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Investigating individual and collective value within a network of communities of practice

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This report examines the value-add of mathematics faculty participating in regional communities of practice (CoPs) embedded within a larger Math CoP network. The CoPs and the network are aimed at fostering the use of teaching with inquiry practices in undergraduate mathematics courses. We examine value found at the individual participant level as well as at the CoP level within the larger network. We present themes identified using Wenger, Traynor and de Laat's (2011) value framework to illustrate how individuals and CoPs find value within the network. In this paper we provide an initial look at how the network can support both regional communities and individual members in finding value and sustaining interaction within the CoP.

Keywords: Community of Practice, Networking, Inquiry, Active Learning

Supporting the achievement of secondary and post-secondary students in mathematics is an ongoing area of concern, particularly due to its impact on recruiting and retaining students in STEM fields (Fayer et al., 2017; Rose & Betts, 2001). One effort to address this is a focus by mathematics faculty on the use of evidence-based teaching practices, such as active learning, to support undergraduate student success. Despite evidence that lecture style instruction is not effective for many students, particularly those from underrepresented populations, it is still frequently used by many undergraduate STEM faculty (Jaworski & Gellert, 2011; Laursen et al., 2019; Stains et al., 2018). Faculty who attempt to employ evidence-based, effective teaching practices often find themselves doing so in isolation, which can make sustained implementation difficult (Banta, 2003). For the purpose of this paper, we use the term "teaching with inquiry" to encapsulate many forms of evidence-based teaching strategies that include: active learning, inquiry-based learning (IBL), project-based learning, problem-based learning, student-centered teaching, ambitious teaching, and team-based learning. Communities of practice (CoPs) provide one avenue of support for like-minded mathematics faculty as they pursue effective teaching and professional development. CoPs focused on teaching with inquiry are positioned to provide support systems by connecting faculty members with common goals and a vision for teaching.

Theoretical Framework

In order for sustainable change to occur, a number of systems need to be in place. Understanding these systems and their influence of the complex nature of teaching and teacher development can be a challenging undertaking. We frame this study by examining CoPs through the lens of value-add, or access to things like funding, resources, and specialized knowledge and expertise (Campbell, 2005), to investigate the ways in which individual members of CoPs and how the broader connecting network facilitates supporting this work.

A community of practice (CoP) is a group of people with common interests who engage in shared learning via ongoing, regular interactions (Lave & Wenger, 1991; Wenger-Trayner & Wenger-Trayner, 2015). CoPs are coordinated around individuals who collaborate toward a common goal, and typically have strong social bonds, active engagement, shared meaning and identities (Henri & Pudelko, 2003). CoPs are often ephemeral- they develop organically out of shared need, but often dissolve, particularly when they do not exist within a formal organization.

Kezar and Gehrke (2017) examined issues with the sustainability of CoPs, particularly those that exist outside the bounds of formal organizations. They found that, "To be sustainable, they [STEM CoPs] had to move from being a loose entity typical of networks and CoPs toward being more like an informal organization...this became a point of tension between becoming more sustainable and losing the value of the loose, informal peer community" (p. 345).

This study examines the Math CoP Network [blinded pseudonym], a National Science Foundation funded project (No. XXXXXXX), aimed at understanding how a network might support, sustain, and promote teaching with inquiry to mathematics faculty participants through engagement in regional CoP activities and interactions. Unique to the research on CoPs, this project examines a group of individual CoPs nested within a larger network. Engel and van Zee (2004) identify elements needed for a successful network, which include having a shared goal, common interests, added value and commitment, capacity to access and contribute to the network, and clarity in planning and management- all focuses of the CoP Network.

Value Framework for Examining CoPs

We utilize the value framework developed by Wenger et al. (2011) to position CoPs within "a dynamic process in which producing and applying knowledge are tightly intertwined and often indistinguishable" (Wenger et al., 2011, p. 21). As Figure 1 illustrates, the framework employs five cycles of value creation - immediate (in the moment resources, information, connections), potential (for the future), applied (tested implementation), realized (actualized implementation), and transformative (broader dissemination to others). In addition to the cycles, value at the CoP level is also supported by strategic value (clarity of the context and vision, ability to engage in strategic conversations) and enabling value (support processes that make network life possible).
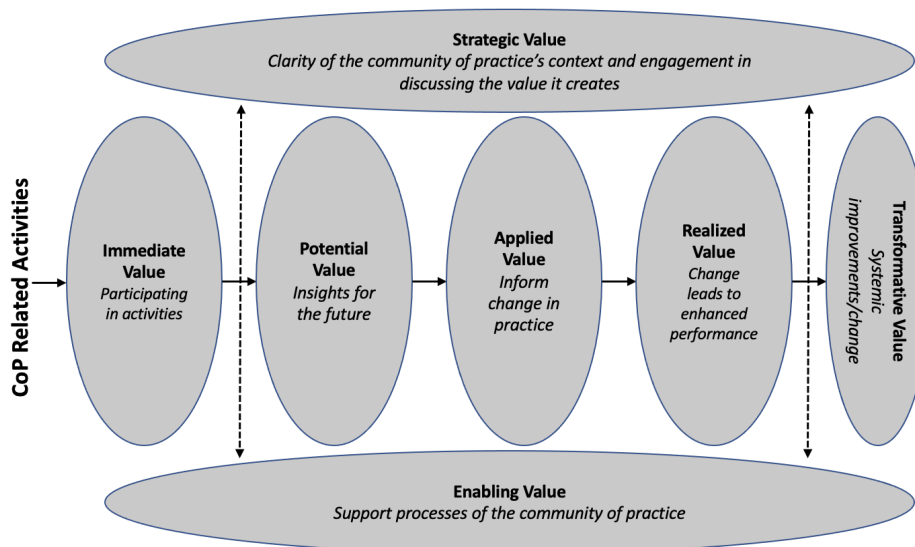

Figure 1. Adaptation of Wenger et al. (2011) Value Framework for CoPs.

Understanding the value-add of individual CoPs and the network that connects them will help identify concrete structures needed to create sustainability. Unpacking the types of value, along with the embedded systems and structures needed to facilitate this value, is therefore vital to supporting active, thriving CoPs. In the first year and a half of this project, our research team has gathered data to identify what individuals find valuable as they engage in activities within their regional CoPs. Moving into the second half of year two of the project, we have expanded

our investigation to also examine the types of value regional CoPs find in the network. Therefore, the research questions for this study are: 1) Where do individuals find value participating in Network activities? 2) Where do regional CoPs find value within the larger Network? This preliminary data investigates these layers of value in isolation. In the future, we aim to integrate our findings to provide a more holistic view of how the Network of CoPs impact both individuals and institutions over time.

Methods

Data Collection and Analysis

We utilized two layers of data collection for this study. The first was survey data from faculty who engaged in one or more regional CoP activities between October 2019 to October 2020. Participants submitted 227 voluntary surveys, where 156 individuals provided identifiable information, representing 115 unique faculty responses. The survey consisted of open-ended responses where questions were aligned to gather evidence of specific value types. The second form of data collected was derived from 20, semi-structured CoP leader interviews representing eight regional CoPs (four regions original to the grant, and four added after year 1). The interview questions were framed around value in terms of structures and systems in place for the regional CoPs and the larger Network. Following the interviews, we compiled regional reports that summarized the key activities, strengths, areas of improvement, and future opportunities or threats of the CoP. Through a member checking process (Lincoln & Guba, 1985), each report was verified by interviewees to increase the trustworthiness and validity of the summary.

We adapted the value framework developed by Wenger et al. (2011) to inductively and deductively code open-ended survey responses for evidence of value across three value types: immediate, potential, and transformative. The survey is administered immediately after participation and therefore only these three value types are able to be coded since participants have not had the opportunity to apply their experiences to practice yet. Qualitative data analysis allowed us to interrogate "how people interpret...and attribute meaning to their experiences (Merriam, 2009, p. 5). We initially coded the data concurrently to calibrate and ensure intercoder reliability (Bradley et al., 2007; Krippendorff, 2004). In the second round of coding, we utilized *a priori* codes where we identified responses aligned with the Four Pillars (Laursen & Rasmussen, 2019). We determined that these codes did not completely encapsulate all participant responses, therefore we conducted a third round of descriptive coding (Miles et al., 2014; Saldaña, 2015) to identify additional emergent codes. For the leadership report summaries, we used an adapted value framework to deductively code, this time for the two contextual factors: strategic and enabling value. Using Nvivo software, we simultaneously dual coded (Miles et al., 2014) the summaries to reconcile evidence of value for both enacted and future (anticipated) strategic and enabling value.

Preliminary Results

Individual Participant Value

At the individual level, survey coding showed three types of individual value (immediate, potential, and transformative) in three, key areas: support with resources to improve practice, support through belief shifts in theory and practice, and support of a community of peers. These preliminary results provide baseline data for CoP members' perceptions of value.

Participants often reported the value of resources to support their implementation of teaching with inquiry (TWI). Learning the "Basics of TWI" was coded 64 times within the 227 survey responses including comments like "Lots of tips and ideas for setting up my first IBL classroom" indicating immediate value. In terms of specific resources and content, technology integration and assessment strategies were frequently mentioned as resources that provided both immediate and potential value for participants. Particularly beginning in Spring 2020 at the onset of the pandemic, immediate and potential value coding became prominent.

Participants also highlighted the value of thinking about teaching using new methods that challenged traditional beliefs of what it means to teach mathematics. For example, participants identified new ideas, such as, "... making the environment conducive to feeling ok to take risks and make mistakes". Participants reflected on how their involvement in CoP activities helped them experience TWI from the student perspective. One participant noted, "The activity itself was not novel, but discussing the activity as a student was the real value. I don't have much opportunity to discuss higher mathematics with others." Participant comments such as this highlight that changing faculty beliefs often includes experiences learning with and from others.

A final and prominent theme from the data emerged around the value in being a part of a community of peers. Participants found immediate and potential value in support from "like-minded peers" where they could be vulnerable sharing their experiences. Although present in the survey results across the full year of data collection, the conditions created by the pandemic intensified the desire for peer support. Participants valued knowing others experienced similar struggles teaching online and commented, "it's a shared experience and a shared concern with other dedicated people." Another participant added, "This was so helpful to learn about strategies for implementing IBL online. I felt like in the winter I was teaching in a vacuum."

Collective Regional CoP Value

The first type of data examined what individuals found valuable participating in Network activities, which aligns to the horizontal value types in Figure 1. From the Network level, we aimed to understand the systems and structures supporting the regional CoPs and so took a broader view. To do this, we identified instances where leaders expressed enabling value (processes that make network life possible) as well as strategic value (promotion of the network's common vision and structures that can make each CoP sustainable long term) as illustrated in Figure 1. Table 1 below shows the coding counts for enabling and strategic value that have been enacted as well as opportunities for future value creation.

Table 1. Coding Counts for Strategic and Enabling Value

Regional COMMIT	Future Enabling Value	Enacted Enabling Value	Future Strategic Value	Enacted Strategic Value
New CoP 1	2	2	0	3
New CoP 2	5	4	2	0
New CoP 3	4	6	3	2
New CoP 4	3	3	1	4
Original CoP 1	4	8	2	1
Original CoP 2	2	13	4	0
Original CoP 3	5	3	3	1
Original CoP 4	2	6	3	1

The regional summaries are, for the most part, focused more on enabling value than strategic value. This perhaps is to be expected as regional CoP leaders spoke more often on what made their regions function rather than the larger network structures. Enabling value focused on the qualities of the leadership team, professional development offerings, and how CoPs are assessing their needs. Original CoPs identified enacted enabling value most often, whereas the majority of New CoPs saw this as a future opportunity. New CoPs are just beginning to create processes to organize leadership teams and consistently implement activities and regional events. They may not yet be positioned to identify features that move toward sustainability. Original CoPs have had more time to develop systems necessary to run a CoP that can sustain as new leaders transition in and out. Preliminary analysis indicates that leaders identified enabling value in having a CoP team composed of other "experienced leaders". Additionally, we found that collaboration was a consistent element of each CoP where participants and leaders are able to seek and share ideas, build relationships with like minded individuals, and through those relationships, develop rapport and trust to engage in vulnerable conversations. In terms of anticipated future opportunities for enabling value, nearly all regional leaders described goals of making connections and collaborating across CoPs, along with finding ways to expand and diversify their membership.

While less prevalent, strategic value was evident in all eight CoPs. All but two CoPs reported finding enacted strategic value in their region, and six of the eight CoPs identified more opportunities for future strategic value than enacted value. Three preliminary themes emerged from the enacted strategic value coding- that of the importance of hosting regular meetings and events within the Network, the role of building common knowledge/vision, and the importance of common structures (e.g., websites, listservs, onboarding tools) in maintaining a functioning Network. Similar to themes around future enabling value opportunities, future strategic value opportunities included devising structures to incentivize and recruit participants, refining communication methods, and identifying systematic ways to enhance cross-CoP collaboration (e.g., hosting a national networking event). This preliminary analysis suggests that CoPs are beginning to share systems and structures in addition to a common vision. However evidence of future strategic value indicates that the Network continues to have areas of improvement for long term sustainability.

Discussion and Questions about the Research

For the MathCoP Network to make intentional and meaningful steps toward sustainability, Network leaders and researchers must understand both individual and regional CoP needs. Thus far, our research has identified a number of individual and regional CoP supports where faculty found value as they work to implement TWI practices into their undergraduate mathematics courses. As we continue to gather data, we are focused on integrating potential value themes from the individual and regional levels to inform Network stability and structures. Our future research will focus on gathering additional, longitudinal data to examine trends over time. Our preliminary results lead to several questions for discussion: 1) Is the value framework an appropriate tool for measuring CoP supports and structures for long-term network sustainability? and 2) In addition to the analysis reported here, we utilize social network analysis to examine social capital and the overall health of the network. Are there additional data worth considering to understand the role of the network for maintaining sustainable CoPs?

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