apprenticeship* framework, harkening to a model of an apprentice learning a trade or skill from a master, and we argue that doing this kind of mentoring alone is daunting. For this reason, we believe a *brokering* framework for mentoring can be more successful, especially when mentoring across differences.

5 | THE NEED FOR A NEW MODEL OF MENTORING IN SCIENCE EDUCATION

Quality mentoring has the potential to provide social and academic support. Yet, as we have argued, it can be a daunting task for one individual mentor. Without formal training, mentors are asked to provide a dynamic set of technical and psychosocial support devoid of explicit preparation. While some institutions offer workshops on mentoring, this important task is generally left as a component of the hidden curriculum of academic life. Moreover, when mentors do not share social norms, gender background, or cultural experiences with their mentees, the multifaceted challenges become magnified. The review of literature above suggests that it is not essential that the mentor be like the mentee to mentor successfully. That said, even when apprenticeship models are rooted in best practices of mentoring, as described above, and/or learning theories such as legitimate peripheral participation (Lave & Wenger, 1991) or cognitive apprenticeship (Brown et al., 1989), mentoring across differences is challenging. Arguably, it is unreasonable to expect a mentor to exhibit all of the characteristics of successful mentors (interpersonal skills, institutional knowledge, self-awareness, communication skills).

For this reason, assumptions about what constitutes mentor-mentee roles and relationships must be radically reconceptualized when mentors advise across differences. One way to shift perspectives on mentoring across differences is to adopt a brokering approach to mentoring in a modern era. Moving toward a *brokering approach* to mentoring removes the assumption that any given mentor should be able to accommodate the many needs of mentees by offering an approach that suggests the mentor serves as a central hub to connect their mentee to social and academic support networks. In this way, an increased number of people with diverse and distributed expertise and experiences can provide a more dynamic set of mentoring services. As well, the unreasonable expectation on mentors to fulfill all the roles and characteristics of a successful mentor is alleviated.

Both the apprenticeship and brokering models of mentoring are rooted in sociocultural constructivist learning theories, wherein mentees have opportunities to learn through situated experiences and discourse (Bredo, 1994; Brown et al., 1989). However, the brokering framework shifts the focus from the efforts of an individual mentor to a collective. In other words, when mentoring is framed as a brokering task, the mentor's role is recast from a singular disseminator of information or provider of wisdom toward that of a conduit to resources. Framing the task of mentoring this way requires the mentor to assess their own strengths and weaknesses, the needs of their mentee, and serve as a hub to connect their mentee to a network, or collective, of mentoring relationships. Said differently, the brokering framework reframes the "do it all" leadership of a mentor to a "connect to all" approach to mentoring.



Scholarship on identity would suggest that the brokering approach also has the potential to support mentees' positive identity development. Gee (2000) explored how signals of "who" an individual is believed to be are communicated across the context of the different sources of an individual's identity (see also Norton & Toohey, 2011). Said differently, "who" we see ourselves being is connected to the source of the identity. That source can be the labels people give us (e.g., smart, witty), or features inherently connected to our identity (e.g., tall, twin). Of note, Gee (2000) suggested that affinity groups provide members a sense of identity as their shared identities and interests give them a sense of collective identity. The source of this identity is that affinity group members share, for example, academic interests or similar cultural backgrounds. Since developing an identity commensurate with academic life is not limited to a singular model, a brokering approach provides mentees with a means to identify with identity domains that most resonate with them and that their mentors may not be capable of providing.

Table 1 outlines numerous types of support embedded in successful mentoring. One assumption that emerges from the brokering approach is that the mentor is no longer operating as a sole source of social and academic expertise. Instead, the mentor makes an assessment about which mentor roles they can provide (see Table 1). For example, some mentors may have a depth of methodological expertise to offer while recognizing that their mentee may benefit from a network of scholars that share the same gender or ideological background. Through a brokering model, they can connect their mentee to networks that support women science educators or to scholars exploring similar conceptual positions. This brokering approach allows the mentor to become a hub of services to provide the support they are capable of providing as well as access to support that is beyond their personal expertise or set of lived experiences. While the roles of the mentor shift with this paradigm, assumptions and expectations about what the mentor should do change as well.

When considering the standard apprenticeship approach to providing technical support, challenges emerge. When scholars attempt to provide topical, methodological, or rhetorical expertise using a standard apprenticeship model, the mentee is limited to the mentor's local sphere of academic expertise. While the narrow nature of this approach benefits from intellectual depth, this approach subverts the potential to expand the intellectual diversity of the field. By contrast, adopting a brokering approach to offering mentees technical support, the mentor now serves a role in connecting mentees to other faculty and organizations where an endless volume of topical, methodological, and rhetorical expertise lies. Whether this expertise involves connecting mentees with third-party training, or to a network of colleagues, the result is mentees grasp the diversity of skills that live well beyond the personal skills of their mentor. For example, enabling mentees to participate in writing groups and connecting them with academic writing programs that exist beyond the scope of one's local university can open the doors to a diversity of writing styles and access to different rhetorical structures. When considering the potential benefits of adopting a brokering approach to mentoring there is a great deal of academic diversity that emerges as the individual becomes a conduit to a community of dynamic expertise.

Though an apprenticeship approach to the technical components of mentoring may offer more in-depth academic training, the psychosocial supports must provide resources to build a sense of both the individual and the community. When adopting the apprenticeship approach, the mentor attempts to offer themselves as a role model, social support, and counselor. Mentees may have the opportunity, then, to experience the social networks of the mentor, but there are limits to what any individual can model for someone who has a vastly different set of lived experiences. Furthermore, it is unreasonable to ask mentors to provide adequate counseling services to help their mentees make decisions about and navigate career, family, and mental health decisions and dilemmas. The brokering approach, on the other hand, offers the mentor access to individuals who may provide academic and social role modeling that connects mentees to peers and mentors who share common identities, potentially creating a sense of connectedness to science education. Furthermore, the brokering approach opens the mentee to a dynamic network of social opportunities where they can participate in organizations and activities with people of similar backgrounds. Whether those activities are research-based or social, they provide the mentees with an opportunity to move from a sense of isolation toward a sense of community. Finally, the brokering approach

TABLE 1 Types of mentoring support across model types

	Role	Function	Apprentice-ship model	Brokering model
Technical support	Topical expertise	To provide mentees expertise about academic topics, readings, research, and literature across disciplines	Mentor does this on their own	Mentor connects mentee to other individuals or networks
	Methodological expertise	To provide methodological training including data collection, and data analysis approaches		
	Writing/reading/publishing	To teach and support explicit and implicit aspects of academic writing, reading, and publishing		
Psycho-social support	Role model	To provide mentee a model of how to engage in professional activities		
	Social support	To provide encouragement and social support for the mentee		
	Counseling	To provide explicit academic and social counseling for mentees as they progress		



lightens the load for the mentor by asking them to identify counseling resources that can provide the support that mentees need.

Though this brokering model, as we are describing it, can be applied more generally across mentor/mentee relationships, we see it as particularly critical in mentoring relationships where there are differences in identity, and especially when the mentee self-identifies with a minoritized identity. As illustrated previously in this essay, minoritized academics are more likely to struggle in academic institutions that are not designed for their success, and as such, having “successful” mentoring relationships are that much more critical for their advancement in their field and for their mental health. In science education, if we are truly committed to broadening participation not just for minoritized science students, but for minoritized colleagues as well, it is imperative that we reimagine the fundamental assumptions undergirding traditional dyadic mentoring relationships when mentoring across differences, and brokering is one way of doing so.

All this being said, we would like to emphasize that by advocating for a brokering approach to mentoring, we are not suggesting that when confronted with a mentee with differing lived experiences—for example, a mentee experiencing microaggressions within their department—that mentors should automatically direct the mentee toward alternative sources or networks of mentorship. We would expect mentors to first ask how they can support their mentee, carefully listen to their needs, and seek avenues for advocating on behalf of their mentee. In other words, the mentor's primary role may at least initially be as an active listener and advocate. What we are proposing with our brokering model is that the next step for a mentor may then be to connect the mentee to additional resources for more individualized support rather than taking on the mentee's needs and interests alone.

Considering the multiple roles mentors play for mentees, and the benefits and risks of an apprenticeship versus a brokering framework, we believe a brokering approach offers both the mentor and mentee something that is hard to come by—diversity. This diversity is not the type of diversity that is maintained within an individual; instead, it is the kind of diversity that enables an individual to define support across the context of academic skill, method, social status, gender, and identity in general. Although this shift seems subtle, it represents a revolutionary shift in our assumptions about mentoring. The quality of mentoring is no longer rooted in the ability of a willing mentor. By contrast, a brokering approach suggests that every mentor starts from where they are and builds a dynamic set of resources for their mentoring, by looking beyond themselves. This more systematic approach to mentoring moves mentoring success from the skill of the individual toward the willingness of a mentor to connect their mentees to needed resources. This is a powerful, revolutionary shift in assumptions about mentoring.

6 | SEPARATE TOGETHER: LESSON FROM THE PANDEMIC

As we emerge from the global COVID-19 pandemic there are numerous lessons that can provide us with resources for how we think about mentoring across differences. Our social isolation led us to value the importance of social connection. As such, we leaned on technology as a way to maintain connections. As our academic conferences and meeting spaces were no longer viable options, people across the globe moved to digital tools to provide academic and social support. Whether the move was from in person research conferences to Zoom-based research convenings, or from dinner parties to Google Meets, we found ways to use digital media to keep us connected. As we think about the value of adopting a brokering approach to mentoring, we should carefully consider how technology can be a bridge to mentoring across differences.

In the same way that digital media helped us accomplish academic and social interactions, it can also play a vital role in a broker-based mentoring approach. When thinking about academic support, mentors can use Zoom and other online academic supports to connect their mentee to supplemental training well beyond the scope of what the individual mentor might provide. Similarly, when thinking about how technology might support the social and psychological needs of a mentee, mentors can connect mentees to networks of other academics from similar backgrounds, or with professors and peers who share a common academic interest, or to help them build initial

relationships with scholars across (or outside of) the country who may share similar interests and/or backgrounds. From a social perspective, the limits of the institutional walls of a singular university can be removed and enhanced by academic mentoring that brokers mentees into dynamic sets of relationships with other science educators. Ultimately, as we move forward in carefully considering how we train the next generation of scholars, we must restructure our framework for mentoring to include a brokering framework that leverages the benefits of technology in our newly hybrid world.

7 | NETWORKING EXAMPLES

The success of a brokering framework depends on networks within and outside the field of science education for mentors and mentees to access. Here we describe some of these existing networks as examples of the possible. These networks, both before the pandemic and in response to the pandemic, often leverage technological tools for connecting members across institutions, states, and countries. They represent the kinds of networks we argue are critical for mentors to leverage within a brokering framework of mentoring to diversify the ecosystem of support that mentees access.

Within the field of science education, there is a growing community of graduate students across continents who are banding together to support one another through their academic journeys. This community is largely organized and sustained through efforts of the Graduate Student Committee of NARST (for which the first author was the Chair from 2019 to 2021). In 2020, amidst isolation caused by the global pandemic, and in response to the 2020 International Conference being canceled, the Graduate Student Committee began hosting what is intended to become ongoing webinars during the academic year on topics such as navigating the job market and thriving through dissertation writing. More experienced scholars were invited to share their knowledge and experiences in these webinars, thus increasing graduate student participants' exposure to scholars and resources related to these technical and psychosocial functions. Additionally, conference events hosted by the Graduate Student Committee (namely, the Graduate Student Research Symposium and the Graduate Student Forum) are designed to further connect graduate students with mentors on a variety of technical and psychosocial topics. Furthermore, the Graduate Student Committee has organized regular meetings of virtual writing groups to hold one another accountable to writing and to share successes with each other, in addition to a Slack group with various "channels" on topics of interest to support one another and share resources as a group. Plans are underway to leverage these and other initiatives to target affinity groups within NARST, including scholars of Color, graduate student parents, and more. As a mentor to graduate students, keeping track of networks and resources such as these, and brokering connections to the groups or individual leaders within the groups, are critical to expanding students' webs of mentoring relationships and resources.

Other NARST committees are also responsible for important mentoring opportunities. For example, the Research Committee organizes the annual Sandra K. Abell Institute for Doctoral Students. Summer schools are also offered through the European Science Education Research Association; the Southern African Association for Research in Mathematics, Science, and Technology Education; and others. These experiences provide layered mentoring opportunities for advanced doctoral students and can help students broaden their professional networks. Additionally, the Equity and Ethics Committee hosts pre-conference workshops each year that target early career scholars and topics of interest to their professional advancement. The Equity Dinner is yet another opportunity for networking, in addition to the committee's administrative sessions sponsored during the annual conference. Furthermore, some of NARST's Research Interest Groups (RIGs), such as the Continental and Diasporic Africa in Science Education RIG (CADASE) and the Latina/a RIG (LaRIG), create cultural safe spaces within the larger organization and provide opportunities for both formal and informal relationships to develop. Mentors who may not associate with CADASE or LaRIG should see groups like these as a part of their professional network. So, as they mentor students who do not share the same identity, they can connect those students with a network of colleagues with shared identities.



Outside of the field of education, the National Center for Faculty Development and Diversity is another important network for academics (<https://www.facultydiversity.org/>). This institute offers a variety of support primarily around writing and publishing. There are webinars available to learn more about writing in academia and how to structure time as a faculty member to set and meet writing goals. There are writing groups and writing challenges throughout the year that offer structured opportunities for accountability and goal setting. There are opportunities to sign up for a writing buddy, again as another accountability model. There are extensive boot camps offered to make use of time over the summer to write. Resources and opportunities offered by the institute not only focus on the technical aspects of academic writing, but also attend to work life balance—that is, the psychosocial needs of early career faculty as well. As a mentor to early career faculty members, connecting them to resources such as this one, and advocating for institutional support to pay for membership, will provide rigorous support with academic writing and work life balance to early career scholars and connect mentees with peers and more experienced scholars outside of science education as well.

Another example outside the field of science education, designed specifically for women academics of Color, is Sisters of the Academy (<https://sistersoftheacademy.org/>). This organization hosts bi-annual research boot camps for doctoral students and junior faculty. They focus on acclimating Black women to the academy. More recently, members have expanded their sights to mentor academics past promotion and tenure into administrative work. Though founded for the benefit of Black women, the organization has also done boot camps with men, and writing retreats, grant-writing workshops, and other virtual events opened more generally to academics. Affinity-group mentoring and networking groups such as this one can be highly consequential for academics, particularly from groups historically marginalized within the academy. When mentoring someone who has a different racial, cultural, or gender background, locating and connecting mentees with affinity groups such as these can be critical.

8 | RECOMMENDATIONS FOR MOVING FORWARD

One of the great benefits within the field of science education is that we already have a largely welcoming community of scholars to engage in and broker across. However, as a result of our reading, writing, and thinking on this topic, we believe the science education community could make critical improvements that are particularly important for those mentoring relationships that are built across differences where mentees will benefit both from the expertise of the mentor and from a web of support outside of the expertise and experiences of their formal mentor.

First, while we are aware of some efforts within the science education community to connect and support graduate students with one another and with mentors external to their institutions, we are aware of fewer opportunities available to early career scholars, or for that matter, to more advanced scholars. For many science education researchers, there is a desire to both mentor and be mentored at the same time. What can we learn from the efforts put forward by the Graduate Student or the Equity and Ethics Committees of NARST that can be applied to support scholars across stages of their careers? Or, what can we learn from the programs offered through the National Center for Faculty Development and Diversity or Sisters of the Academy? For example, the Website Committee of NARST is exploring how they might utilize the NARST website not only to better inform members of NARST happenings, but also to build connections between members. Might some of these efforts more intentionally build in aspects of mentoring? Initiating these efforts through a professional association like NARST is a good start, as locating mentoring opportunities within a central professional association is helpful (Maulucci & Mensah, 2013). However, it is not a prerequisite. How might groups of individuals across institutions leverage online tools to build networks and communities? For example, researchers attending conferences like SEEDS, ASTE, or ESERA, or attending mini-conferences or workshops, might start a list with colleagues interested in writing accountability to form partnerships for the duration of the academic year with regular check-ins on writing goals.

These networking opportunities can be widely shared through social media so that more people learn about them. Mentors may then recommend them to their mentees and join in themselves.

We also believe that more opportunities are needed for networking and mentoring to support scholars who are doing equity- and justice-oriented research and teaching in science education. What lessons can we learn from groups like Sisters of the Academy or efforts within NARST's RIGs to look to as a model of the kinds of networking and mentoring that equity- and justice-oriented science educators might benefit from? For example, forming more affinity groups for particular groups of individuals within science education who are engaged in equity-oriented work could offer important technical and psychosocial support to individuals, particularly when their primary mentor(s) do not share common cultural backgrounds or life experiences. These affinity groups would be important networks that mentors can encourage their mentees to join. Another idea could be to use this issue of *Science Education* to host webinars with panel discussions on the topics of mentoring, reviewing, theory, and others. Importantly, leveraging technological tools to build and sustain networks of scholars interested in ongoing conversation and mentoring support on these topics would be critical for sustained learning opportunities.

A third proposal for science educators is to build networking opportunities that can put mentors in touch with one another to share resources, ideas, and experiences. As we have described in this essay, being a mentor is challenging and multi-faceted work. Mentors are typically asked to engage in mentoring without training. Just because a person has a level of expertise and success in what they do does not mean that they have all of the skills and resources needed to be an effective mentor. Furthermore, effective mentors do not necessarily have all of the knowledge and characteristics needed to mentor any given mentee they meet, especially when considering racial, cultural, gender, sexuality, or ability differences. Additionally, the places and spaces where we mentor affect the kinds of mentoring we provide and the resources that we are connected to. Thus, networks for mentors to share resources and experience with one another across institutions and to be able to ask questions of one another about particular challenges they face in mentoring are critical to developing a more well-prepared body of mentors in the field of science education.

It is our opinion that the science education field is well primed to build the kinds of networks that can effectively support and mentor scholars of diverse backgrounds into the field to mold and shape our field toward a promising future of science education research. Through adopting a brokering framework of mentoring and abandoning constraining assumptions about the need for one-to-one apprenticeship models, the entire field of science education stands to benefit.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this essay.

ORCID

Christa Haverly  <http://orcid.org/0000-0003-0624-7656>

Bryan A. Brown  <http://orcid.org/0000-0001-8350-7998>

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