

Engaging with CC Bio INSITES: Experiences of Barriers, Supports, and Belonging in Community College Faculty Participating in Biology Education Research

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ABSTRACT

In an effort to increase community college (CC) biology education research (BER), an NSF-funded network called CC Bio INSITES (Community College Biology Instructor Network to Support Inquiry into Teaching and Education Scholarship; INSITES for short) was developed to provide intellectual, resource, and social support for CC faculty (CCF) to conduct BER. To investigate the efficacy of this network, we asked about the barriers and supports INSITES CCF have experienced when conducting BER and how specific INSITES supports have mitigated barriers and provided support for network members to engage in BER. We conducted interviews and focus groups with 17 network participants, representing 15 different CCs. Qualitative thematic analysis revealed six main barriers that INSITES CCF experience when conducting BER: time constraints, knowledge, incentives or rewards, administrative or peer support, infrastructure, and stigma or misconceptions associated with being CCF. Participants indicated how the supports provided by INSITES helped to mitigate each barrier. Social support was especially critical for CCF to develop a sense of belonging to the CC BER community, though that did not extend to the broader BER community. We describe how these supports function to support BER and recommend four actions for future support of CCF conducting BER.

INTRODUCTION

It would be a mistake [to] ignore or dismiss the importance of community colleges, with their many roles in and contributions to improving STEM education ... for a much larger and more diverse population of college students. (Labov, 2012)

Almost half of all undergraduates nationally are attending community colleges (CCs), which enroll the majority of all Latina/o, Native American, and Black undergraduates and large proportions of low-income and first-generation students (American Association of Community Colleges [AACC], 2021). Further, nearly half of students receiving science, technology, engineering, and mathematics (STEM) bachelor's degrees complete some undergraduate training in CCs (Tsapogas, 2004). Because the first 2 years of college are considered “the most critical to the retention and recruitment of STEM majors” (President's Council of Advisors on Science and Technology [PCAST], 2012) and because such a large proportion of students—particularly those from marginalized backgrounds—receive that initial training at CCs, CCs have been broadly recognized for their potential to influence early undergraduate learning in STEM (National Academy of Engineering and National Research Council, 2012; PCAST, 2012). Indeed, recent

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efforts to feature CCs at meetings of the Society for the Advancement of Biology Education Research (SABER) West and the call for CC-specific articles from *CBE—Life Sciences Education* reflect increasing recognition of the importance of CC contexts in biology undergraduate education.

Despite growing interest in CC contexts and an understanding that BER plays a key role in efforts to transform biology education (American Association for the Advancement of Science, 2011; Offerdahl *et al.*, 2011; PCAST, 2012), relatively little BER has occurred in CC contexts to date (Schinske *et al.*, 2017; Lo *et al.*, 2019; C. Creech, personal communication). An investigation in 2017 by Schinske and colleagues found that only 3.2% of articles published in seven prominent BER journals over a 3-year period from 2012 to 2015 were focused on CC contexts or included CC authors. Similarly, a study of articles in *LSE* and abstracts submitted to the national SABER meeting over the period from 2012 to 2015 also found that there was a paucity of studies on CC contexts (<1% in both cases; Lo *et al.*, 2019). More recent work updating the findings from Schinske *et al.* (2017) found that, among those seven BER journals, 98 CC BER-specific papers were published between 2016 to 2020, an increase from 3.2% to 4.09% (C. Creech, personal communication). Among published CC BER articles, a majority focus on the introduction of new curricula and teaching methods, while relatively few studies focus on issues of equity, diversity, or transfer (Schinske *et al.*, 2017; C. Creech, personal communication). These prior findings are somewhat surprising, given that CCs serve highly diverse student populations and have vast potential to enhance equity in higher education (National Academy of Engineering and National Research Council, 2012). In addition, the paucity of CC BER as a whole raises two concerns. First, it highlights a missed opportunity to better understand the valuable teaching and learning strategies that arise in CC contexts, and more specifically how BER can best serve diverse populations, especially because CC student demographics likely forecast future demographics at 4-year colleges and universities (Hussar and Bailey, 2016). Second, given the potential for BER to inspire pedagogical transformation and drive change (Grunwald and Peterson, 2003; Prochaska and DiClemente, 2005; Handelsman *et al.*, 2007; Holme *et al.*, 2010), the lack of CC faculty (CCF) involvement in BER is concerning, as it could hinder national efforts toward biology education reform for nearly half of all undergraduates.

The vast potential of CC BER to improve undergraduate biology education, in addition to the concerns highlighted earlier, has motivated efforts to build capacity and infrastructure for the CC community to engage in BER and successfully drive national conversations about CC biology education. For example, the NSF-funded Improving Undergraduate STEM Education (IUSE) project Fostering a Community of Scholarship among Community College STEM Faculty through Support for Discipline Based Education Research (CCREST; NSF no. 1711693) and the Community College Anatomy and Physiology Education Research (CAPER) Network (NSF nos. 1829157 and 2111119) both aim to support CCF in conducting BER through a network-based approach, with the first focused on supporting a faculty community in the central Midwest and the second aimed specifically at supporting anatomy and physiology instructors. Other networks, such as the Biology Educator/Researcher Cross-Segment Collective (BERCC; NSF no. 1920315), bring together faculty

from 2- and 4-year institutions to improve CC and transfer student outcomes. These networks have experienced success in encouraging BER. For example, the CCREST network provided scholarly training in discipline-based education research (DBER) to 18 CC STEM faculty members through course releases and payment honoraria during the summertime. After 3 years of support and training, these new DBER scholars have all presented their research to local, regional, or national communities, becoming more adept and confident in designing independent research projects (H. Seitz, personal communication). In response to the success of the CCREST network, some CCs have made such DBER scholarship training available under an institutional program with ongoing stipends for their faculty. Within the CAPER network, 12 CCF have participated in the network to develop and carry out research projects to investigate the implementation and effectiveness of evidence-based instructional practices in anatomy and physiology CC classrooms (Jensen *et al.*, 2020). Through mentorship and coaching from the CAPER network, these 12 CCF have successfully collected student anxiety and self-efficacy data for future publication, contributing to a biology education literature that is currently lacking CC representation. These results support the overall success of a network-based approach that supports CC instructors in engaging in BER.

The network that is the topic of this work, the Community College Biology Instructor Network to Support Inquiry into Teaching and Education Scholarship (CC Bio INSITES; NSF no. 1730130; also known as INSITES) is similar to these efforts in that it focuses on supporting CCF engagement in BER via a research coordination network. CC Bio INSITES was founded shortly after the work done by Schinske and colleagues (2017), which identified potential CC BER constraints and proposed solutions and mechanisms of support. CC Bio INSITES draws upon this work by aiming to provide CC instructors with the specific types of support proposed in the 2017 meeting report: intellectual, resource, and social support (see *Frameworks and Theory*). The network draws on established theories of change (Choi, 2011; Corbo *et al.*, 2016) and honors the tenets of community-based participatory research (CBPR; Strand *et al.*, 2003; Hacker, 2013) by emphasizing a holistic approach to change, taking into account the unique cultures of CCs and CC settings, and highlighting the value of research done for a community by *members of that community*. As such, the network aims to empower CCF to ask and investigate their own BER questions with the support of CC administrators, experienced BER researchers (from both CC and 4-year institutions), journal editors, and national BER leaders. The network was founded with the explicit goals of increasing the number of CC BER studies and publications being conducted and authored by CC instructors and providing avenues for network members to take leadership roles within the BER community. To date, the network has made progress toward these goals. With 55 participating CCF split into various research teams, network members have made progress on more than 20 CC BER projects, presented at multiple conferences (e.g., SABER, SABER West, NABT, HAPS, NARST, ASM-CUE), supported publication of multiple peer-reviewed articles (Vander Waal Mills *et al.*, 2019; Vemu *et al.*, 2019; Holmberg *et al.*, 2021), and sparked at least three research proposals to national funding agencies (Ko *et al.*, 2021). Furthermore, network members who were new to BER led or

substantially contributed to a majority of these efforts (e.g., two out of three publications, and 14 out of 23 conference posters and presentations). INSITES members have already grown as leaders in the field, occupying seats on numerous advisory and editorial boards and being elected to lead and organize sessions or workshops at national meetings.

Given the success of CC Bio INSITES in increasing CC BER and increasing access (Ko *et al.*, 2021), participation, and leadership of CC instructors within the national BER community, we are ideally positioned to investigate the *mechanisms* through which CC Bio INSITES has successfully provided support. Thus, we posed the following questions to better understand participants' experiences and inform us about what worked (and what did not) within our network:

1. What barriers have INSITES participants encountered and do they continue to encounter with regard to conducting CC BER?
2. What supports have INSITES participants experienced when conducting CC BER, both from CC Bio INSITES and from other sources?
3. How have specific supports helped INSITES participants to overcome barriers to conducting CC BER?

Our investigation and results have potential to inform revisions and improvements to the professional development (PD) offered through CC Bio INSITES and to inform similar efforts to support CC instructors and other underserved groups in conducting DBER.

Frameworks and Theory

The frameworks we use to inform our work draw both from established time-tested theories that describe how community membership is formed and how expertise is established and also from inductive frameworks that emerged while working with the CC community we are seeking to support. This dual approach allows us to draw on existing knowledge while also honoring the experiences and perspectives of the CC instructors engaged in BER.

Social Learning Theory: Legitimate Peripheral Participation

Legitimate peripheral participation (LPP) is the concept that explains how social learning occurs within a community of practice (Lave and Wenger, 1991). Communities of practice are groups of people who share a common interest, be it a concern for an issue or passion about a subject, and who continually deepen their knowledge and expertise in the shared area of interest through regular interactions with others in the community (Wenger *et al.*, 2002). According to Wenger *et al.* (2002), in a community of practice, learning occurs through social participation in shared practices, thereby allowing tacit knowledge to be shared and informal learning to occur through people's interactions. The CC Bio INSITES network brings together a CC BER community of practice, with both novice and expert BER members connected together through the work done as BER scholars at CCs.

Specifically, LPP describes how newcomers or novice members become experienced members within a community of practice (Lave and Wenger, 1991). LPP identifies learning as a contextual social phenomenon, achieved through participation

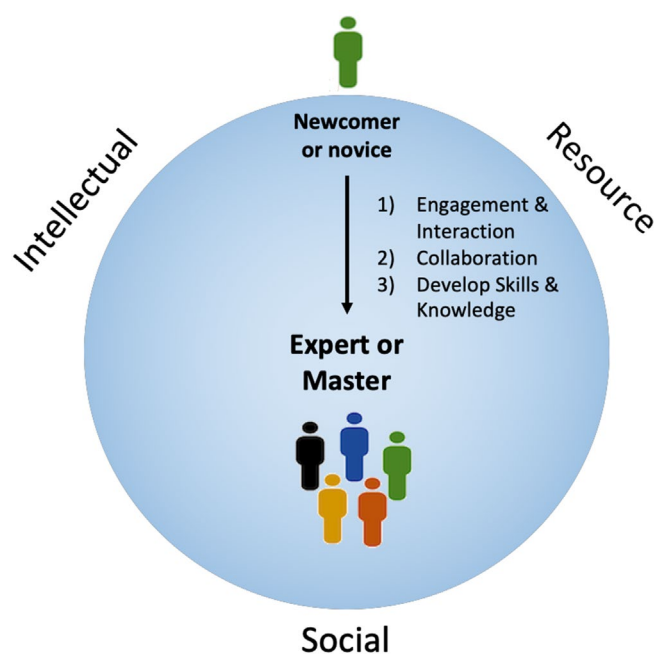


FIGURE 1. Social learning in a community of practice occurs through LPP. Newcomers or novices become more central to the community of practice through social interactions with other members, who confer the necessary knowledge to become relied-upon experts of the community.

among communities of practitioners, where “the mastery of knowledge and skills requires newcomers to move towards full participation in the sociocultural practices of the community” (Lave and Wenger, 1991, p. 29). Each component of LPP explains how an individual learns and interacts in a community of practice: “legitimate,” because newcomer or novice individuals are acknowledged as members of the community of practice who will take part in social activities within the group; “peripheral,” because new members move around the periphery of the community of practice with access to sources for learning through growing involvement and learning from observing other members’ practices, thereby absorbing the culture of practice; and finally, “participation,” when individuals observe and/or participate interactively in a situation with other members as the means in which knowledge can be acquired and skills practiced. Learning occurs between the members through observation, story sharing, personal experiences, or members helping one another to understand certain issues and problem solve. LPP provides a framework for measuring the extent to which newcomer CCF are able to become proficient BER scholars, informed through full participation in the BER community of practice. New members learn by moving from the periphery of a community of practice through collaboration, interaction, and engagement within the group and learning and practicing BER skills, to the center of the community as they become experts or masters (Figure 1). Ultimately, newcomers become experts who fully participate in the community, having gained a recognized level of mastery, and their participation becomes more central to the functioning of the community.

The CC Bio INSITES network strives to support its members by facilitating a welcoming and productive BER community of

practice to allow for newcomers to become proficient and fully participate in BER scholarship. Though many network members are newcomers to BER, CC Bio INSITES is composed of individuals from across the spectrum of BER expertise, allowing CCF who are new to BER to learn from their expert peers. Guided by LPP, INSITES is designed to facilitate the optimal social learning environment for those CCF new to BER by providing three specific types of support: intellectual, resource, and social (Figure 1).

Sources of Support for CC BER

Our second framework describes three types of support proposed to help CCF overcome barriers with regard to conducting CC BER as CC instructors. These three categories of support emerged from the conversations of 24 participants (17 of whom were current or former CC instructors) over 2 days during the 2015 CC BER Meeting (Schinske *et al.*, 2017). Individuals at the 2015 CC BER Meeting identified five hypothesized constraints to conducting CC BER: 1) lack of time to learn about or conduct BER, 2) limited access to infrastructure and resources for BER, 3) lack of administrator and peer support for conducting BER, 4) misalignment between teaching and research identity, and 5) few incentives or rewards for conducting CC BER (Schinske *et al.*, 2017). In founding CC Bio INSITES, we proposed that these constraints could be grouped into needs related to: 1) intellectual support (constraints 1 and 4), 2) resource and infrastructure support (constraints 2 and 5), and 3) social support (constraint 3). Thus, we aimed to deliberately offer these three types of support for network members. Drawing upon conversations and themes from materials at the 2015 meeting (Schinske *et al.*, 2017), we defined each type of support as follows:

1. **Intellectual support** describes opportunities to gain access to both the content and how-to knowledge required for engagement in biology education research (BER). For example, providing instruction in how to do a certain analysis or collaborating with someone to provide a specific expertise would be forms of intellectual support. This type of support is characterized by a supporting individual having and providing the knowledge or skill needed to assist another individual in conducting CC BER.
2. **Resource support** describes access to resources that enable BER work. For example, providing an individual with access to an institutional review board (IRB), journal articles, or funds to do BER would be considered resource support. This type of support is defined by the supporting individual having the resources to assist another or providing ways for another to access those resources (e.g., providing an opportunity to apply for funding).
3. **Social support** consists of emotional support, camaraderie, and encouragement gained through social interactions with other individuals. This type of support is defined by the supporting individual having a disposition, desire, and social identity that allows the individual to support, encourage, and/or validate another.

Based on discussions at the meetings and advocacy roles proposed by meeting participants, we hypothesize that these three types of support will mitigate many of the constraints associated with conducting CC BER as a CC instructor and will influence one another, such that support in one area will enable

access to other supports. We hope to address these hypotheses with the investigation described here.

METHODS

Positionality

The first author (M.M.C.M.) identifies as an international, Asian, religious, woman, with immigrant parents. Because she holds concealable stigmatized identities (CSIs) among the biology disciplinary community, she feels shared solidarity with the CCF who express feeling stigmatized based on their institutions. CSIs are identities that can be hidden (e.g., LGBTQ+, religiosity), but when revealed can result in discrimination or loss of status within the community for that individual (Link and Phelan, 2001; Quinn, 2006). Her shared CSI identities may have affected the interpretation of results, particularly in framing participant responses around their CSIs, hopefully making the analysis more thoughtful and thorough (Day, 2012; Jacobson and Mustafa, 2019). The corresponding author (L.A.C.) identifies as a white woman and holds a strong identity as an educator, BER researcher, and advocate for CC and transfer students. The second to last author (J.N.S.) identifies as a white man, a CC educator, and a BER researcher and is also a strong advocate for CC students and faculty. As former (L.A.C.) and current (J.N.S.) CC instructors, both are passionate advocates for students who attend CCs and strongly believe that CCF and students engage in unique and beneficial pedagogical practices that are often not discussed, may be overlooked, or are not available to members of the BER community. Both also have experience teaching the unique populations of students who attend CCs and can empathize with the variable challenges of teaching biology at CCs, which may differ from the challenges faced at many 4-year institutions. S.N. and A.C. identify as white women and are undergraduate students at R1 universities. They have no substantial connections to the CC community. However, as students at a university with significant resources for research, they understand the barriers that may be posed to CCF in conducting BER without these resources.

Data Collection

This study was approved by the Institutional Review Board for Human Subjects at the University of Colorado, Boulder (no. 17-0389).

Programmatic Components and Structures

CC Bio INSITES is structured to provide continuous support to its participants throughout the year, with foundational annual meetings serving as yearly cornerstones that frame the network PD efforts for the coming year. CC Bio INSITES annual meetings are multiday events that provide participants with social networking opportunities, PD focused on salient aspects of BER, and opportunities for structured work time to advance BER projects (Supplemental Table 1). Each annual meeting lays the groundwork for the year, with subsequent activities aligned with the themes defined at the annual meeting or arising in response to participants' needs. At the initial INSITES meeting, research teams of three to four people were established to promote collaboration and accountability and provide social support for network members who were new to BER. In year 2, facilitators of the network recruited BER analysis mentors who were early-career BER researchers and were 1) experienced in

specific analytical techniques relevant to members' research and 2) specifically interested in supporting CCF and/or CC students. Mentors joined specific research teams in support of their work and continued to work with them as needed throughout their projects. Network facilitators encouraged INSITES participants to work with their research teams and research mentors between annual meetings by attending other PD offerings (e.g., quantitative workshops) together, arranging team retreats with funds from INSITES, or meeting together online via Zoom. Research teams were provided with up to 20 hours of consultation time with their mentors. INSITES participants were queried on a biannual basis about what specific supports they would find most helpful. Professional development between the annual meetings was tailored to address these requests (e.g., quantitative workshops were designed and offered specifically due to participant requests). Throughout the program, INSITES facilitators actively introduced leadership opportunities that had potential to help INSITES participants play a more central role in the BER community (e.g., grant reviewing, guest editing, serving on conference steering committees).

Program components, frequency, timing, incentives provided, and a description of each component are provided in Supplemental Table 1.

Population and Recruitment

The CC Bio INSITES community has members from a range of BER expertise. CC Bio INSITES was founded in 2018. Individuals were originally recruited and welcomed to the CC Bio INSITES community in two ways. First, they were invited to become a "founding member" of the network by the network principal investigators (PIs). Founding members included 17 individuals who were recognized as current and active members within the biology education community at the time of invitation. Several had published BER work, others had spearheaded large biology education efforts, and others held unique positions (e.g., editor) within the BER community. The vast majority were current or former CCF, and many had attended the CC BER meeting (Schinske *et al.*, 2017). Founding members were then asked to invite one or two additional members from their institutions or CCs with which they were affiliated. This snowball invitation constituted the second way we recruited and welcomed network members. They were encouraged to invite individuals who were interested in BER, but had not yet embarked on a BER project in order to achieve the goal of broadening participation in CC BER. Due to this recruitment design, CC Bio INSITES consisted of a diverse community of "expert" and "novice" researchers (Lave and Wenger, 1991) with founding members generally having higher levels of expertise than the colleagues they invited. At the start of network activities in 2018, membership included a combination of individuals who had published multiple articles in biology education journals, individuals who had just recently embarked on their own BER projects, and individuals who had yet to engage with BER. This population constituted our population of interest for this work.

For this study, a total of 17 CCF members of CC Bio INSITES volunteered to participate (31% of the total participant pool). Participants were recruited via email through the CC Bio INSITES network Listserv ($n = 55$) in Fall 2020. All participants have been involved in the network for approximately 3 years.

Among our participants, 94% ($n = 16$) identified as women, 24% ($n = 4$) as a person historically excluded in science because of their ethnicity or race (PEER; Asai, 2020), 24% ($n = 4$) were founding members from the inception of CC Bio INSITES, and all were full-time faculty in their institutions. Compared with national statistics of CC instructor representation (CC instructors are 50% women, 85% white, and 33% full-time; McFarland *et al.*, 2018), we recognize that our sample overrepresents women, PEERs, and full-time CCF. Therefore, we are cautious in drawing any general conclusions about CCF barriers and supports, as these results are constrained by the perspectives of this subgroup. Our participants hail from institutions with a range of diversity, including 10 institutions serving greater than 50% minority students, five serving greater than 25% minority students, and two with minority enrollment under 25% (minority enrollment as defined by Community College Review, 2021). Geographically, our participants represented colleges across the northern and southern regions of western states, midwestern states, and northern and southern eastern states. In total, 11 U.S. states were represented in our sample. Please see demographics in Table 1 for further details per participant.

CCF Interviews and Focus Groups

We chose to conduct both interviews and focus groups (FGs) to capture a greater depth and breadth of perceptions, feelings, and opinions, in CCF's own terms and frameworks of understanding (Williamson, 2018). FGs have often been used to explore consensus or lack thereof among the population of a study and to obtain a broader overview, while interviews better ascertain a detailed, in-depth individual understanding of topics, especially sensitive personal topics such as identity (Williamson, 2018). By using both types of data collection, we could broadly capture the lived experiences of CCF conducting BER. The interview protocols were vetted by two faculty members from different institutions (authors J.N.S. and L.A.C.), two biology education postdoctoral researchers (author M.M.C.M. and another), and two biology education graduate students (members of the REACH Lab at the University of Colorado, Boulder). The protocol wording and questions were informed by the previous meeting report (Schinske *et al.*, 2017), along with the collective knowledge of the authors, some of whom are currently working at a CC (J.N.S.) or have worked at a CC (L.A.C.). Among the participating CCF, nine CCF agreed to take part in both interviews and FGs; five in only the interviews; and three in only the FGs. CCF chose their own pseudonyms at the start of the interview and/or FG. Interview and FG protocols can be found in the Supplemental Material. Interviews and FGs were all conducted via Zoom, with video and audio recorded. The audio was subsequently transcribed.

Interviews. Semistructured interviews were conducted with 14 CCF, with an average interview length lasting about 55 minutes. Interviews probed five main topics: 1) their BER participation pre-network, 2) past and current barriers to participating in BER, 3) supports that help mitigate or remove barriers to BER, 4) sense of belonging in the network and within the broader BER community, and 5) the interface of salient identities and BER. To answer our research questions for this study, we focused on participant responses to topics 2–4.

TABLE 1. Demographics of 17 CCF who participated in interviews and/or FGs, including gender, ethnicity as demarcated through PEER status, whether they were founding members of the network from the Schinske *et al.* (2017) report, and the percentage in which their CC serves minority students

Pseudonym	Gender	PEER status ^a	Interview	FG	Founding member	Minority-serving range at CC
Maria	Woman	PEER	Yes	Yes	Yes	>25% minority students
Hoodoo	Woman	Non-PEER	Yes	Yes	Yes	>25% minority students
Joan	Woman	Non-PEER	Yes	Yes	Yes	>25% minority students
Cassandra	Woman	Non-PEER	Yes	Yes	No	>50% minority students
Kathleen	Woman	Non-PEER	Yes	Yes	No	>25% minority students
Vanessa	Woman	Non-PEER	Yes	Yes	No	>50% minority students
Nymphadora Tonks	Woman	Non-PEER	Yes	Yes	No	>50% minority students
Cameron	Woman	Non-PEER	Yes	Yes	Yes	>50% minority students
Teresa	Woman	PEER	Yes	No	No	>50% minority students
Jessica	Woman	Non-PEER	Yes	No	No	>50% minority students
Sabrina	Woman	Non-PEER	Yes	Yes	No	>25% minority students
Elizabeth	Woman	Non-PEER	Yes	No	No	>50% minority students
Sue	Woman	Non-PEER	Yes	Yes	No	<25% minority students
Rocinante	Woman	PEER	No	Yes	No	>50% minority students
Anonymous Cell (A.C.)	Man	Non-PEER	No	Yes	No	<25% minority students
Maddie	Woman	PEER	Yes	No	No	>50% minority students
Sam	Woman	Non-PEER	Yes	No	No	>50% minority students

^aPEER, persons (in science) excluded because of their ethnicity or race (Asai, 2020).

Focus Group. Three semistructured FGs were also conducted, each taking approximately 56 minutes with three to five CCF per group. FGs probed two main topics: 1) BER supports (intellectual, social, and resource) from outside or within the network and 2) the relative importance of each support type to participating in BER. A defining characteristic of functional FGs is that participants should be reasonably homogeneous (Williamson, 2018). Thus, we ensured that FGs were composed of CCF who have consistently participated in the INSITES network, making them a homogenous group in that regard and enabling them to comment in detail on how network activities did nor did not provide support and the degree of importance of the support given.

To capture different perspectives on barriers and network support in conducting BER, we attempted personalized email invitations to network members who had less involvement than those represented by this study. For example, we emailed people who had only attended one annual INSITES meeting (from a possible total of four meetings from 2018 to 2021) or who had notified us that they needed to prioritize other work and disengage from the network. We hoped the interviews and FGs could capture their potentially different perspectives on supports and barriers; however, none of them responded with availability or interest. Thus, our results are a compilation of the reflections of individuals who have consistently participated in the network. Among the 17 CCF participants in this study, 88% ($n = 15$) participated in all four INSITES annual meetings, 82% in three meetings, and all participated in at least two annual network meetings. We may be missing perspectives of barriers and/or supports from those who did not participate as extensively. Yet a benefit of gathering perspectives from individuals who consistently participated is that they can comment in depth on all aspects of how the CC Bio INSITES network did (or did not) function.

To avoid undue influence upon participants and allow a space for them to reveal dissenting or divergent perspectives on barriers to CC BER and the role of network, all email recruit-

ment invitations, email correspondence, interviews, and FGs were conducted by the postdoctoral research associate and first author of this paper (M.M.C.M.). Having M.M.C.M., who does not facilitate any PD for the network, as the primary researcher communicating with network members about the research was a deliberate decision made by network PIs to avoid coercion and encourage candid responses. Participants were never directly invited to participate in this research by the CC Bio INSITES network leaders, mentors, or anyone who had an influence over their network participation or position at their local institutions. In correspondence with M.M.C.M., participants were always reminded that they had the option to stop participating in the research or network at any time without penalty or repercussions. In addition, participants were made aware that any data that key facilitators of the network who were also conducting this research (e.g., L.A.C. and J.N.S.) had access to would be completely de-identified before their viewing, ensuring confidentiality and anonymity.

Data Analysis

An exploratory phenomenological approach was used to explore patterns related to lived experiences of barriers and supports for CCF INSITES network members (Sloan and Bowe, 2014; Williamson, 2018). A priori content coding was conducted on the interview and FG data based on Schinske *et al.*'s (2017) list of constraints for CCs to participate in BER (Time, Identity Misalignment, Infrastructure, CC Admin and Peer Pushback, Incentives) and CC Bio INSITES purposeful support structure (intellectual, social, and resource support). A priori coding consists of researchers using an existing codebook or framework to identify and categorize participant ideas within those given themes (Saldaña, 2012). We paired this coding process with inductive, open coding to explore any other major themes to emerge not captured by the previous literature (Saldaña, 2012). Through inductive coding, one new theme emerged for BER barriers (Desire for BER Skills and Knowledge)

and a previous *a priori* theme changed (Stereotypes and Implicit Attitudes of CCF). To answer our research questions, three working codebooks were developed for barriers to BER, supports for BER, and origins of barriers/supports.

The preliminary codebooks capturing the themes and codes of CCF's barriers, supports, and origins in conducting BER were developed by three researchers (M.M.C.M., A.C., S.N.). To begin, these three researchers initially coded three interviews and one FG independently and then met to resolve discrepancies, propose new codes, and edit definitions. After initial development, feedback was received from the other authors (L.A.C., J.N.S.), and definitions and codes were clarified, expanded, or merged based on their comments. Subsequent coding of interviews ($n = 11$) and FGs ($n = 2$) were then divided into three pairs among four researchers (e.g., pair 1: M.M.C.M. and A.C.; pair 2: M.M.C.M. and S.N.; pair 3: M.M.C.M. and L.A.C.), with each member of a pair coding specific transcripts independently and then consolidating and resolving codes as a pair. One researcher (M.M.C.M.) coded all transcripts and held the master file of all agreed-upon codes. Because this researcher coded all transcripts, she was able to ensure that code interpretation and application remained consistent among coding pairs.

To examine interrater reliability, a member of the coding team trained on the codebook but who had coded only two interviews (L.A.C.) used the final codebooks to review and code a randomly selected set of 30% of all quotes within each theme (13 codes among six themes in barriers; eight codes among three themes in supports; and five codes for two themes in origins). To accomplish this, units of meaning (i.e., quotes) corresponding to a code were removed from interviews and FGs and placed in their own cells in an Excel document. Codes were then assigned to each unit of meaning by the coder independent of the interview context. In rare cases, a single unit of meaning had two codes that both applied. The coder was informed of these instances with special highlighting, and the coder assigned two codes when this was the case (a match was designated when both codes were correct). The lead coder (M.M.C.M.) then compared the agreed upon codes from each rater team with the codes generated to test interrater reliability. Cohen's κ interrater score was at a strong level (>0.8) for each category (Landis and Koch, 1977), calculated at 0.81 for barriers, 0.802 for supports, and 0.879 for origins. Any coding discrepancies were resolved with discussion.

After final coding and resolution of disagreements, we tallied the total number of participants reporting each code for themes across all three codebooks (Supplemental Tables 2–4). To answer the research questions, we report the percentage of participants for whom each theme emerged for barriers to BER, supports for BER, and origins. Numbers of participants reporting each code can be viewed in Supplemental Tables 2–4. Illustrative quotes are provided for each code, along with participants' chosen pseudonyms (Supplemental Tables 2–4 and *Results*) and whether the data came from an interview (I) or FG. Whenever possible, we present a participant's quotes verbatim; however, some quotes have been lightly edited for clarity and confidentiality. Square brackets were used if changes were made to the original quotes.

Limitations

Our findings are constrained to the participant sample collected. Interview and FG participation was voluntary. The CCF

participants all consistently participated in the network, often fully exploiting the supports provided to members (e.g., attendance at meetings, workshops, taking opportunities for more involvement in BER). Therefore, this sample did not represent individuals who may have struggled to participate in the network. CC Bio INSITES is also a unique population of CCF individuals interested in conducting education research, who may not broadly represent the perspectives of all CC instructors. Specifically, this population is likely to represent individuals who were interested in and motivated to engage with BER, whereas not all CCF are likely to have this motivation and interest. In addition, our sample CCF consisted of mostly women, and thus our findings capture the experiences of that demographic, although all participants shared similar barriers and supports regardless of race/ethnicity. While we were careful in considering how to allow spaces for dissenting, divergent, or even negative perceptions of the network to be shared in the interviews and FGs (i.e., ensuring only the postdoc communicated with participants about research), it is possible CCF may have felt more inclined to share affirming and positive perspectives. To better facilitate franker conversations, we always phrased questions related to network support as something that may or may not exist (e.g., "If the network has provided these supports..."), as seen in the interview and FG protocols. Despite these constraints, our work can shed light on the supports that have worked to mitigate barriers experienced by CCF conducting BER.

Finally, data were collected during the COVID-19 pandemic. CCF were asked to reflect on the barriers and supports to participating in BER before and after joining the network; however, their perspectives may have been influenced by how the pandemic impacted them personally and professionally. During interviews and FGs, some participants honestly shared their experiences of physical isolation, how it negatively impacted the typical social supports received from the INSITES network (e.g., virtual meetings vs. in-person meetings at HHMI) and highlighted the importance of having social supports to do BER. Future studies would benefit from investigation of the influence of COVID-19 on CCF BER participation.

RESULTS

CCF Experienced Six Types of Barriers in Participating in BER

CCF experienced many of the same barriers detailed in the previous meeting report (Schinske *et al.*, 2017), including constrained time, lack of incentives or rewards, low accessibility of infrastructure, and lack of administrative or peer support. There were also barriers associated with the accessibility of new knowledge and specific biases perceived as a CCF member. All of the non-founding members ($n = 13$) who participated in this study identified these barriers, as did founding members ($n = 4$). We will describe each theme in detail with illustrative quotes and list the prevalence of that theme among participants.

Time Constraints. As similarly articulated by Schinske and colleagues (2017), time constraints continued to remain a significant barrier for CCF when conducting BER for all study participants (100%). In this theme, CCF expressed not having enough dedicated time for research, which included time to learn about BER or conduct essential BER tasks. When

discussing time as a barrier, CCF often described either 1) *what* they needed more time to do or learn to do in BER or 2) *why* they felt time constraints when participating in BER. In the former, skills such as data collection, data analysis, sharing results (e.g., preparing manuscripts or presentations), completing an IRB, or regular allocation of time to accomplish BER during the year were included. For example, Maddie (I) succinctly explained where she could not invest the time: “Well, I mean, it’s time-consuming to learn the statistics and the data analysis.”

In the latter category, CCF expressed *why* time to do BER was constrained. Their responses were rooted in either agentic or non-agentic priorities. For the agentic priorities, CCF chose to prioritize their time in doing other important tasks or activities, such as time with family or teaching students above BER. For example, Elizabeth (I) described this type of agentic prioritization when she spoke about the importance of making time to build relationships with her students first before research: “Finding the time to really make a connection with my students has to take priority over the research ... and I think that all our time and resources are spent with our families and with our jobs.” Others among our CCF participants expressed the responsibilities of being a parent and prioritizing time with their children and families in this category. Non-agentic priorities are tasks or activities that CCF did not express the agency or control to change. These tasks took priority over doing BER. They included teaching-related responsibilities. For instance, Maddie (I) explains: “Yeah, just community college faculty teach a full load every semester. There is no time allocated for doing research. So the time that you have is spent on teaching, and doing lessons, and grading, and working with students. But not research.” Other responses under this lack of time theme had CCF simply articulate how they do not have time to do BER, not specific to the *what* or *why*. All interview participants (100%) discussed time as a limitation to participating in BER.

Desire for BER Skills and Knowledge. The need for access to new knowledge and skills also emerged as a prevalent barrier in BER participation among all CCF study participants (100%). While the Schinske and colleagues’ (2017) meeting report referenced this briefly within the constraint describing time “to learn about or conduct CC BER,” we saw this emerge as a separate theme. Beyond only expressing that they did not have time to learn BER skills, this barrier was characterized by CCF expressing that they desired direction in how to begin to conduct BER and where to look for BER resources. For example, when Rocinante (FG) was sharing how she first began doing BER with the network’s support, she said, “When I started CC Bio INSITES, I didn’t know what IRB stood for. I’d done research before, but never done educational research and had never even read those papers, the way I should be reading them, I just looked up the abstract and I would look up the discussion, I wouldn’t, I would not know how to even discern a paper like that.” Data analysis, IRB, or funding knowledge were some of the specific types of BER knowledge that CCF felt they needed to acquire. As in the Schinske and colleagues’ (2017) report, this theme was often paired with time constraints, with participants reporting that they felt they needed to acquire a BER skill (desire for BER skills) but that they did not have time to learn (time constraints) that skill.

Under this theme, CCF also frequently expressed a lack of perceived qualifications to be participating in BER or expressed feelings of impostor syndrome in doing BER. CCF would share how they “didn’t have any formal training” and therefore felt they could not contribute or be a biology education researcher. Such feelings were rooted in their self-perceptions, which stemmed from not having received prior biology education training or from other individuals in the BER community implying they needed more BER training or PD. For example, Sam (I) explained how her colleagues would tell her she needed to have more formal training in biology education to do the research: “I had people—and I think a lot of these people were biology education researchers at four-year institutions—who really thought that without going and doing a postdoc, since I already had a PhD in ecology, that I needed to go and do a postdoc in education research in order to be qualified to think about doing research. That was a little discouraging. And I wasn’t really sure what to do to get around that.” CCF would often refer back to their graduate training (e.g., ecologist or microbiologist) and use that to point out their perceived need to learn more BER skills (e.g., qualitative data analysis).

Lack of Incentives or Rewards. The third barrier that emerged among CCF was a lack of incentives or rewards motivating participation in BER. CCF shared how professional expectations and incentive structures at CCs emphasize teaching and service, not research. Incentives specifically related to factors that motivated one to do BER *before* the BER work was done, while rewards related more to appreciative compensation provided *after* the BER work was complete. CCF described that, without formal incentives, CC institutions and administrators signal to CCF that they do not value research, and thus CCF are not incentivized to see CC BER as a worthwhile professional endeavor. CCF pointed to a lack of teaching releases, professional advancement (i.e., toward tenure), or extra monetary stipends as examples of the absence of incentives from the institutional administration to pursue BER, with CCF often saying: “This is not part of my job description.” For rewards, a lack of institutional or external recognition or monetary compensation post BER work was listed. Rocinante (FG) remarked on the lack of monetary compensation, saying: “We are not provided any kind of support, or any remuneration for doing this kind of work.” Similarly, Nymphadora (I) explained, “We get nothing for doing [BER].” A lack of monetary compensation could be related to both a lack of motivating incentive or reward to do BER. Twelve interview participants (86%) discussed the lack of incentives/rewards as a barrier to participating in BER.

Stereotypes and Implicit Attitudes of CCF. This theme captured tensions or misalignment CCF felt between their identities as teachers or researchers, similar to the Schinske *et al.* (2017) report. Elizabeth (I) felt these tensions, explaining: “I took this job because I love teaching. And if I had to choose between teaching and research, what would I do? And I’m not sure. I’m not sure that research would come out on top of that.” However, a new category within the theme surfaced wherein CCF felt or experienced stigma or misconceptions related to their CCF identities. Misconceptions regarding the rigor of CCF doing BER from others in the BER community were most common. CCF felt negative implicit attitudes of being stereotyped

as a “less rigorous BER scholar” from these individuals. For example, Nymphadora (I) shared how she felt negative judgment as a CCF doing BER, with individuals not wanting to establish meaningful collaborations with her: “I feel that people classify you as a person who is not successful or qualified enough to be at a research institution ... And so I feel that when I interact with people, especially at larger gatherings in research, that it’s more what I can do for them rather than me working with them. So, I can gather data because I have a community college class, but not really that I’m fully taking part in it.” These stigmas were not only felt as CCF among non-CCF, but even as a part-time or adjunct CCF among the full-time CCF. For example, Kathleen (I), a former part-time faculty member, said: “I’m not going to be supported financially [to do BER], because I’m an adjunct.” Twelve interview participants (86%) discussed bias based on their status as a CCF as a constraint to participating in BER.

Lack of Administrative and/or Peer Support. The fifth barrier that emerged among CCF related to a distinct lack of support from administrators/bosses or CC peers for their BER work. Administrators or faculty peers may view CC BER as at odds with normal CC roles and responsibilities and may therefore express skepticism about individuals engaging in CC BER. CCF may experience administrator and/or peer resistance or apathy toward their BER. For example, when A.C. (FG) tried to talk to his administrators about counting his BER work toward tenure, he said: “I brought it up to [the] administration and they’re like, ‘No, we are teaching institution.’” Other categories within this theme include a lack of available mentors (including unwillingness of potential mentors to engage), a sense of isolation due to a lack of connectedness or community, and a fear of consequences from administration for prioritizing BER. For instance, Maddie (I) remarked on how she felt she needed to hide her BER work, leading to feelings of isolation: “I just had this anxiety, because I thought, ‘Great, my Dean’s gonna know, my colleagues are going to know, the administration is going to know, and I’m going to get in trouble, they’re going to tell me that I can’t do this research.’ And, yeah, this is secret and lonely.” Ten interview participants (71%) discussed lack of administrative and/or peer support as a constraint to participating in BER.

Limited Access to Infrastructure. Finally, limited access to formal infrastructure within CCF’s institutions was the sixth reported barrier for CCF to participate in BER. Infrastructure includes funding (e.g., travel funds, PD, publication costs), availability of administration offices (e.g., IRB offices), research tools (e.g., statistical programs), information (e.g., access to journal articles or student data), structures to facilitate the development of collaborative networks (e.g., to find mentors), and personnel support (e.g., statistical consultants, postdocs, or grad students). CCF require these tools to both learn about and conduct BER. For example, Joan (I) remarked, “We don’t have access to the stats packages,” which made it difficult for her to conduct BER on her own and thus required her to find collaborators who have access to such resources. Recognizing that she needed personnel support to help her progress in her BER goals, Jessica (I) also reflected: “I’m realizing that, you know, we might need to have more access to more statisticians to help us out. And it’s not something that we necessarily have at our com-

munity college.” Nine interview participants (64%) discussed lack of infrastructure as a constraint to participating in BER.

CCF Also Expressed Critical Support from the CC Bio INSITES Network to Participate in BER

When discussing supports, participants described supports that originated from both the CC Bio INSITES network and beyond. Within our group of participants, we found that each broad type of support and each specific support code was provided to varying degrees by the CC Bio INSITES network. Given our research questions, in the following sections, we specifically focus on the supports arising from the network and how these supports helped CCF navigate barriers. Specifically, participants indicated how the INSITES network has helped them to overcome barriers to participating in BER through intellectual, social, and resource support. Similar to the barrier themes, all the support themes that emerged were endorsed by both founding members and non-founding members.

Intellectual Support. Intellectual support provides CCF with access to knowledge that supports and further encourages their engagement in BER. CCF found that this support was manifested through help with research, new shared opportunities, and collaborations. First, CCF discussed receiving help with research as important for them to persist in their BER work. Help with research ranged from learning skills in a workshop or PD activity, analysis support, receiving feedback for BER work or progress, or decoding the “hidden curriculum” associated with navigating BER. For example, Elizabeth (I) explained, “I think one of the big things that’s been helpful is having access to people who are not just people who know how to do it [analysis], but people who are there to show you how to do it, you know, I think there’s a big difference there. Like, there’s always people around who know how to do stuff, but it’s way easier to ask questions when those people are there to teach you how to do stuff.” Essentially, Elizabeth appreciated being connected with mentors who could not only do the statistics but teach her and her team how to do it themselves. Further, Vanessa (I) described how being brought together with other CC BER scholars helped her uncover elements of the hidden BER curriculum she wanted to learn about: “I did a lot of that by sitting around with other people at [the CC Bio INSITES meeting], and finding out what other folks are doing. ‘How can you get incentives?’ ‘What [are] other colleges doing?’ So I think that a big part of CC Bio INSITES is learning about how to do this [BER].” Being with the other network members allowed Vanessa to seek answers to questions about BER she did not even realize needed to be answered.

Second, under sharing new opportunities, CCF often pointed to opportunities such as being a reviewer (e.g., for a journal article, an NSF review panel); holding a leadership role in the community (e.g., coeditors on a special issue of a journal); learning about other workshops, PD activities, or funding opportunities; and connecting to other networks/groups to support their research or teaching interests (e.g., journal clubs). For example, Vanessa (FG) recalled how “[A CC Bio INSITES leader] had shared with me—shared with all of us actually—a chance to be on the [NSF] IUSE review [panel].” By being a reviewer, Vanessa learned more about authoring grants and building partnerships with 4-year institutions and felt further

emboldened to advocate for CC BER. Finally, CCF discussed the importance of building collaborations with skilled or experienced BER scholars from both from inside (internal) and outside (external) their institutions as another type of intellectual support. During the FG, for instance, Hoodoo (FG) was grateful to INSITES for “helping us one-on-one with forming our teams at [our] school. [It] really resonated with me, because it didn’t have to be just me forming the team.” All interview participants (100%) discussed intellectual support as important to their BER work.

CCF discussed how these types of intellectual support helped them to manage or overcome barriers related to time constraints and a desire for new skills and knowledge to conduct BER. Help with research from the network would reduce the time spent in learning BER, and also support their growth in knowledge in BER. Elizabeth (I) described this support as “reducing the activation energy” in conducting BER, because the network helped to “reduce the amount of time it takes to find the help that you need, [and] it can really go a far way to making things easier.” Concerning combating lack of knowledge, Teresa (I) explained that “doing the series of abstract workshops [provided by INSITES], that was actually really helpful, because the way BER structures them is definitely a little different than the abstracts I’ve put together. There’s some different pieces in there. So I think that was really helpful.” Having intellectual support positively impacted CCF’s self-efficacy in participating in BER. After an FG discussion on the intellectual support received from INSITES, Sue (FG) remarked, “And now I feel very confident because of that intellectual support that CC Bio INSITES has given. Along with just a lot more confidence of [sic] performing and executing education research.” Such support from the network encouraged Vanessa to begin thinking of herself as a change-maker, further advocating for more CC BER. Vanessa (I) reflected on how the purpose of the INSITES network empowered her “to try and create little pockets of culture” to help CCF think: “Hey, we [CCF] can do research, it doesn’t have to be impossible [for us].”

Resource Support. The second type of support given to CC Bio INSITES participants was through resources. These included access to monetary and nonmonetary resources. Among the nonmonetary resources, CCF pointed to the importance of having access to primary literature, an IRB office, software, personnel, and student data. For example, Nymphadora (FG) shared how having access to papers to do BER is critical, and this access became impossible for her being at a CC: “The resource support—that’s something that’s really important ... like access to papers, like, I mean, I suddenly came to a community college and all of a sudden, I can’t [access] anything. And ... that is the very beginning of starting any research project. And I’m like, I can’t get any papers, like I have to, like, beg everybody for papers, you know, email, friends, and then you feel bad. And because you’re constantly asking for papers, and I mean, a lot of them are open access in education, but not all of them are, especially certain kinds of papers I want, or if I’m on a specific topic. And so just having that resource for both funds and journal articles [is important].” Among the monetary resources, CCF listed how receiving travel money for conferences, stipends for participating in network programs and workshops, or money for publication fees was important to their BER. When discuss-

ing resources, Vanessa (FG) explained the importance of travel funds, because such funding is scarce among CCs: “I would also say, funds to travel to a conference like [the INSITES annual meeting] or SABER, whatever other conferences we end up doing is important, because that’s limited.” Access to such resources enabled CCF to conduct their BER work.

Resource supports were used to mitigate barriers related to a desire for new skills and knowledge and limited access to infrastructure. CCF used personnel resources introduced by INSITES to learn new skills or access spaces typically not available to them. For example, during her interview, Joan described how CC Bio INSITES gave her access to resources to overcome both barriers. Joan (I) pointed to how INSITES connected her to personnel support via the INSITES mentors, saying: “CC Bio INSITES has allowed me to connect to graduate students and early-career faculty who have the statistical insights, and ... I know the literature better now. So, when I have an interesting question, I feel like I have a group that I can go take that to.” Joan (I) also acknowledged how her network collaborators helped her gain access to an IRB office and avoid Collaborative Institutional Training Initiative (CITI) training fees: “So the person in our network who provided the IRB has a school that has [one]. So this person was able ... to support us under the wing of her institutions’ subscription. So we were able to get that CITI training for free. It didn’t cost us. Our school probably would not have dug up the funds for that.” Finally, when discussing travel funds, Joan (I) remarked how “CC Bio INSITES has been great for supporting travel, to disseminate your ideas ... I can get some money from CC Bio INSITES to travel to cover some of my costs.” By directly providing travel funds or covering publication costs, INSITES mitigates barriers related to access to infrastructure for CCF.

Resource supports provided by the network were also used to partially alleviate the barrier related to the lack of incentives or rewards. This barrier pertains to a lack of monetary or non-monetary incentives or rewards for conducting BER. When CC Bio INSITES provided participants with monetary stipends for their participation in network programs (e.g., conferences, BER PD), CCF indicated that it helped incentivize them to continue working on BER. For example, during the FG, Rocinante (FG) explained how monetary stipends helps to motivate her BER work: “Some stipends, some kind of motivation to do these kinds of things would be [important].” In the same FG, Sue (FG) also shared how monetary stipends helped her participate in BER: “At the beginning, they [CC Bio INSITES] were able to give us like a stipend as part as participation in the network. And that was really helpful.” Despite these reports that illustrate how external financial compensation provided CCF incentives to engage in BER work, this compensation does not originate from the CCF’s home institutions, and thus, may only partially mitigate this barrier. In total, 13 interview participants (94%) mentioned use of resource support.

Social Support. The third type of support provided to CCF was social support. This type of support is gained through social interactions, encounters, and experiences with other individuals, such as those from the INSITES networks or colleagues from the broader BER community. Social supports were mainly characterized by feelings of becoming part of the community, camaraderie among peers, emotional support, feelings of

support from administrators and peers, social accountability, receiving encouragement and validation, and being able to give back to the community. Becoming part of the community, camaraderie, and emotional support were rooted in CCF's perceptions of their experiences within BER, and especially within the CC Bio INSITES community. For example, Kathleen (FG) described: "I feel like I have a lot more connections, like people I know, [and] places that I wouldn't have known before," because of the network. CCF described feelings of acceptance, connectedness, and integration into the BER community through being included in conversations or having a meaningful involvement in education research projects. CCF also described feeling acceptance within the broader BER community when they recognized others by name (and were also recognized) at large BER conferences such as SABER. Jessica (I) described such feelings of community: "I felt like by having our initial [CC Bio INSITES meeting], where we were kind of immersed in community college instructors really helped. Because it felt like then we had some, some, like, colleagues or some people that we already knew. So when we ended up going to these larger conferences, there were people there that we could point out and be like, 'Oh, I remember you.' And you felt like you kind of had a buddy in the room with you." CCF articulated a sense of camaraderie when they recognized the shared values and common goals/interests in teaching and research among their colleagues. For example, when Maddie (I) was considering joining the network, she remarked, "I came into it knowing that this CC Bio INSITES is really about equity. And it's about having a platform for community colleges, and also for allowing community colleges to be at the forefront when it comes to educational research." Finally, CCF found emotional support in their social interactions with peers and their administrations when they felt trusted, heard within the network, safe in conversations, and cared about as a person and for their work.

The other two characterizations of social support, social accountability and receiving encouragement and validation, were always expressed in the context of CCF's BER work. These supports were given by INSITES peers, non-INSITES peers, and administrators. CCF appreciated having dedicated work time with their groups and, therefore, social accountability in meeting their BER goals. Nymphadora (FG) discussed in her FG how she appreciated INSITES "pushing us to present at conferences, to present it SABER West, to present at SABER [National], and just, you know, basically pushing us a little bit to do that, and providing the support and the feedback to do a good workshop." Similarly, Kathleen explained, "Every time I've come to a meeting, I've taken a little step forward with the project idea that I had when I came to the very first meeting ... And I don't know if that would be like a kick in the pants to work on something more often." By setting time aside for groups to work on BER, INSITES used a social space to encourage positive accountability for BER goals to be met. Finally, CCF also described how impactful receiving encouragement and validation for their BER work or validation of themselves as a researchers was on their motivation and persistence in BER. CCF described how encouragement from others helped to validate the worth and contribution of their BER. For example, Sam (I) described how "that kind of welcoming attitude [from INSITES] has also contributed to sort of me feeling like I like the ideas that I have for

education research projects are worthwhile." CCF persistence and satisfaction in BER is tied to the presence of such social supports.

CCF recounted how social supports reduced barriers related to time constraints, lack of administrative or peer support, and the stereotypes and implicit attitudes of CCF. Time constraints were countered with having dedicated work time, deadlines, and especially social accountability; while lack of administrative or peer support was often alleviated by finding supportive peers through INSITES. When writing an abstract to submit for a conference, Kathleen (I) articulated how she felt she could complete the task in a timely manner because she had accountability via the INSITES abstract workshops: "Yeah, I mean it took an hour in part in person, in Zoom, and then you know, another probably hour of prep work. That's two hours a week, that's entirely doable. Two hours every two weeks, actually, is entirely doable, but having somebody who is not me, stand outside of the project and say, 'This is what you have to do to get this done.'" To counter the stigma associated with holding a CCF identity, CCF described how INSITES helped them feel important to the CC BER cause. Nymphadora (I) explains experiences of mattering within the network: "When I went to [the first INSITES meeting] we're treated really great ... You feel like, you matter. And everything around the way that CC Bio INSITES has run things has always made me feel that way." Such experiences of mattering contribute to an individual's sense of belonging within a community. Social support was often the greatest contributor to a CCF's sense of belonging in BER, reducing impostor syndrome, increasing self-efficacy, and facilitating development of identity as a researcher in biology education. For example, when attending a large BER conference with only a few CCF, Maria (FG) spoke about how being a member of INSITES gave her "more credibility" and recognition as a CC biology education researcher, further growing her self-confidence in BER: "So it was really ... really great. And it helped me, I don't know [get] socialized ... you feel more self-confidence.... I feel great and more recognized." All 14 interview participants (100%) discussed social support as important to their BER work.

Interestingly, some CCF would describe a desire to give back to the BER community in order to feel like they truly belonged. Being able to contribute to the INSITES community and broader BER community made CCF feel like they had come full circle in their work, helping to address the paucity of CC BER work. Successfully publishing BER work, sharing the resources they have received from INSITES, and getting more CCF involved in the network or in CC BER are all examples of giving back. Sam (I) shared her aspirations in her BER participation, explaining, "I would like to eventually be a member contributing research of my own to the bio education research community. I would see the Bio INSITES network being a really important tool for me to get help at the different steps [in publishing] and depending on how long this network lasts, maybe somewhere down the road being able to help other people sort of join the community." For Sam to feel like she fully belongs in the community, she first wants to be a contributing member through conference presentations or peer-reviewed publishing, and eventually connecting others to BER and being a support for them. Successfully publishing or presenting BER in the community is a form of external validation to CCF, signaling that their work matters and they

can make an impact. When asked about her sense of belonging in the broader BER community, Jessica (I) shared: “I still feel a bit like I don’t quite 100% belong, but it might just be because we haven’t published any research. We’ve basically been doing some research and kind of dabbling with it. And we’ve presented our preliminary research, but I feel like until we’ve gone through this whole, like peer edit and review process, that we’re not really part of the community until we’ve published something.” Participants often acknowledge how the support from INSITES is necessary for CCF to be able to successfully give back to the community.

Social Supports Are Important to Building Sense of Belonging within the CC BER Community, but This Belonging Did Not Extend to the Broader BER Community

Though social supports contributed to participant CCF’s sense of belonging within the INSITES community, this did not always extend to a sense of belonging within the broader BER community. Several CCF highlighted the stigma associated with being from a CC, sharing that they feel “lesser than” compared with their 4-year faculty colleagues and the BER work produced at 4-year institutions. For example, when Vanessa (I) described her sense of belonging to the INSITES community, she said: “I feel very much like I belong in our CC BER community. Like when I’m in that group, I feel like that I fit in here. I’m at the same level as a lot of other people and I’m a little ahead in some ways, a little behind it [in] others. But I feel like we’re all kind of in it together and we get it, we each have similar stories. So I would say I do feel like I belong.” But when asked about belonging to the broader BER community, she shared: “I still feel I’m a little bit, like, that analogy we’ve all heard before is very much how I feel: I’m at the kids table. I don’t quite want to ask any questions, because I’m afraid I’m gonna look like the dumb community college professor who came because they needed someone. I do feel a little bit like I’m not as respected there.” When Vanessa addresses CCF “needing someone,” she reveals her sense of being in a vulnerable position as an instructor from a CC who needs support from her community to conduct BER.

Several individuals reported that the reduced sense of belonging they felt originated from a sense of feeling “out of place” at large national BER events. They recalled specific biases that they encountered when explaining this. For example, Nymphadora shared how respected individuals within the BER community actively failed to recognize CCF as having potential to contribute to BER. She described how these individuals encouraged 4-year faculty (but not CCF) to do BER work at CCs to counter the scarcity of CC BER. Another faculty member, Maddie (I), described the caution with which she enters into collaborations, stating that she wanted to avoid being the requisite CC person:

They [CC Bio INSITES] are a group of similar minded individuals that care about what I care about. I think there is a certain level of exclusion in BER that I’ve experienced, you know, whether when I go to SABER national, and it almost feels like community college inclusion is an afterthought. You know, that it’s there, because they have to. So I’ve experienced what I call elitism within BER, and it’s difficult to then gain the trust. So when there’s been exclusion of community college that has

been deliberate and consistent for years, and then you start seeing people applying for grants and putting community colleges on them and they want to collaborate, it’s very difficult not to ask the question, is this genuine? Or is this because—for lack of a better word—it’s the end of their career, they can’t get a grant but community colleges are, because of the neglect, NSF and NIH and all these [organizations] are paying attention to them so let’s collaborate with them so we could get a grant. So it’s very difficult to gain the trust, when the trust was not initially the focus of the relationship or when there was no relationship.

This sense of caution and lack of trust out of fear of being used prevented her from wholly participating in the BER community. Here, Maddie expresses feelings of being the “token” CC instructor on grants, without having meaningful involvement in the research. Such experiences have negatively contributed to CCF’s sense of belonging to the broader BER community.

Origins of Barriers or Supports

Origins of barriers or supports were also coded throughout the interviews and FGs to determine where they came from, and specifically if supports originated from the INSITES network. Origin codes were only coded if CCF pointed to individuals, groups, or institutions to which they could attribute the barrier or support. Unsurprisingly, when comparing the origins of the barriers or supports for CCF, many of the supports were attributed to CC Bio INSITES. The network contributed to all types of intellectual, resource, and social support across all codes. For example, in the interviews, all CCF pointed to having support from INSITES leadership. During FG discussion, Cassandra (FG) remarked: “So [the INSITES leadership team], was critical in helping us identify appropriate surveys for our research questions, how to implement and distribute those surveys, how to recruit.” Importantly, instances in which support originated from INSITES were used to specifically identify how INSITES supports mitigated barriers, as described in earlier. INSITES members were not the only origins of support, however. External origins, including institutional administrators, CC peers/personnel not affiliated with the network, and non-CC peers, were cited as sources of some support. Yet these same external origins were often also sources of barriers when administrators or peers were either indifferent or resistant to BER. During her individual interview, for instance, Cassandra (I) explained how “the rest of my department has no idea” what she is doing in her BER work.

DISCUSSION

CCF Continued to Report the Same Barriers That Were Described in the 2017 Report, yet Support Provided by the CC Bio INSITES Network Helped to Mitigate Each Type of Barrier

Five categories of constraints were described in the 2017 meeting report by faculty at the CC BER meeting. These constraints were associated with the time it takes to conduct and learn BER; having limited access to infrastructure; lacking administrator and peer support at one’s CC; experiencing a misalignment between professional and research identity; and receiving few, if any, formal incentives or rewards for CC BER (Schinske *et al.*, 2017). These barriers remain today, with all barriers reported in more than half of the interviews conducted in this

study. Adding to this list, we found that participants also specifically mentioned a desire for new BER skills and knowledge and bias against CCF conducting research. As anticipated, faculty who participated in the network were not free from such constraints and barriers. This mirrors research describing faculty teaching PD (TPD), wherein lack of time, resources, institutional support or incentives, perceptions of student resistance, and conflicting professional role identities are reported as barriers to attending PD to reform their classrooms (Brownell and Tanner, 2012; Lowenthal *et al.*, 2013; Sabagh and Saroyan, 2014; McCourt *et al.*, 2017; Bathgate *et al.*, 2019; Corwin *et al.*, 2019). However, we found evidence that the supports provided by CC Bio INSITES were able to mitigate each of these barriers to some degree. This mitigation was context dependent and varied by individual, reflecting the dynamic nature of supporting individuals in developing expertise across a range of BER participation and becoming expert members within a community of practice (Lave and Wenger, 1991).

Time and Knowledge Were the Most Prevalent Barriers Reported and Were Mitigated Primarily by Providing Intellectual Support, but to Some Degree by the Other Types of Support as Well

Time and a need for BER skills and knowledge (which were described together in the 2017 report) were reported by *all* participants in this study. This is unsurprising, given recent research describing time as a very salient challenge for CCF to pursue other academic endeavors such as TPD (Corwin *et al.*, 2019; Holmberg *et al.*, 2021) or BER (Pape-Lindstrom *et al.*, 2018). Typically, CCF spend between 13 and 17 hours of time in the classroom, as compared with research university faculty, who spend between 3 and 6 hours, and CCF have no formal time allocation for research (Cohen *et al.*, 2013). Thus, during the school year, CCF who wish to engage in or learn how to conduct BER must typically do so above and beyond their extensive teaching and service responsibilities. The lack of formally allocated time to BER becomes an issue, especially for those who need to spend time combing the literature or learning new education data-collection techniques and analyses. Intellectual and resource supports have helped reduce barriers to BER participation for CCs in the past (Pape-Lindstrom *et al.*, 2018). For example, Pape-Lindstrom *et al.* (2018) described how they carefully considered the time constraints for the CCF on their project by relegating much of the initial project design meetings to the summer, so as to not overlap with the CCF's teaching, and relying on the 4-year partners to provide access to grant funds for a summer salary, statistical expertise, and access to the literature. Our study demonstrates how providing these supports through a network can similarly mitigate barriers to BER.

Notably, lack of time and knowledge go hand in hand as barriers. Faculty in this study frequently reported having a lack of time to both do BER and learn about BER. This link provides us with mechanistic insight into *how* intellectual support helped these faculty to partially alleviate time constraints. As individuals become more expert via social learning in a community, the time it takes them to complete tasks decreases. Likewise, the time it takes them to establish new social connections that enable them to learn more decreases (Lave and Wenger, 1991). Therefore, by providing intellectual support that participants described as having access to people who

“know how to do it” and also are specifically there to “show you how to do [it],” CC Bio INSITES decreased the time to conduct BER that participants would have had to spend if they were navigating learning BER alone. As nearly all participants, regardless of BER expertise or experience, expressed that they were still learning different aspects of how to conduct BER, this generally held true across the participants in our study. However, individuals who had previously not conducted BER also expressed that intellectual support elucidated the “hidden curriculum” (Jackson, 1968) and enabled them to move through more common BER processes (e.g., distributing incentives, obtaining IRB approval) more quickly and seamlessly than they would have otherwise. They described this as “reducing the activation energy” to engage in research. This is reminiscent of the research describing *scientific research capital* in undergraduate biology students, which explains how different types of capital influence a student's trajectory to engaging and succeeding in research experiences (Thompson *et al.*, 2016; Cooper *et al.*, 2021). Bourdieu (1986) describes capital as valuable resources that can confer social advantage within specific fields, which can be categorized into economic (e.g., money), social (e.g., resources through social ties and relationships), or cultural (enculturated norms, values, attitudes, and preferences within a group) forms. Cooper *et al.* (2021) found that undergraduate researchers were more likely to have scientific research capital, particularly cultural capital (e.g., knowledge about how to seek out research opportunities), compared with undergraduate non-researchers, to find, secure, and participate in undergraduate research experiences. Similarly, scientific research capital, as provided from the INSITES network, can subsequently confer knowledge about the “hidden curriculum” in BER and reduce time constraints for CCF to participate in BER.

While providing intellectual support was the most direct way in which faculty reported alleviating barriers associated with time and knowledge when conducting BER, resource supports also contributed to the alleviation of knowledge barriers. In cases in which participants described this relationship, they frequently mentioned resource supports enabling access to personnel or information (e.g., literature). For example, by hiring skilled personnel (i.e., using monetary resources), INSITES members were able to connect to a community of skilled practitioners and learn new techniques. Thus, resource supports enabled researchers to purchase access or otherwise gain access to more knowledge and saved them time when they did not need to learn a technique on their own. Again, this aligns with capital theory, which describes how economic capital (i.e., anything that can be converted into money) can be used to access many other forms of capital and reinforces the idea that well-resourced organizations and individuals can both gain access and *provide* access to others more easily and efficiently (Bourdieu, 1986). As CCs do not typically have resources earmarked for education research, this is an important consideration when supporting BER. Providing social support was also mentioned as helping to alleviate the constraint associated with time. While the provision of this support did not directly decrease the amount of time it took to conduct BER per se, participants mentioned that the encouragement and structure of PD workshops created accountability and broke tasks into smaller

more manageable chunks that could be accomplished on a reasonable timeline. Such strategies have had similar success in encouraging TPD among faculty and graduate students (e.g., Gardner and Jones, 2011). Gardner and Jones (2011) recommended having intensive, ongoing exposure to TPD for graduate students to maximize their pedagogical effectiveness. Providing CCF with manageable blocks of time to work together on a BER task makes it more likely they will complete their projects.

Resource Supports Helped to Partially Mitigate Barriers Related to Lack of Available Infrastructure and Incentives or Rewards

Resource supports described monetary resources or resources that could have been purchased with money but were not directly monetary (e.g., access to journal articles, consulting/personnel support). It is broadly accepted that having more resources results in positive educational outcomes (Baker *et al.*, 2001; Arroyo, 2008) for all age groups (Raudenbush *et al.*, 1998; Archer *et al.*, 2012) and across fields (Raudenbush *et al.*, 1998). Likewise, having more funds or economic capacity is tied to research productivity (Stuart *et al.*, 2017; Grineski *et al.*, 2018; Shields and Feller, 2020; Randazzo *et al.*, 2021). This does not change for CCF engaged in BER. Participants in our interviews, regardless of whether they were expert or novice BER researchers, expressed that having access to important resources, such as papers, was essential to advancing their work, and sometimes these resources represented “the very beginning of starting any research project.” Essential research functions, such as grounding a study in existing literature, obtaining IRB approval, and disseminating findings all require funds and infrastructure (e.g., to purchase literature or to travel to conferences). For these more concrete necessities, resource funds were critical to project advancement. As mentioned earlier, this is corroborated by findings that economic and social capital can provide individuals access to opportunities or resources that lead to success in that field (Bourdieu, 1986). CCF would often rely on their 4-year collaborators to provide access to these forms of capital in order to fully participate in research (e.g., Pape-Lindstrom *et al.*, 2018). These benefits are conferred through social connections, with the members with more resources and knowledge sharing them with the newcomers in the community of practice (Lave and Wenger, 1991).

Resource supports were also found to partially mitigate barriers related to lack of incentives and rewards. Some CCF shared how monetary stipends provided by INSITES helped to motivate them to participate in BER. However, such external supports only act as a temporary fix in removing or alleviating this barrier. The cause of this barrier stems from a lack of value for BER within CCs, which can then manifest as a lack of incentives or rewards for CCF to conduct BER (e.g., Brownell and Tanner, 2012). Thus, while the network compensated CCF's time to pursue BER, thereby motivating further BER participation, the fact that it remains external to participants' own CCs means that CC instructors still do not perceive that their own institution values their BER work. A change in the internal perception and value of BER is needed to more fully remove this barrier to CC BER and encourage CCF motivation and persistence in BER.

Lack of Administrative or Peer Support and the Stereotypes and Implicit Attitudes of CCF Were Discouraging for CCF Engaged in BER, but These Barriers Were Often Countered by Social Supports Provided by the CC Bio INSITES Network

Previous work has described how constraints associated with lack of support from peers, stereotype threat, and bias can discourage individuals from persisting at a task or developing a sense of belonging within a community. For example, in academic settings, some tasks are not valued or not emphasized, and this leads to either disengagement from the task (e.g., teaching; Brownell and Tanner, 2012) or a sense of guilt or anxiety when engaging in the undervalued task (Shortlidge and Eddy, 2018; Chen Musgrove *et al.*, 2021). This happens frequently within research institutions where teaching is undervalued and can occur for individuals at different career stages, including faculty (Brownell and Tanner, 2012), postdocs (Trejo, 2017) and graduate students (Shortlidge and Eddy, 2018; Chen Musgrove *et al.*, 2021). A similar pattern is observed in this work investigating CCF, except flipped, with research becoming the undervalued task. Like the individuals described in the studies cited, our participants often stated that they do not or cannot prioritize BER, because of their professional identities and teaching responsibilities. Notably, pressure to prioritize teaching over research was described by participants as having both *internal* and *external* origins (see the agentic vs. non-agentic codes in Supplemental Table 2), very similar to the findings of Brownell and Tanner (2012) regarding research. Many faculty commented that they had chosen a CC career *because* teaching was their first priority and that it has *remained* their first priority, similar to the intrinsic motivation mentioned by Pape-Lindstrom when referring to her work in BER (Pape-Lindstrom *et al.*, 2018). The BER they do is auxiliary in support of teaching, so teaching responsibilities would always take priority over research efforts. Others described the pressure to emphasize teaching and *only* teaching as coming from their peers and administrators. Similar to those who pursue excellence in teaching at R1 institutions, they reported experiencing trepidation and anxiety about institutional administrators' and peers' reactions to their research efforts. They worried that these individuals would see their efforts as detracting from their primary job responsibilities.

Stereotype threat, microaggressions, and misconceptions about one's intention and role can result in decreases in the sense of belonging for various groups within communities of higher education (Hurtado and Carter, 1997; Lee and Davis, 2000; Woodcock *et al.*, 2012; Harrison and Tanner, 2018; Sue and Spanierman, 2020). Among these groups, biases against transfer students *because* they previously attended a CC, and this education is perceived as less rigorous, also exist and pose a threat to belonging within their classrooms (Corwin *et al.*, 2020). Similarly, individuals in this study report experiencing instances of microaggressions, biases, and misconceptions associated with their CC identity (e.g., individuals assuming that they cannot do BER rigorously or assuming lower skills levels), with most of the reports of such instances occurring at national gatherings of diverse BER stakeholders and originating from individuals holding faculty positions at 4-year institutions. Microaggressions can be described as brief, sometimes subtle, everyday exchanges that either consciously or unconsciously

disparage others based on their personal identities, characteristics, or perceived group memberships (Harrison and Tanner, 2018; Sue and Spanierman, 2020). Such exchanges can emerge as a result of negative stereotypes about CCs and may further reinforce misconceptions of CCF as “less rigorous” researchers compared with those from 4-year institutions. Instances of specific biases against part-time faculty were also mentioned, reminiscent of a recent popular press article discussing subtle, even unconscious, biases from students, faculty, and administrators toward adjuncts more broadly (Fulk, 2019). CCF (both in permanent and temporary positions) might consider themselves to have a type of stigmatized identity. Stigmatized identities are identities that may evoke negative social stereotypes and can result in discrimination or loss of status within the community (Link and Phelan, 2001; Quinn, 2006; Quinn and Chaudoir, 2009). These identities can be based on more apparent features of an individual (e.g., ethnicity, weight) or can be hidden (e.g., LGBTQ+, religiosity, mental health). Individuals who hold a stigmatized identity have reported a lower sense of belonging within a community (Bosson *et al.*, 2012). CCF in our study share how their CC identities can feel like a hidden stigmatized identity among the broader BER community, where they are cautious about asking questions about BER openly out of fear of being seen as the “dumb community college professor.” Such stigmatized identities can lead to stereotype threat, which is the threat that others’ judgments or one’s own actions will exacerbate negative stereotypes held about particular groups within specific domains (Steele, 1997). In this case, CCF fear that their actions and others’ judgments will exacerbate the perception that CCF cannot meaningfully contribute to or conduct BER. When such challenges arise, prior research has documented the incredible resilience that individuals from stigmatized groups embody when persevering (Azmitia *et al.*, 2018; Morton and Parsons, 2018; Ong *et al.*, 2018). CCF from this study similarly shared their personal resilience and pointed to ways they cope with these obstacles. For example, Cameron explained that her prior experiences in BER, personal identity, and peer support have helped her to navigate the BER community: “And so, you know, I’ll just use those forces [my personal resilience strategies] for what I think is good. Not always, appropriately, probably, but I think that helps me feel confident that this is a place where I belong. And if someone wants to question it, I can pull something out of the hat.”

An encouraging finding from our work was that social supports, specifically from CC Bio INSITES, helped to mitigate barriers, particularly overcoming the lack of administrative and peer support from participants’ own institutions and also the stigmas and stereotypes associated with being a CCF conducting BER. Social supports were mentioned by all faculty and were very frequently mentioned as being the type of support that prompted entry into and persistence in the CC Bio INSITES network and engendered an increased sense of belonging. Social supports described by participants originated from either within or outside the INSITES network. One participant in particular described how participation in a welcoming BER group outside INSITES had provided support for her entry into the BER community. However, given the nature of our interview protocols and research questions, participants most frequently reported the specific social supports provided by INSITES that accomplished this goal, describing how being members of the network

made them feel important to the BER cause and more efficacious as researchers. They also specifically mentioned how being members of INSITES and encountering other members at large national events helped to create spaces where they felt valued and mitigated the constraints mentioned earlier. While professional stigmatized identities, such as being a CCF, are vastly different from those associated with race or ethnicity (e.g., Earnshaw *et al.*, 2013), these observations are somewhat reminiscent of “counterspace” as described by Ong and colleagues (2018) in reference to Black women’s experiences in STEM. Originally characterized as “safe space” for homogeneous groups of marginalized individuals who exist at the margins of mainstream educational communities of practice (Solórzano *et al.*, 2000), the definition of “counterspaces” was expanded by Ong and colleagues (2018) as existing both at the margins and centers of communities and consisting of heterogeneous groups that vary in terms of race/ethnicity, gender, and power level. In these spaces, the effects of marginalization may be countered, creating havens from isolation and microaggressions and places of support, validation, and encouragement (Ong *et al.*, 2018). INSITES and the other networks described in the *Introduction* (e.g., CAPER and CCREST) could be acting as similar spaces for those who hold CCF identities within the INSITES community. Likewise, groups that recognize and welcome CCF into the broader BER community could create counterspaces, subsequently allowing further formation of such spaces and cultural shifts to more inclusive practices. One example of this is the inclusion and centering of CCF expertise at the regional SABER West meeting, a nationally recognized gathering of BER researchers that features and prioritizes CC BER.

A final notable and encouraging finding regarding social support was that several individuals who either previously held expertise in BER or developed it via participation in the INSITES network described how the network provided the opportunity to “give back” to other CCF. This action of giving back increased these members’ centrality within the network and increased their own belonging to and ownership of the network. Most commonly, “giving back” was mentioned with respect to either publishing (making an intellectual contribution) or making new connections, including creating opportunities for others to build their social networks or access leadership positions, such as guest editing or reviewing. This increase in expertise, centrality, and belonging marks the quintessential movement of individuals in a community of practice toward being experts (Lave and Wenger, 1991). When CCF remarked on how INSITES helped increase their confidence, recognition, and involvement as BER scholars within the community and how they now felt they could give back, it was apparent that they had become more central to the community’s function (Lave and Wenger, 1991). Likewise, this reflects tenets of social and cultural capital theory (Bourdieu, 1986), which describe how capital can be leveraged to increase an individual’s access to resources. In this case, CCF participants are describing how, through occupying more central positions within the community, they can leverage their developed social and cultural capital to confer knowledge of the academic science culture, thereby allowing other CCF to successfully participate in education research. Interestingly, prior research has found that giving back is often predicted by a high sense of belonging in addition to how motivated an individual is to instill change within a

community (Drezner and Garvey, 2016; Drezner and Pizmony-Levy, 2020), although this giving back is usually in the form of monetary gifts rather than specific actions. Further investigations examining how providing opportunities to give back may increase the sense of belonging for individuals and contribute to their progression toward centrality within a community of practice would be interesting for INSITES and future networks. This progression of participant CCF into more central roles has increasingly become a priority for the network and will inform future network actions and efforts.

Social Supports Are Likely to Be Critical for CCF to Develop a Sense of Belonging to the BER Community, yet Social Supports Originating Only from Specialized Networks, Such as INSITES, May Not Be Sufficient to Promote a Broader Sense of Belonging within BER

Despite reporting a strong sense of belonging to the INSITES network itself, many participants described that they *still* felt a lack of belonging to the broader BER community. As explained in the *Results*, several individuals reported that this stemmed from microaggressions and biases that they encountered when interacting with BER communities outside INSITES. These interactions made them feel unseen and undervalued. Importantly, some interactions, such as being included in research to fill the role of “the” CC person, are reminiscent of descriptions of tokenism (Kanter, 1977; Smith, 1985; Niemann, 1999). Tokenism is defined as instances in which minority group members are treated as representative of their entire group, especially when they are a numeric minority or the only person from that group present (Kanter, 1977; Smith, 1985; Niemann, 1999). Such actions often result in increased pressure to perform and increased exposure to stereotype threat, which in turn threatens sense of belonging and, ironically, increases exclusion from the dominant group (Kanter, 1977). Similarly, encountering microaggressions decreases belonging (Torres *et al.*, 2010; Wang *et al.*, 2011). It is clear that some of the barriers we have described remain present and active within the broader BER community, while they may be absent (or at least less prevalent) in the INSITES community and others.

A second source generating a sense of lack of belonging originated from not having achieved formative goals that some participants considered hallmarks of being a BER researcher, such as publishing a BER paper. Participants explained that achieving this type of external validation of their work would affirm their confidence and thus increase their sense of identity as a BER researcher (and thus belonging). This is in line with many avenues of theory and research that describe the relationship between research mastery experiences, self-efficacy, and identity (Lave and Wenger, 1991; Usher and Pajares, 2008; Graham *et al.*, 2013; Robnett *et al.*, 2015). However, it is likewise theorized and true that communities consist of individuals in all stages of intellectual development and accomplishment (Lave and Wenger, 1991).

These findings indicate that, to fully facilitate increases in belonging for CCF and other marginalized groups engaged in BER, we need to consider both how to remove barriers associated with stigma and bias throughout the *broader* BER community and how to help faculty access experiences that constitute forms of external validation (abstract acceptance, publishing, invitations to speak). Offering specific spaces in which CCF and

other groups feel an increased sense of belonging, such as INSITES, can only get us part of the way there in becoming a truly inclusive community.

IMPLICATIONS AND RECOMMENDATIONS

This study and the related, supporting literature cited have several important implications for future work aimed at including new members in the BER community, especially when considering how to best include and center new members from underserved groups:

- Knowledge and resource supports are important factors for engaging a new population of faculty in BER, but programs must also attend to social support. We feel it is important to emphasize that the combination of the supports noted here is critical to support a new population of faculty in engaging in BER. In particular, social support provided the most direct links to the development of a sense of belonging, which ultimately predicts persistence in a community of practice (Hausmann *et al.*, 2009). While there is evidence that social supports offered via mentoring and encouragement contribute to the success of PD, especially for adjunct faculty and CCF (Diegel, 2013; Ching and Hursh, 2014; Edwards *et al.*, 2015), it is difficult to find work that describes *how* PD can be structured to maximize such support. Our findings emphasize that consistent encouragement, structured meetings to create accountability in goal achievement, validation of value, and numerous opportunities to connect with others who share similar goals and values are specific mechanisms through which social support acts. Such support can unveil the hidden curriculum in doing BER and further create the necessary scientific research capital needed for CCF to pursue and persist in BER. We hope that future PD programs attend to the provision of social support through deliberate design elements such as those we have described. We also encourage future research to further investigate the ways in which social supports can best be incorporated into BER PD.
- Cultivating belonging in the broader BER community requires social support and recognition beyond local affinity groups. While there are clear benefits to establishing local affinity groups, such as CC Bio INSITES, our work indicates that such groups are only the first step in welcoming new populations of faculty to the BER community. To cultivate a broader sense of belonging, more action is needed. CC Bio INSITES has experienced some success in establishing connections between the broader BER community and INSITES members via encouraging opportunities for social connection and collaboration between emerging CC BER scholars and others already immersed in the field. In particular, early-career postdoctoral researchers and faculty with an interest in establishing new collaborations have been particularly supportive of emerging CC BER scholars' work within the INSITES network. Indeed, other networks are focused on establishing successful collaborations between researchers at CCs and other heavily research-focused institutions (e.g., BERCC). Our work suggests that such collaborations are likely to be especially beneficial and successful if they attend to models of collaboration that emphasize the value of *full* participation of researchers hailing from the community under study, such as participatory action research (PAR; McIntyre, 2007) or

CBPR (Hacker, 2013). These models may be especially important in assisting to avoid tokenization, which may lead to feelings of isolation on the part of CCF (Kanter, 1977). Other methods for engaging emerging BER scholars could focus on practices that promote equity and inclusion at conferences, such as scientific presenting strategies to promote equity and engagement (Corwin *et al.*, 2018).

- Actively disrupting stereotypes regarding who is valued in BER and what assets emerging BER scholars can bring may help to promote belonging and persistence of more diverse community members. Our results indicate that many members of this study encountered stereotypes that minimized and underestimated the value that they could bring to the BER community. The language used in presenting these stereotypes and misconceptions was often deficit focused. Previous research on combating microaggressions in academia has focused on the importance of language (Harrison and Tanner, 2018). Thus, by avoiding language that implies a deficit model regarding CCF, part-time faculty, and other groups of emerging scholars, we may be able to promote belonging and persistence and avoid the damage that is so often caused (Smit, 2012) by promoting these views. We can also challenge these stereotypes by actively ensuring that CCF and part-time faculty are included in leadership roles in BER and that their voices are valued and prioritized. We can challenge stereotypical narratives by creating BER ethnographies or scientist spotlights (Schinske *et al.*, 2016) that reflect the diversity of individuals who engage in and advance BER. Finally, we may wish to openly challenge the perceived conflict between holding a research or teaching identity, thereby demystifying why individuals from both 2- and 4-year institutions perceive this tension.
- LPP, in addition to the tenets and philosophies espoused in CBPR and PAR, could prove helpful in the design and implementation of future programs engaging new individuals in BER. LPP recognizes *all* individuals with varying levels of skill and knowledge as *legitimate* participants in a cohesive community of practice. By virtue of recognizing that individuals with varying experience and skills exist together in a community, this framework is inclusive. It also frames legitimate participation as occurring through *social* interactions that advance an individual toward a more central community position. Similarly, CBPR and PAR both emphasize that *legitimate participation* of the community under investigation is necessary to promote inclusion and social justice. If we combine these frameworks, they elucidate a path through which members of historically marginalized communities can enter, participate, and become central to a community of practice. We feel that these frameworks can and should serve as guides for future programs seeking to engage new individuals and communities in BER.

CONCLUSION

To accurately represent all peoples and institutions in the current BER literature, we need to increase participation of researchers from underserved groups, such as instructors from CCs. Our results suggest that when CCF have a three-pronged support structure—intellectual, resource, and social support—the barriers they experience when conducting BER are mitigated. Further work is needed, however, to ensure CCF's full

participation in and belonging to the broader BER community. Networks such as CC Bio INSITES are the first step in facilitating the progression of new individuals to becoming central members of the BER community of practice.

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