The Influence and Outcomes of a STEM Education Research Faculty Community of Practice

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Abstract

To address the need to increase STEM faculty member expertise in STEM education research I developed a faculty community of practice (FCP) focused on increasing knowledge and experience in STEM education research. The STEM Education Research Scholars Group (SERSG) met every other week during the academic year to study and engage in education research. The participants applied to be part of the group (eight scholars per cohort) which was facilitated by an expert educational researcher, and committed to engage in both individual and group STEM education research projects. At the end of the fourth year, I conducted an exploratory study of the program outcomes and influences by surveying the 31 program alumni. From the 21 former scholars that participated in my study, I found that SERSG involvement had substantial impact on the participants' collaborations and perceptions of STEM education research. In my report I detail my findings, discuss the results, explore some implications, and offer some possible directions for future research.

Key Terms: STEM Education Research; Faculty Learning Community; Developing Expertise

Introduction

Most university science, technology, engineering, and mathematics (STEM) faculty members are expected to conduct research as part of their workload (Mancing, 1991). It is standard for STEM faculty members' research to be related to their STEM domain's expertise. Funding for STEM focused research can come from a variety of public and private sources, with support commonly being sought through responses to solicitations or calls for proposals from organizations such as the National Science Foundation or the National Institutes of Health. Competition for funding from these (and other) agencies has become fierce (and more competitive), and funding agencies have increased the requirements that must be addressed to be considered for funding (Twombly, Garison, & Mainelli, 2009). For example, the National Science Foundation requires nearly all funded projects to include an educational outreach plan along with a method for documenting the outcomes of the outreach activities (National Science Foundation, 2013). Further, there are increasing opportunities for STEM faculty members to be funded to conduct STEM education research (e.g. NSF CAREER Grants). The challenge with the additional requirement of educational research within funded STEM research projects, or with general STEM education research projects, is that many STEM faculty members have never engaged in educational research and are unlikely to have background, knowledge of, or expertise in educational research.

To address the issue of STEM faculty members needing or wanting to build capacity to effectively conduct educational research as part of their external funding commitments or desire to be more competitive in applications for external funding, we formed the "STEM Education Research Scholars Group" - a faculty community of practice (FCP) composed primarily of STEM faculty members with interests in or commitments to conducting education research. I have led four years of the STEM Education Research Scholars Group (SERSG) with a different cohort of approximately eight scholars participating each year. My report details the impact of the program on the participating STEM scholars' perceptions and knowledge of STEM education research.

I conducted a mixed-methods survey of the scholars who participated over the last four years to determine the impact of the research scholars group on their perceptions, knowledge, and engagement in STEM education research. My annual evaluation of the program revealed trends of greater collaboration among the FCP members, and an increased number of proposals submitted for external funding. However, I was interested in gaining a deeper understanding of the expectations and outcomes of the individual FCP participants. Of particular interest was the influence of the community of practice on the participating scholars' knowledge of and their sustained involvement and interest in STEM education research. However, given the exploratory nature of my research I was open to a wide range of possible outcomes.

Faculty Communities of Practice

In an effort to increase capacity, engagement, and collaboration of faculty members, many campuses support or encourage the formation and involvement of faculty communities of practice (Cox, 2004). Faculty communities of practice (FCP) can take many forms and focus on a variety of topics (Richlin & Essington, 2004). The foci or themes of FCPs may be based on topics related to teaching or pedagogical techniques (Beach & Cox, 2009), collegiality, and productivity (Ortquist-Ahrens & Torosyan, 2009), or exploration of the scholarship of teaching and learning (Cox, 2003). The FCP we developed and implemented focused on conducting STEM-centered educational research.

Many possible structural configurations exist for FCPs. Some FCPs are structured to be rather short-term, meeting once or a few times for intense study or information sharing (Caffarella & Zin, 1999), whereas others are longer-term with faculty members engaging in regular meetings over an academic year or beyond (Nadelson, Shadle, & Hettinger, 2013; Sirum & Madigan, 2010; Smith, et al., 2008). FCPs can be led by a facilitator, through the shared responsibility of the faculty member in the FCP, or a combination of the two (Nadelson, et al., 2013). Regardless of the timeframe for meeting or the leadership structure, it is beneficial if the participants share commitment to working toward a common goal or vision and contribute to the progress and work of the community of practice. In the case I studied, the STEM Education Research Scholars Group FCP met every other week for one and a half hours, was facilitated by a faculty member with expertise in STEM education research, and each participant was expected to contribute toward the group STEM education research project while also maintaining responsibility for an individual STEM education research project.

Developing Expertise in Professional Learners

Developing expertise is typically a long-term process (Ertmer & Newby, 1996), with as many as 10,000 hours or five years of sustained practice needed to become an expert (Bransford, Brown, & Cocking, 2000). Yet, the process can be expedited if individuals have related knowledge or experience that can be transferred to the new concepts they are learning (Bransford et al., 2000) and have well developed learning abilities (Hodges, Edwards, Luttin,

& Bowcock, 2011). Thus, the time needed for STEM faculty members to develop STEM education research expertise, an activity that many STEM faculty members have very limited knowledge or experience with, is likely ameliorated by their well-developed learning abilities.

In addition to learning abilities, the prior knowledge or experience of STEM faculty members should also be a major consideration when working with them to developing expertise in educational research. For example, developing expertise in STEM education research among STEM faculty may be complicated if their paradigm of research is constrained to investigations within their STEM domains. There is a reasonable possibility that there is little to no overlap between the research norms, methods, and practices used in STEM domains and those of educational research. Yet, STEM faculty members may want to apply their STEM research knowledge toward education research, a transfer that may not be appropriate or aligned. Further, there is a need to help STEM faculty members understand that while education research may be conducted in accordance to different paradigms, there are expectations of rigor and scientific approaches (National Research Council, 2002).

For example, a chemist doing research on enzyme reactions is able to maintain control of many variables and replicate an experiment multiple times, generating a large and consistent quantitative data set. In addition, the process used to analyze the data and interpret findings relies on successful data collection over multiple trials, resulting in repeated sampling to form a consistent data set. In contrast, educational research seldom is conducted in conditions that allow for the control of multiple variables, and oftentimes research cannot be replicated under the same conditions (e,g, participants mature and gain knowledge or the samples differ). Educational research is typically based on rather small samples and may not require a large data set analysis, particularly for qualitative research.

The contrast of consistency in STEM domains compared to variability in education research, and the large samples to establish consistency in STEM domains compared to small samples to document an experience in education research, are two examples of how STEM domain research and educational research can substantially differ. Thus, when working with STEM faculty members to help them develop education research expertise, I begin with a discussion of research paradigms and work with the group to compare and contrast research processes and norms.

Learning about Education Research

There are multiple ways to build the education research capacity in STEM faculty members such as building on their scholarship of teaching and learning (Streveler, Borrego, & Smith, 2007). Building knowledge of educational research in faculty members may also be facilitated through the process of having them apply new and unfamiliar knowledge (Smith, et al., 2008). Through the application of educational research knowledge, faculty members can develop deeper understanding of concepts and processes. In the case of STEM faculty members, developing expertise in education research means creating the opportunity for the faculty members to engage in and conduct education research. In the multiple education research FCPs I formed and led, I created opportunities for the participating faculty members to collaborate on a common research project and engage in actively applying the norms and processes of educational research. To further build expertise, I held the expectation that the participating faculty members would conduct individual education research projects with technical assistance and feedback provided through the FCP. I posited that through mentoring, support, and the application of concepts associated with conducting both the group and individual education research projects, the faculty members would more rapidly gain the knowledge and capacity to independently engage in educational research.

While most faculty members were interested in researching teaching and learning within their disciplines (Singer, Nielsen, & Schweingruber, 2012), the foundation for quality scientific education research is ubiquitously transcending disciplines (NRC, 2002). The discipline focus for the research that was of interest to the faculty members that I worked with were associated with learning concepts and process unique to their courses, but not necessarily unique to their disciplines. For example, one of the faculty members was interested in research on how students applied mathematics to problems within her discipline. As she explained her interest, it became apparent that much of her interest was aligned with general quantitative reasoning. Thus, while a focus on disciplinary research may have helped the faulty member gain deeper understanding of how her students were applying mathematics in her discipline, there already exists a large body of related studies in the quantitative reasoning research. As a result, part of my role was to help the faculty members become aware of the education research literature outside their disciplines and push them to think about what unique information their discipline-based education research contributes to the larger body of education research.

It is important to note that while educational research may be an effective method for increasing faculty members' reflection on teaching and learning, and transform what and how they teach (Singer, et al. 2012), increased awareness of educational practice was not an explicit focus of the FCP. Again, the goal of the FCP was to increase expertise in educational research that could be applied to fulfill funded-project expectations or gather pilot data that may be included in proposals for external funding. However, there is a high likelihood that the participating faculty members did gain greater awareness of their teaching and student learning, and develop a deeper and more reflective educational practice.

Methods

The goal of my study was to determine the impact that an FCP structured to develop expertise in education research had on the participating STEM faculty members. More specifically, I wanted to determine if faculty member involvement in the FCP led to increased knowledge of and engagement with STEM education research, which are indicators of increased capacity and progress toward education research expertise. I used the following questions to guide my investigation and analysis:

1. What were the participating faculty members' expectations for the STEM Education Research Scholar Group?
2. What did the faculty members learn about education research from participation in the STEM Education Research Scholar Group?
3. How have the Research Scholars Group participants used the knowledge they gained from their involvement in the FCP?
4. How has participation in the STEM Education Research scholars group impacted the participants' perceptions of teaching and learning?
5. What did the participants perceive to be the greatest benefit to being involved in the STEM Education Research Scholars Group?

I anticipated that faculty members participating in the STEM Education Research Scholars Group would experience increased knowledge of educational research. I also anticipated that a secondary impact would be an increased engagement in education research.

Participants

My study participants were faculty members who participated in one of the four FCP cohorts. The 31 participants represented a diversity of STEM disciplines including mathematics, engineering, health science, and the physical and natural sciences. Although the majority of the participants I selected for the FCP were full-time tenure track faculty members, I have included some part-time and non-tenure track faculty members who were in key STEM related positions including a STEM-focused librarian and a STEM student success coordinator.

Although all former participants were invited to participate, 21 of the former FCP members completed the surveys. Given my relationship to the participants, I made the data collection anonymous, thus, I am not aware of the identity of those who completed the surveys. However, in general, the FCP participants were dispersed among two to more than twenty years of experience in higher education STEM teaching and learning. They were nearly evenly divided between males and females, and had little or no prior educational research experience.

The STEM Education Research Scholar Group FCP

I began the STEM Education Research Scholars Group faculty community of practice with funding from the university research division. The funding was used to provide me with a course release to lead the program, a nominal stipend for the participating scholars, support materials for the scholars, and nominal assistance for the scholars to conduct the research. The idea of the SERSG appealed to the VP of Division of Research due to the focus on building expertise in educational research that STEM faculty members could potentially use in the drafting and support of funded projects. The funding of the group shifted to a funded project was included the SERSG in a proposal that was funded, and provided support for the group for five years. The actual cost of funded a SERSG FCP is likely to vary between institutions, the size of the group, the goals of the group, and the extant resources that may be used to support the group.

The structure of the SERSG FCP evolved over time. In the first year of the program the focus was on reading and learning the vocabulary and methods of educational research, with each participant engaging in an educational research project or drafting and submitting a proposal to secure external funding to conduct educational research. In the subsequent years I modified the SERSG FCP to include a whole group research project and the individual project or proposal which I used as contexts for mentoring the faculty members.

Each year, STEM faculty members that were actively engaging in research or activities that would benefit from knowledge of STEM education research were invited to be part of the SERSG. STEM faculty members interested in participating in the group provided justification for why they want to be part of the group, and had possible projects or areas of interest they wanted to explore during their involvement with the group. Eight STEM faculty members were selected to be part of each of the four SERSG cohorts, which were facilitated by an experienced STEM education researcher. The SERSG meet every other week for one and a half hours to discuss progress and plan for the individual and whole group research projects.

In the initial meeting of the SERSG a group project was decided upon, and the participating faculty members brainstormed topics for their individual research projects. I expected that faculty members would decide upon and began to pursue their individual STEM education project by the second meeting of the SERSG.

The whole group projects started with sharing ideas and questions about STEM teaching and learning, and progressed to discussions and reviewing the related literature to further focus the research plan. The intention of the group project was to use the progression from idea to publication over the academic year as a model for how educational research might take place and is published. The responsibility for the whole group project was shared among the participants, however, as facilitator I led the project and used the research activities to engage the participants in discussion and activities which were explicated to build expertise in STEM education research among the scholars.

Topics for the group projects have included STEM student professional identity development (Nadelson et al., 2015), trust in science and scientists (Nadelson et al., 2014), individual usefulness of science (Nadelson et al., 2015) and classroom interactions that foster STEM student retention, persistence, and interest in learning (Nadelson, Hardy, & Yang, 2015). Individual projects were more nuanced to specific interests of the STEM faculty members. The faculty members' individual projects tended to focus on professional interests such as research experiences for undergraduates (REU) and curriculum development aligned with STEM domain research activities. Most of the individual projects were pilot studies or explorations designed to gather preliminary data that could be included in external funding proposals or presented at a STEM education conference.

It is important to note that while there may be some potential benefit of engaging faculty members in discipline-based education research (Singer et al., 2012), to increase knowledge and engagement in reflective teaching I tended to generalize education research issues. Again, the goal of the FCP was to build faculty members' capacity to conduct education research. Therefore, I worked to make explicit the general education research ideas for specific situations so that all in the group could gain from the conversation. Further, the generalization provided the opportunity to gain understanding of how discipline based education research for the most part involves contextualizing ubiquitous education research methods.

Data Collection

To measure the influence of the SERSG on the participating faculty members, I developed a series of free response survey questions. Given the exploratory nature of my research, I tried to limit the items to the foci of the SERSG and the related shifts in the participants' perceptions and engagement in education research. Of particular interest was how participation in the SERSG influenced the faculty members' knowledge, engagement, and perceptions of STEM education research. Therefore, I developed questions such as "What led you to join the group?" and "What goals and expectations did you have for being part of the group?" To determine if involvement in the group influenced other perceptions of teaching and learning, I included items such as, "Has the knowledge you gained from your involvement in the group effected how you view teaching and learning?" The final survey had fourteen free-response items. Once I had developed the items, I distributed them to other faculty familiar with the SERSG (but not involved in the group as a participant) and requested feedback on the items. After a few modifications to the language of the items, I determined that the survey was ready for use. Once validated, I ported the survey to an online survey tool for distribution.

In an email, I distributed an invitation to participate, details of the nature of my research and the link to the survey to the 31 former SERSG participants. I collected data using the online survey tool for two weeks, and then emailed a reminder to the SERSG faculty members and gathered data for additional two weeks. At the end of data collection, 21 of the 31 participants had completed all survey questions.

Analysis

I used a content analysis approach to analyzing the data (Marshall & Rossman, 2014), examining the participants' responses as telling their story with respect to their participation in the SERSG. I developed a set of a priori codes to analyze the data but left open the possibility for emergent themes. The process of coding the responses involved sharing the codes with a graduate research assistant and having the assistant code the data. To establish inter-rater reliability I also coded a portion of the data to compare to the codings of the graduate student. Given the nature of the responses and coding of the data, I determined at least two rounds of comparison were necessary to ensure coding consistency. At the end of the second round of coding, we established an acceptable level of inter-rater reliability of approximately 85% (Stemler, 2004), at which time the graduate research assistant completed the data coding. It is important to note that it was possible for a participant to share multiple ideas in an item response that aligned to multiple codes, therefore, frequencies of codes do not sum to the number of participants, but rather the number of aligned responses.

Results

Participant expectations. My first research question asked, *What were the participating faculty members' expectations for the STEM Education Research Scholar Group?* To answer this question I examined the responses to my survey item that asked the participants to share their goals and expectations for being part of the group. I used a combination of deductive and inductive coding. For my deductive coding, I sought data as indicators of expectations associated with increased awareness of education research, research methods, cross discipline collaborations, research on teaching and learning, and research scholarship. In terms of inductive coding, I examined the data for emergent themes seeking patterns or trends that were shared by the participants. Through my inductive coding I exposed trends associated with time management, grant writing, and program goals.

The data (see Table 1) suggest that most of the

Coding	Freq. of Response	Representative Responses
Increased Awareness	8	"…insight in how to structure and think about research in STEM education"
Methodology	4	"…learn more about research design and assessment."
Collaboration	6	"…meeting other faculty from different disciplines in terms of understanding different perspectives and in terms of forming research collaborations."
Teaching Practices	1	"…rich perspectives on learning and instruction."
Student Learning	2	"…rich perspectives on learning and instruction."
Grant Writing	1	"…be a better proposal writer."
Research Scholarship	5	"…add to my knowledge of STEM education research and produce some scholarship."
Clear Goals	1	"… learning outcomes…"
Time Management	2	"… more time to focus on individual projects and tools for STEM ed research."
Unsure / Not Used	1	"… it is early to judge."

Table 1. Code, Frequencies, Representative Responses, and Graphic Representation of Coding for Participants' Goals and Expectations

participants were seeking to increase their awareness of STEM education research. Several anticipated expectations and goals that were associated with forming collaborations. Research scholarship and methodology were mentioned with relatively the same frequency, indicating that both productivity and process of STEM education research were expectations for participating in the group. Less frequently shared were issues associated with teaching, student learning, time management, and grant writing. Overall, it appears that the faculty members' expectations and goals were focused on gaining deeper understanding of educational research, but also being productive in their research endeavors.

Knowledge of educational research. My second research question asked, *What did the faculty members learn about education research from participation in the STEM Education Research Scholar Group?* To answer this I used the same codings from my first round of analysis and examined the responses to the item which asked the participants to share what they learned about educational research due to their involvement in the research group. My analysis revealed the most prominent learning that took places was associated with the participants' increased knowledge and understanding of educational research methodology. Also frequently shared were a general increase in awareness of education research norms and practices and the associated literature. The codings, frequency of responses, and representative responses are presented in Table 2.

Coding	Freq. of Response	Representative Responses
Increased Awareness	5	"It is not so much what I learned, but that it began in me the interested to learn more. It got me to question many of the assumptions that I made about learning, etc. and how my ideas could actually be good areas to investigate."
Methodology	9	"I learned how to create and interpret a survey instrument. I learned various approaches to achieve a result based on the population being studied and what data you are interested in obtaining."
Research Scholarship	1	"It was interesting to develop a research project within the group and then do it."
Education Literature	4	"I learn some background, literature, and details of the research."

Table 2. Code, Frequencies, Representative Responses, and Graphic Representation of Coding For Learning about Education Research

Using knowledge learned. My third research question asked, *How have the Research Scholars Group participants used the knowledge they gained from their involvement in the FCP?* To answer this question I examined the answers to the item asking the participants to share the ways in which they used what they learned from working with the group. I used the same deductive and inductive codings that I previously developed.

The analysis revealed a wide distribution of responses in the data (see Table 3) suggesting that the participants were using the knowledge that they gained from participation in the FCP to accomplish a wide range of goals. My analysis failed to reveal one particular coding dominating the responses, which suggests that the participants were using the knowledge they gained to attend to a number of personal objectives.

Impact on teaching and learning. My fourth research question asked, *How has participation in the STEM Education Research scholars group impacted the participants' perceptions of teaching and learning?* To answer this question, I examined the participants' responses to the items asking them to share the ways in which their involvement with the FCP impacted their perceptions of teaching and learning and their teaching practices. For this question I shifted the focus of my analysis, which involved the use of some of my established codings and the addition of a few others that I selected to specifically expose evidence aligned with perceptions of teaching and learning and teaching practice. My analysis (see Table 4) revealed data suggesting that the majority of the respondents expressed increases in awareness of their teaching practices and exploration with their instructional practices.

In my analysis of the participants' responses to the item regarding how participation in the group impacts their perceptions of teaching and learning, I found that increased awareness dominated the responses. Many of the responses indicate perspectives suggesting that the group members were unsure how their participation in the group influenced their perceptions of teaching and learning or had not yet experienced impact on their views (see Table 5).

Coding	Freq. of Response	Representative Responses
Increased Awareness	1	"I am able to sit on a Master's thesis for an education student which would have been more difficult without this course."
Methodology	4	"As I continue my educational research I have used the statistical ideas to focus some of my work…"
Collaboration	1	"Good collaborations involve working with efficient people who are willing to provide constructive feedback on the collaborative work."
Teaching Practices	1	"I have been able to adjust my teaching style in support of the results of the survey."
Student Learning	2	"Surveying my students and gaining insight into their learning"
Grant Writing	3	"I submitted an federal grant application (not funded) that included some STEM Ed research questions."
Research Scholarship	4	"I am having my research assistants help me develop a project related to STEM major retention."
Education Literature	2	"I have also tried to consult the literature to better understand my own ideas."
Unsure / Not Used	3	"Not sure"

Table 3. Code, Frequencies, Representative Responses, and Graphic Representation of Coding For Using What Was Learned

Greatest benefit. My final research question asked, *What did the participants perceive to be the greatest benefit to being involved in the STEM Education Research Scholars Group?* To answer this question, I examined the answers to the item that explicitly asked the participants to share what they perceived to be the greatest benefit of the group. My analysis revealed data that indicated that collaboration between the faculty member and others dominated the responses with the second most frequent themes being increased awareness and engagement in research scholarship (See Table 6). The link between participation in the FCP with shifts in teaching practices was only mentioned as a benefit by one participant, indicating that although there may have been influence of participation in the group on faculty members' perceptions of teaching and learning, increased knowledge of teaching and learning was not communicated as one of the greatest benefits.

In an effort to address the interest of STEM faculty members to engage in STEM education research we created the STEM Education Research Scholars Group (SERSG), a faculty community of practice focused on increasing the STEM education research capacity of the faculty members. The challenge of the project was to increase awareness and knowledge among expert learners in a domain where they had little or no expertise, but have had tangible experience as teachers and in their work with students. To determine the influence of participation in the FCP, I surveyed the members to determine if my goals of building capacity in STEM education research were achieved.

I first examined my data to determine the expectations and goals of the group members. Consistent with my communication about the group when recruiting members, the participants voiced responses consistent with building capacity to engage in STEM education research. The domination of awareness is likely due to the participants' knowledge that developing expertise is a long-term process and may require sustained engagement over time. The focus on awareness is also likely due to the STEM faculty members' limited knowledge of education research, and thus, a need to start their learning with building awareness the associated processes and norms. How long STEM faculty members think it may take to develop expertise in STEM education research, and how building their capacity could be best accomplished are excellent directions for future research.

I next examined what the participants learned from being in the group. The responses were dominated by increased knowledge of educational research methodology. I attribute the focus on methodology to the structure of the FCP, which engaged participants in a STEM education research project and in an individual STEM education research project. Both the group and individual projects were discussed at length and explored in detail during the group meetings. Further, participating in a research project from conception to publication provided a tangible model for exploring multiple processes involved in conducting and reporting educational research. I assert that the active engagement of the process of the FCP provided an effective context for increasing the STEM faculty members' knowledge of educational methods.

The participants' response to how they used the knowledge gained from being part of the group reflects a range of STEM education research needs and potential applications. The diversity of participant responses suggests that there is a range of processes and concepts that were attended to in the group. I attribute diversity of views of the participants to the structure of the FCP that included engaging in individual projects, which allowed the faculty members to meet a range of personal objectives from involvement in a diversity experiences. The high level of engagement and processing of conceptions that was required for completing of the projects fostered the development of a diversity of skills and knowledge.

The impact of the participation in the group included an increase in the participants' awareness of STEM teaching and learning. The data indicate that the faculty members

Coding	Freq. of Response	Representative Responses
Increased Awareness	8	"I thought more about how I approach mathematics with ideas from other areas."
Teaching Practices	7	"I heard a lot about good teaching and try to put these things into practice."
Student Learning	3	"Helping me learn about how students learn."
Research Scholarship	1	"As stated above, I have incorporated class surveys that help inform the delivery of project based courses." *[From above response: "I have conducted several surveys of my class and published the results at ASEE."]*
Education Literature	1	"I have sought some input from the literature to validate/refute some of my ideas…"
Unsure / Not Used	2	"Not really."

Table 4. Code, Frequencies, Representative Responses, and Graphic Representation of Coding For Impact on Teaching Practices

Coding	Freq. of Response	Representative Responses
Increased Awareness	7	"Awareness."
Methodology	1	"… I was able to better understand the nature of educational research and how it is different from the scientific research I am more familiar with in my current field."
Collaboration	1	"In discussions with the broad group of participants and facilitator, I was able to better understand…"
Teaching Practices	3	"I am starting to look more from the student's perspective and to reflect on how my behavior in class affects role development."
Student Learning	1	"It has made me rethink trying to train students to view themselves as professionals in the major instead of as students."
Research Scholarship	2	"Greater awareness of how classrooms can be a laboratory for research."
Unsure / Not Used	4	"Not yet."

Table 5. Code, Frequencies, Representative Responses, and Graphic Representation of Coding For Perceptions of Teaching and Learning

experienced increases in understanding of how people learn, effective instructional strategies, and classroom interactions. I attribute the increases to the focus of the FCP on education research, much of which was associated with classroom or laboratory teaching and learning. The focus on classroom teaching and learning likely led faculty members to be more reflective of their practice, which led to the development of a deeper understanding of teacher-learner interactions. Although the desire to transform the participants' knowledge of teaching and learning to inform their practice was implicit and not an overt goal of the FCP, the faculty members' knowledge of teaching and learning did increase. What particular aspects of the group interactions were most influential on building levels of knowledge of teaching and learning is a potentially fruitful direction for future investigation.

My final area of analysis focused on the greatest benefit of the SERSG to the participants. As anticipated, the greatest benefit shared by the participants was associated with conducting research and engaging in collaborations, which were topics I explicitly focused on in the FCP meetings. However, other conversations and activities associated with the group likely expanded the participants' perceptions of benefits into teaching and learning. Given the potential for long-term impact, I did not find it unusual that a few of the participants were not yet sure how they benefited. I plan to continue to explore the long-term benefits for the faculty members participating in the FCP. In particular, it is important to gain a deeper understanding of the return on investment in the FCP, and if the benefits and outcomes of the program justify the cost.

Coding	Freq. of Response	Representative Responses
Increased Awareness	5	"Increased awareness of evaluation methods."
Methodology	3	"It opened my mind to some other ways to conduct research outside of the bench."
Collaboration	9	"Networking and collaboration opportunity."
Teaching Practices	1	"The greatest benefit was to help me keep my mind open to using research and doing research to enhance my teaching."
Research Scholarship	3	"… made me more motivated to do research with my heavy teaching load."
Education Literature	3	"… develop expertise in educational research."

Table 6. Code, Frequencies, Representative Responses, and Graphic Representation of Coding For Greatest Benefits Discussion

Implications

There are several implications of this research. The first implication is that a year-long community of practice focused on STEM education research appears to be an effective way to enhance STEM faculty members' capacity and understanding of STEM education research. Thus, efforts to increase STEM faculty member engagement in educational research may be achieved through involving them in a structure that actively engages them in discussing and conducting educational research.

The second implication is that engaging faculty members in a FCP that focuses on educational research may enhance their awareness and understanding of teaching and learning and their associated practices, even if teaching and learning are implicit to the FCP. However, my explicit focus on STEM education research overshadowed the focus on teaching and learning, as I would have predicted due to my desire to enhance the participants' capacity to effectively carry out education research projects. Thus, the impact of the education research FCP on the participating faculty members' engagement and reflection on teaching and learning may be enhanced if there is an explicit attention paid to the associated practices.

The third implication is an apparent need for continued support of faculty member engagement in educational research. Although a year was sufficient to increase awareness and some understanding, the building of expertise is a longer-term process that may require additional mentoring and support. My data does suggest that the year-long SERSG may lay a foundation for engaging in educational research, but developing expertise will likely require on-going commitment and engagement of the faculty members.

Limitations

The first limitation of my study is the sampling. Only about two thirds of the faculty who were members of a FCP (over the four years of the program) participated in the data collection. Thus, the other members may have had different experiences. However, the 21 faculty members who did participate did provide me with a diversity of answers, and I contend that they were likely representative of the experiences of those who participated in the four cohorts.

The second limitation of my study is associated with analysis. Interpreting responses without the ability to ask clarifying questions to determine meaning required me to make some assumptions about what the participants shared. However, the consistency of answers suggests that I was likely accurate in my codings, and the assumptions I made are consistent with the participants' communications. However, in future research on the group I would likely include focus groups to both increase participation and bring clarity to the responses.

The final limitation of my study is the notion that my research took place at one institution. Faculty members from other institutions may respond differently as the motivations and support for STEM education research may vary. However, possible variations in responses by institutions also reflect the potential for building STEM faculty members' capacity to engage in STEM education research may be contextual. I hope that others will consider my work and attempt to replicate both the FCP and research the group processes and outcomes to determine if my findings are site-specific or ubiquitous.

Conclusion

The shifting landscape of the outreach projects associated with extant funding for STEM research to require investigations of effectiveness and outcomes has led to the necessity of STEM faculty members to be familiar with and engage in STEM education research. Further, there is a desire to use an evidence-based approach to address issues associated with STEM student recruitment, retention, success, and engagement, which require research on teaching and learning in STEM. We created a faculty community of practice - the STEM Education Research Scholars Group- to enhance the capacity of STEM faculty members to effectively consume and produce STEM education research. My investigation suggests that the endeavor has had a positive influence on the educational research knowledge and engagement of the faculty members who have been participating, suggesting that the FCP is an effective means of increasing STEM faculty members' capacity and engagement in STEM education research.

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