Community Roles for Supporting Emerging Education Researchers

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DBER attracts many faculty from other STEM disciplines, and these faculty have little or no specific training in DBER. DBER requires a mastery of quantitative, qualitative, and/or mixed methodologies, and also a nuanced understanding of breadth of topic, research questions, and theoretical frameworks. This interdisciplinarity is particularly challenging for emerging DBER researchers who often switch into DBER with only discipline specific content and research training. As part of a large study about how STEM faculty become involved with DBER, we interviewed a number of emerging DBER faculty about their pathways into DBER. We conducted a thematic analysis of these interviews grounded in the theoretical frameworks of the reasoned action approach and conjecture mapping. Based on our analysis we identified 3 roles that support new faculty entering DBER. These roles are the peer, the subject matter expert, and the project manager.

I. INTRODUCTION

The traditional route into academic STEM positions is well defined. People begin as students, go through graduate school, complete a postdoc (or several), and then finally obtain a tenure track faculty position. This traditional route prepares people through a combination of coursework and mentoring to become an academic faculty member in their discipline. While lots on literature focuses of faculty teaching development [1–3], there is little literature on faculty development as researchers (though some work has investigated specific aspects of research development or has commented on it [4, 5]). Academic communities largely assume that faculty learn the skills they need to perform research in their disciplinary sub-field before being hired as faculty.

Discipline based education research (DBER) challenges this assumption that faculty are well prepared to conduct research in their sub-field. Research on science faculty with education specialties (SFES) has shown that many SFES are not formally trained in DBER [6]; many faculty transition into DBER after training exclusively in non-education STEM subfields. As people develop skills and identity as education researchers, we refer to them as "emerging discipline-based education researchers" (EDBERs); if they are already faculty at that time, "faculty EDBERs".

These faculty EDBERs often lack confidence and background knowledge when interacting with the DBER community. Providing support and education to faculty EDBERs is a non-trivial task, especially because few formal programs exist to train and support them [7]. Many of them are at small institutions and struggle to access a network of experienced SFES. These faculty EDBERs keenly feel the lack of formal and informal professional development support for research, and strongly desire to connect with other SFES. Here we ask what roles can SFES fill to best support EDBERs as they transition into DBER?

Through thematic analysis of interviews with 7 faculty EDBERs we explored their needs around their transition into DBER. We posited three roles that EDBERs need to support them in their transition: *peers*, other EDBERs with whom they can work and learn together; *project managers*, mentors who help administer and plan research projects; and *subject matter experts*, mentors who provide guidance about DBER subject knowledge and about engaging with the DBER community. We use conjecture mapping to show how these roles can support EDBERs within the context of the Professional-development for Emerging Education Researchers (PEER) program [7].

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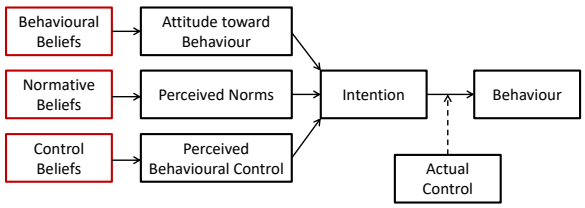

FIG. 1. A diagram of the reasoned action approach. We see how beliefs give rise to attitudes and perceptions, which in turn give rise to intentions. Finally external influences moderate whether intentions become behaviors.

II. THEORETICAL FRAMEWORKS & CONTEXT

Our project began as discovery research around the needs and motivations of people moving into DBER, as part of a larger project developing materials to meet EDBERs needs [7–9]. Why do some faculty choose to transition into DBER? What challenges do they face? What kinds of support do they need? We chose the reasoned action approach [10] (RAA, see figure 1) as our theoretical framework to aid us in understanding the motivations behind peoples actions and choices.

According to the RAA, beliefs drive behavioral decisions. The RAA specifies three kinds of beliefs: behavioral beliefs, normative beliefs, and control beliefs. Behavioral beliefs are related to the consequences of engaging in a given behavior (e.g. publishing a paper may support my tenure package). Normative beliefs relate to the norms surrounding the behavior (e.g. my department expects me to have 7 publications to obtain tenure). Control beliefs are about one's control over the behavior (e.g. I can apply for a waiver that will pay for my page charges).

A person's beliefs give rise to their overall attitude toward the behavior, perceived norms around the behavior, and perceived control over the behavior. For example, because I believe publishing to be beneficial to me, I may develop a positive attitude towards it. People's attitudes and perceptions give rise to intentions, which finally give rise to a decision about behavior (moderated by their actual level of control over the particular behavior).

While the RAA helps us frame decisions in terms of beliefs which serve as a bridge between participants motivations and actions, it does not suggest actions or mechanisms to support or change EDBERs beliefs. Being thoughtful about how we support or seek to change particular beliefs held by EDBERs is critical to guiding them on their path into DBER. Conjecture mapping [11, 12] is a powerful tool that allows us to ground our theoretical and design ideas about professional development in components of a specific program. We have used conjecture mapping to show how the results of our analysis are implemented in the PEER program. The basic elements of a conjecture map are *theoretical conjectures*, *design conjectures*, the *embodiment* of the program, *mediating*

FIG. 2. Conjecture mapping allows us to link the theory and data concerns that drive research with the practical design concerns which drive professional development programs. Our work in this paper has been grounded in the design of the PEER program. Our design and theoretical conjectures in this paper explain how the three roles we posit connect the embodiment, mediating processes, and outcomes of PEER.

processes, and *outcomes*. The first two are our conjectures about how the other three are linked, while the last three represent the practical design elements of the program, and their consequences for participants. Their interactions are depicted in figure 2. We use conjecture mapping to ground our results in the context of the PEER program.

The PEER program brings together EDBERs at a workshop to do intensive writing and thinking about research questions and research design. The program also covers selected topics in research based on participants's needs (there may be workshop sessions focused on particular methods or theories for example, or on authorship). The bulk of the program centers on participants working together and sharing and refining research ideas together with the support of PEER coordinators. PEER coordinators intersperse groupwork activities with instruction and guided discussion around subject matter and research design. The PEER coordinators also provide a scaffold for project design and planning.

Participating in PEER provides participants with useful subject matter knowledge. It also provides participants with a network of other people including peers and mentors. A further outcome of participation in PEER is that it strongly influences participants's behavioural, normative, and control beliefs about their participation in DBER. Using conjecture mapping as a bridge to connect our analysis of EDBERs beliefs to posited roles we can build a picture of how community support is enacted as a part of the PEER program.

III. METHODS AND ANALYSIS

The data for our research in this paper is drawn from a set of 7 interviews with faculty EDBERs (specifically math faculty). These faculty have a range of experiences with DBER, from having never engaged with DBER before, to having engaged with projects on and off for more than 7 years. All of the faculty are tenure track faculty at primarly teaching institutions. They all have an interest in participating in DBER, but for various reasons they do not feel prepared. Our interviews with these faculty focused on their experiences in education research in their discipline. We had conversations about their projects, their major successes and challenges, and the various barriers and supports that had impacted those projects. Each interview lasted for about 50 minutes and was conducted by author 1 and author 3 over zoom.

We conducted an exploratory thematic analysis of the interviews around the motivations of faculty EDBERs and the supports that they need to become more successful in DBER. Success was defined by the participant. Our discussion centered on their own experiences, and the kinds of supports they would like to overcome barriers to their participation in DBER. We also discussed what success looked like to them, and what motivated them to pursue DBER.

In this paper we explore a theme around mentorship and/or peer groups which are mentioned explicitly by all of our participants. This is in line with prior work on teaching development for faculty [13–16], and also in line with work on research development for undergraduate and graduate students [17–19].

Based on participants's discussions of and interest in mentorship and community support we posited three roles that SFES could fill to support faculty EDBERs. These roles form the basis for three design conjectures for the PEER program (Table I). Using the RAA as a theoretical lens we analyzed participants's responses in interviews to see what kinds of beliefs they held about their status or potential status as members of the DBER community. We then based our theoretical conjectures (Table I) about how these roles can support PEER participants on these findings.

The first role is the *peer*. Peers are other faculty EDBERs with varying levels of familiarity with DBER and SFES. The most important aspect of peers is that they have similar experiences and understand the unique challenges of transitioning into DBER as a faculty member. Peers can support each other in a variety of ways: as collaborators, as participants in accountability groups (reading and writing groups for example), and simply as a network of friends and contacts. As one participant states, *"when we talk about community,[. . .] it's just providing the network of people that are regionally close by that have similar goals and have dedicated time with me."* They express a desire for a network of approachable collaborators with similar goals. Our participants keenly feel their lack of access to the DBER community. This prompts our first design conjecture: PEER's active idea sharing and interactive research building brings together EDBERs to form peer groups.

Particants also fear reaching out to collaborators and the community in part due to perceived stigma. One worries, *"[. . .] is there is a stigma for bringing in a whole bunch of other people [in DBER]?"*. This leads to two theoretical conjectures, the first: Meeting other people and forming groups at PEER reinforces the control belief that they can find and work with welcoming collaborators. The second: Having peers from a similar background helps to normalize this transition from non-education STEM backgrounds into DBER. This supports a normative belief around being an EDBER. By

	Design Conjecture	Theoretical Conjectures		
		Control Beliefs	Normative Beliefs	Behavioral Beliefs
Peers	PEER's active idea sharing and interactive research building brings together EDBERs to form peer groups.	Peer relationships reinforce the belief that they can find and work with collaborators.	Peers legitimize being new and entering DBER in a non-traditional way.	
Subject Matter Expert	Providing responsive instruction around field specific knowledge and practices allows EDBERs to take up these ideas.	Taking up ideas supports EDBERs confidence in incorportating new DBER knowledge into their research.	Selecting among ideas and narrowing the focus of research questions normalizes speciliazation within DBER.	Developing greater comfort with DBER knowledge increases EDBER confidence in positive interactions at conferences.
Project Manager	Scaffolding research design and project planning gives EDBERs space to safely begin managing a project.	Working within the scaffold provided and receiving feedback on plans boosts EDBERs confidence in project planning and execution.		

TABLE I. Three roles for supporting faculty EDBERs while they are transitioning into DBER. We have explicitly tied each role to the RAA framework [10], and have outlined how the roles are connected to theoretical and design conjectures of our conjecture map for the Professional-development for Emerging Education Researchers program.

making it apparent that EDBERs are welcome, legitimate participants within the DBER community we support EDBERs in their efforts to become more involved with community discourse.

The second role is the *subject matter expert*. Subject matter experts are experienced SFES who have extensive knowledge of their DBER field. One interview participant notes: *"Like, I felt like these people had trained for five to six years, you know, decades, and so that they would just have so much more knowledge."* All faculty EDBERs expressed a need for support in understanding the methods and theories of the field they are transitioning into. Our second design conjecture states that subject matter experts providing responsive instruction around field specific knowledge allows EDBERs to take up DBER ideas.

Participants further expressed hesitation about networking in DBER because of negative interactions with experienced SFES (both real and imagined interactions). *"When I talked to people [at the RUME Conference] they said, 'Oh you sound like someone who's interested in education research, but you don't use any of the correct terms or phrases', so I felt very much like 'ok I'm not really doing it'."*. EDBERs express uncertainty due to their lack of experience with DBER terms, theories, and methods. This can make it difficult for them to engage constructively with conferences and journals. Subject matter experts can help EDBERs identify appropriate venues for their work, and can help them develop their familiarity with field specific lingo. This supports our third and fourth theoretical conjectures: By supporting EDBERs in taking up subject specific knowledge we support a control belief that EDBERs can incorporate DBER theory, methods, and concerns into their research. Further, increased subject knowledge and appropriate venue choice promote positive experiences for EDBERs when interacting with the DBER community. This supports a behavioral belief that conferences and community interactions can have positive outcomes.

Finally, EDBERs often hold a belief that their work might be perceived as uninteresting, or unimportant to the community. According to a participant: *"To have time to do [DBER], you probably need grant funding, and if you're going to get grant funding, it has to be important, right?"* They go on to explain that as an "incrementalist", they feel that their work *"doesn't require grant funding because it's not really important enough to generate grant funding."* EDBERs feel that DBER must be a community of generalists. This leads to our fifth theoretical conjecture: Subject matter experts can support a normative belief that specialization is accepted by showing EDBERs how they specialize within the field, and introducing them to appropriate groups and funding streams within the field. Normalizing selectivity also allows EDBERs to use their resources more efficiently, easing resource pressures.

The third role is the *project manager*. Project managers are experienced SFES who coordinate research projects with EDBER collaborators. The project manager helps EDBERs organize the project, set goals and timelines, and deal with administrative concerns. A common concern among EDBERs is that a project may fail due to poor time, resource, or paperwork management, leading to a loss of all invested time and resources. The common sentiment that they need support in project management is captured in the following quote:
"So it would probably take like somebody to say like, 'hey, I'd like you to be part of my project. I need you to do this and this, and I'm going to take care of this and this, right?' Somebody else[...] and they've kind of thought through some of the structure and so you can kind of get into something like

on somebody's coattails, right?"

Our third design conjecture states that scaffolding research design and project planning gives EDBERs space to safely begin managing a project. This opportunity to engage with DBER safely while receiving organizational support, feedback, and guidance frees EDBERs to focus more of their energy on mastering subject knowledge. This also gives us our third theoretical conjecture: Being mentored in project management also helps EDBERs build a control belief that they can plan and administer a research project successfully.

We note that traditional graduate advisors can take on roles of *subject matter experts* and *project managers* with their graduate students; indeed, many EDBERs expressed a desire for "mentors" within DBER. While these roles can be performed by the same person, it's also possible that some people may fill only one role for any given EDBER, or may take on different roles in different contexts. Our design conjecture allows us to separate these roles to better understand how they support different control beliefs. A summary of all of these roles can be found in Table I.

IV. DISCUSSION

DBER faces a unique challenge training faculty who cross into the field from other STEM disciplines. These EDBERs acutely feel a lack of DBER training and access to community that their more experienced SFES counterparts have, and this perceived lack impacts them in unique ways. We used the RAA as a theoretical lens to explore the kinds of beliefs that drive EDBERs to transition into DBER as well as the beliefs that hinder their transition, and to posit ways of helping EDBERs foster and develop confidence in their transition. We identified support roles to support EBDERs' beliefs about transition. Peers, subject matter experts, and project managers can support EDBERs during their transition into DBER. We posit that these roles can help to build and maintain EDBERs confidence in DBER, thus promoting their growth within the community.

We have used conjecture mapping to demonstrate how the roles developed in this paper are already incorporated in a faculty development program. The Professional development for Emerging Education Researchers (PEER) program supports EDBERs of all levels, including faculty, through active research project development, community building, and collaborative feedback [7]. This research also suggests that explicit discussion and workshops around navigating these roles and relationships would be valuable to EDBERs as part of their professional trajectories. As part of future PEER workshops we will try to build and incorporate sessions on navigating community relationships.

While we have discussed these roles in the context of transition, we recognize that faculty need mentors and peers at all stages of their careers. As part of our future work we intend to investigate the importance of these roles to faculty at other stages in their careers, as well as investigating what other roles may be significant to faculty. An example of a role which does not appear in our data on the needs of EDBERs is supervisees, even though as faculty they may already supervise students in research. Students, postdocs, and junior faculty play significant roles in the academic world. We expect this role to become significant for more established faculty and for faculty who operate in large groups of mixed experience.

We recognize that this preliminary work is based on a small dataset. As we work to extend the analysis of these beliefs and roles, we are collecting additional interviews with faculty EDBERs involved in PEER workshops. Though this paper has focused on the theme of community access and mentorship, a more robust data set will allow us to investigate other needs that EDBERs may have. This will allow us to expand upon the roles that are needed to support faculty research development, and also examine other kinds of supports that may be helpful to EDBERs.

It is our hope that SFES faculty will consider taking up these roles to better facilitate EDBERs' transition into the DBER community. It is particularly critical to support EDBERs at small institutions without senior SFES by reaching out and collaborating between institutions. By welcoming more faculty into DBER we increase the reach of the field, as well as including a wider variety of experiences and ideas in the DBER discourse.

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