Special Session: STEM Faculty Development Research Agenda

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***Abstract*—Expectations for faculty members are high: STEM faculty are expected to establish a sustainable research trajectory, a teaching practice, and a service/leadership role all while pursuing tenure and promotion success. Although many colleges and universities have established STEM faculty development programs, a deficiency in holistic professional support remains, specifically in the integration and alignment of these disparate professional activities with individual and institutional goals. This session will involve participants to continue the work undertaken to bring together multiple stakeholders in academia, government, and industry to establish a research agenda for STEM faculty development. The audience includes those interested in furthering this research agenda.**

Keywords—STEM, faculty development, research agenda

I. Introduction and Motivation

The aim of this special session is to engage communities of research and practice in conversation about needed research in the area of science, technology, engineering, and math (STEM) faculty development. The preparation and continued education of STEM faculty are more important than ever for purposes of educating more STEM graduates needed for the workforce and ever increasing demands on faculty members' time. It is therefore important that holistic faculty development reinforce the importance of all aspects of faculty responsibility, including research, leadership, service and teaching. Unfortunately, many faculty struggle with balancing the sometimes competing goals of these responsibilities, and are often influenced by a reward structure that prioritizes research. However, research on teaching suggests that external motivation such as university reward structures can transition to more internal motivation through professional development experiences [1]. Research also suggests the need for faculty support beyond the new faculty orientation and other initial programs [2]. The same may be true for the implementation of such strategies to enhance research, mentoring of graduate students, publishing, and the other requirements for tenure, highlighting the importance of sustained holistic faculty development.

This session is unique in that we will engage participants in looking at further development and refinement of a draft research agenda that is focused on holistic STEM faculty development. Unlike many faculty professional development efforts on teaching and learning in the STEM classroom, we intend to move beyond the classroom to examine, incorporate, and support the many facets of faculty responsibility and professional development. We are organizing this research agenda around the inputs to, the processes of, and the outputs from faculty development. This new agenda proposes research topics that address all areas of expectations for faculty. Research that is pursued in these areas will work to examine the procedures and policies that will ensure future faculty success.

The specific goals of this session are to:

1) Present a process model for the creation of a draft research agenda (NSF grant #EEC-1551605) and for use in an additional NSF workshop (NSF grant #EEC-1638888);
2) Describe the preliminary research agenda initiated for STEM faculty development that focuses on holistic areas of teaching, research, service, and leadership;
3) Engage participants in reviewing and revising the agenda;
4) Involve participants, and the greater community, in determining and disseminating the next steps of the agenda.

II. Research Agenda Development Model and Process

In 2016, a Clemson University team in collaboration with partners at Drexel University and University of Washington received funding from the National Science Foundation to developing a national research agenda for broadening the participation in engineering for those self-identifying as veterans, LGBTQ+, Low income/First generation, and those with disabilities. Specifically, authors Stefl and Martin along with co-PI Amy Slayton of Drexel University hosted a national conference in October 2016 at Clemson University entitled "*Who's Not At The Table?:* Building Research Capacity for Underserved Communities in Engineering." With collaboration from author High, this team created and refined a model for engaging the research, academic, and professional communities. Through hosting a national 1 and ½ day working conference, the team brought together 70 experts who provided their collective

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expertise to initiate the first stages of a national research agenda using this community engagement model, the full details of which are in [3]. On the first day of the conference, the Martin, Stefl, Slaton team encouraged their participants to generate ideas on sticky notes (i.e. one idea about research questions, methods, contexts, etc. were recorded on an individual note). They placed sticky notes onto one of several large boards placed throughout the room, each board represented an overall theme guiding discussions and activities related to that theme. On day two, the sticky notes generated during the various sessions from day one were distributed to small groups of no more than 10 participants, who then collaborated to categorize these notes under similar themes. The participants were asked to label, describe, and relate these groupings to form concept maps representing the categorization and relationships between categories of generated ideas. The research team leading the event then analyzed these concept maps and corresponding groupings of sticky notes.

This community engagement model was adopted by the High, Stefl, Lee, and Linder team (authors on this paper) in collaboration with Faiza Jamil (Clemson University). Our team went on to host a separate NSF sponsored workshop in February 2017 at Clemson University entitled "*How Many Hats Do You Wear?*: Building Research Capacity for STEM Faculty Development." The goal of this event was to develop a national research agenda on holistic STEM faculty development. Over 50 leading experts in various STEM disciplines, in educational and programmatic research, and in faculty development engaged in directed discussions and working sessions to elucidate the many facets of faculty development and to develop research questions, methods, and theories related to holistic STEM faculty development. Our participants were professionals from government, industry, non-profits and academia (i.e. university administration and faculty in all phases of their career-early, mid, late emeritus) . The specific details of our workshop are outlined in [4].

Using the model developed by Martin, Stefl, and Slaton, we also solicited participant-generated feedback and insights documented on hundreds of individual sticky notes that our participants organized into concept maps (shown in Figures 1 through 3). This data formed the body of knowledge from which we are building the research agenda.

III. Research Threads And Agenda Development

In February 2017, discussions surrounding the research agenda were grounded in one of the following three major themes (or "threads"), which are detailed below:

1) The 'inputs' thread of holistic faculty development focuses on topics related to the characteristics of faculty members and institutions that serve as barriers or supports to the adoption and implementation of holistic STEM faculty development programs.

2) The 'mechanisms/processes' thread focuses on topics related to the actual implementation of STEM faculty development and we consider the potential models or structures of STEM faculty development that are currently in place or conceptualized in theory.

3) The 'outputs' thread focuses on identifying and refining research questions, potential methods and pathways for exploration, and potential limitations for topics related to how to best understand the influence of STEM faculty development on various factors. These factors include, but are not limited to, STEM faculty identity in relation to faculty development, and how faculty development influences overall faculty wellbeing, career satisfaction, and work-life balance.

Throughout the first day of the workshop, we encouraged our participants to engage in discussions and share their ideas on sticky notes. On the second day, participants worked in small teams of 8-10 people to organize the sticky notes generated for one of the three threads. We then asked each team to create a visual concept map to represent the categories they had organized sticky notes into along with outlining relationships among their categories. Each thread was assigned two teams giving us a total of six concept maps (two for threads 1, 2, and 3). We provide some examples of the visual concept maps created by our participants in Figures 1, 2, and 3.

To begin analyzing these concept maps and associated sticky notes of ideas, author Stefl transcribed the visual maps of categories and relationships as well as each individual sticky note into a digital format from those sessions. Here, we share an example of the digital recreation of these concept maps that we used as the initial point to develop our research agenda (Figures 4 and 5).

Figure 1: Participant-generated concept map for thread 1 (Inputs)

Figure 2: Participant-generated concept map for thread 2 (Processes)

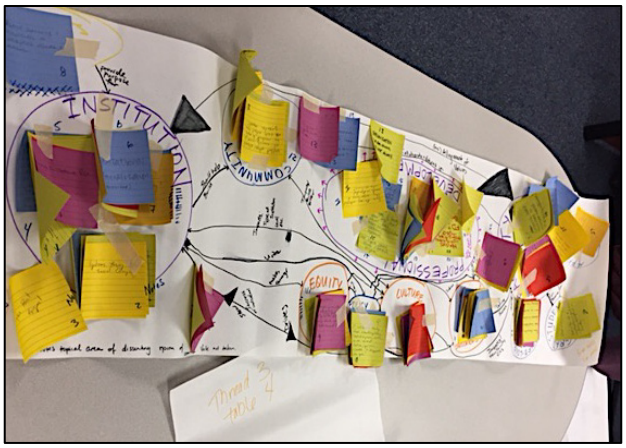
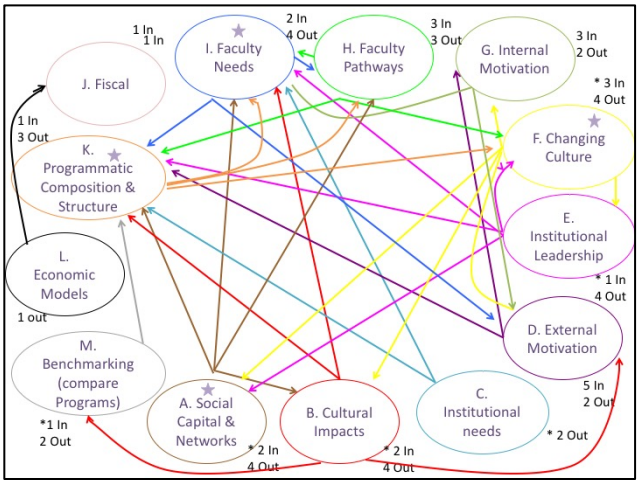


Figure 3: Participant-generated concept map for thread 3 (outputs)



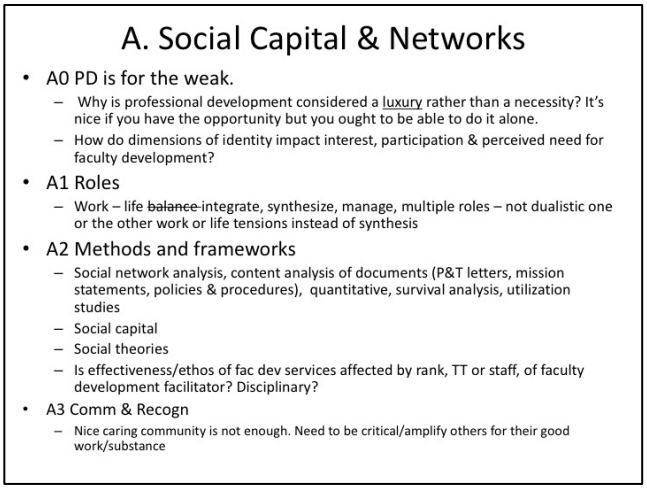


Figure 4 and 5: Digital recreation of thread 1 concept map and an example of the sticky notes associated with one of the categories (Outcomes)

IV. Intended Audience For The FIE Special Session

In this FIE special session, we will engage new research experts and professional community members by asking them to challenge, expand upon, and refine the research agenda we have developed thus far.

Designed to be a dialogue between the presenters and the participants, our intended audience is that of experts in STEM education research, program developers, practitioners, organizational leaders and staff of centers for excellence in teaching and learning, and new, mid, and senior faculty representing all STEM fields. We also welcome those who may soon become faculty members, university leaders, and policy makers.

These audiences will benefit from this session because this provides them with the opportunity to provide feedback on the research agenda. This research agenda is unique in that it looks at holistic faculty development (teaching, research, service, and leadership) as well as all STEM fields. The engagement with this agenda at this session will give the participants an opportunity for their voice to be heard to help ensure the agenda is relevant to all stakeholders.

V. Description of Session and Anticipated Outcomes

In this session, we will focus on the process used to create a draft research agenda on holistic STEM faculty development. Through group interactions as part of the agenda development process, our participants will review and provide input on i) the agenda, which is characterized by the three research threads ii) other experts to involve in the agenda development process, and iii) on the methods for disseminating these novel results.

We will first inform our participants of the process we used to create our draft research agenda and the preliminary research agenda to continue this STEM faculty development dialogue. Our participants (in small groups) will engage in round table sessions to improve the draft agenda by considering all ideas from all members for purposes of further evolving this STEM Faculty Development research agenda.

The session will be organized as follows:

1) Description of the process to develop a research agenda (10 minutes)
2) Presentation of the draft STEM Faculty Development research agenda including discussion of the three threads – inputs, processes/mechanisms, outputs (10 minutes)
3) Group work on research agenda/three threads (each table will focus on one of the threads) (40 minutes)
4) Tables report on the main topics of discussion (10 minutes)
5) Discussion of others to involve in revising this agenda; avenues for dissemination (10 minutes)

Session outcomes will be the group work presented as well as future plans for research agenda revision and dissemination.

VI. Future Work And Initiatives

In conjunction with this workshop, authors High, Lee, and Linder also established a STEM Faculty Development Collaboratory (SFDC) for purposes of engaging research, educational, government, industry, and foundation professionals in STEM faculty development both here and abroad. Participants in this effort will engage in research projects, delivery and the evaluation of faculty development programs both at Clemson and participating institutions, both public and private.

We are currently crafting a proceedings document that describes the workshop and continual activity, and our external evaluator is also writing her summary regarding the efficacy of our workshops. We are also revising our national research agenda based upon our research thus far which we will disseminate via a website (under construction). This website will host the research agenda, workshop proceedings, the evaluation report, and the annotated bibliography of papers and articles generated from this research.

For those interested in joining the collaboratory or the ongoing process of refining the research agenda, please contact the team at (STEMFACDEV@clemson.edu).

VII. Resources

Our website will provide the following information: i) the contact information for the workshop participants/organizers, ii) links to the workshop proceedings, iii) PowerPoint presentations of the proceedings; iv), workshop photos of participants; v) concept maps; vi) a large annotated bibliography including references from workshop participants, vi) the current iteration of the research agenda; vii); links to all conference papers upon which this research is based and viii) ongoing research projects related to STEM faculty development. We will also provide a registration page for those wishing to join our collaboratory.

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