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The Development of Social Capital Among College Faculty: Investigating Teaching-Focused Personal Networks and Instructional Practice

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Abstract

Scholars recognize that K–12 teachers' social interactions, particularly within teaching-focused relationships, are important to professional development. This is true whether discussions take place in formal or informal settings. Few studies, however, seek to link the teaching-focused relationships of *college faculty* directly to their instructional practice, nor to explore perceptions of what these relationships entail and how they influence teaching at the college level. Using surveys (n=868), interviews (n=83), and a social capital theoretical framework, this mixed-methods social network analysis explores associations between teaching-focused "personal networks"—compilations of relationships surrounding individual faculty—and the use of evidence-based instructional methods. We also explore faculty perceptions of how network interactions shape their teaching. Quantitative results indicate that the size, range, and strength of faculty teaching-focused personal networks positively correlate with the use of evidence-based instructional methods, while qualitative results point to the ways faculty see different kinds of network ties, relational mechanisms and objects, and returns influencing teaching practice.

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Successful educational reform depends on well-informed, knowledgeable teachers (e.g., Darling-Hammond & Sykes, 1999). Research over the past several decades demonstrates that personal interactions focused on instruction—through which teachers access knowledge, information, and support from others—can contribute significantly to professional development (e.g., Louis et al. 1996; McLaughlin & Talbert, 2001). Importantly, studies have shown this to be true across educational levels, whether these "teaching-focused" relationships, as we refer to them, take place in organized, formal settings or more ad hoc, informal settings (e.g., Borko, 2004; Roxå & Mårtensson, 2009). With this in mind, and in the context of continued efforts to improve teaching in higher educational institutions around the world (e.g., Department for Education and Skills, 2003; President's Council of Advisors on Science and Technology [PCAST], 2012), we examine the influence of teaching-focused relationships on one sphere of teacher professional development: the instructional practices of college and university faculty.[1]

Social learning offers a useful vantage point for considering instruction-oriented professional development. Numerous studies looking at K–12 teachers as social learners show that when teachers are able to reflect critically on student learning and their own teaching practices, these discussions provide knowledge and support and lead to a number of benefits, from higher job satisfaction (Johnson et al., 2012) and collective efficacy (Voelkel & Chrispeels, 2017) to improved student achievement (Vescio et al., 2008) and instruction (Louis & Marks, 1998). Though less voluminous and typically focused on organized learning communities, research at the postsecondary level suggests that personal interactions can offer similar advantages for college and university faculty. Studies indicate that teaching-focused discussions allow faculty to exchange information and knowledge, focus on connections between their instruction and student learning, and authentically ground their content expertise (Fletcher, 2018; Gehrke & Kezar, 2017; Roblin & Margalef, 2013).

Still, more research on faculty social learning is needed. With some exceptions (Benbow & Lee, 2019; Pataraia et al. 2014, 2015; Roxå & Mårtensson, 2009; Van Waes et al., 2015, 2016), few studies explore in detail specific facets of college faculty teaching-focused relationships shown to benefit K–12 teachers and professionals in other workplace settings, including the number and strength of these personal ties, whether discussion partners are from within or outside the academy, and how such relational characteristics link to faculty instructional methods (e.g., Coburn & Russell, 2008; Granovetter, 1973; Reagans & McEvily, 2003). Even fewer concurrently analyze such relationships across the many different formal and informal social contexts—personal, professional, organizational, geographical, or otherwise—in which faculty

[1] We refer to those teaching in educational institutions at all levels as "teachers." We use the term "faculty" for those who teach undergraduate students within associate- and bachelor-level higher educational institutions, whether these people hold full-time, part-time, tenure-track, nontenure-track, or adjunct instructional positions.

interact and learn in their day-to-day lives (see Rienties & Kinchin, 2014). Considering ongoing efforts to increase faculty use of active learning strategies linked to improved student learning, referred to here as "evidence-based" instructional methods (e.g., Chi & Wylie, 2014; Freeman et al., 2014; Henderson et al., 2011), this gap presents an opportunity not only to better understand connections between social learning and faculty teaching, but also to inform faculty development interventions meant to foster higher undergraduate achievement (e.g., Grossman et al., 2009; Osborne et al., 2019).

Social network analysis (SNA) is a research perspective and set of methods that focuses on the links between relationships, or "social ties," and behavior (Wasserman & Faust, 1994). The approach, which precisely examines the influence of groups of social ties called "social networks" on outcomes, has proven to be particularly effective for examining interactions among K–12 teachers. More recently, it has been used to study college faculty. Existing studies show an association between stronger and more expansive faculty teaching-focused relationships and instructional benefits (Pataraia et al., 2015; Van Waes et al., 2015) and shed light on how reflective, feedback-oriented conversations supplement faculty teaching knowledge and behavior (Benbow et al., 2020; Pataraia et al., 2014; Roxå & Mårtensson, 2009; Van Waes et al., 2016). These studies also point to the need for further empirical work that links faculty relationships more directly to teaching practice; focuses on larger faculty samples across more diverse institutions; and incorporates mixed-methods analyses that allow for precise, numerical analysis of relational and behavioral data as well as ecological grounding of these data in lived experience (Hollstein, 2014).

To address these gaps in knowledge, this exploratory study takes a convergent mixed-methods case study approach (Creswell & Plano Clark, 2018) to investigate the influence of teaching-focused social networks on faculty use of evidence-based instructional methods (e.g., Chi & Wylie, 2014; Henderson et al., 2011). We examine instruction focused on teaching specific "noncognitive skills," or intrapersonal and interpersonal competencies, abilities, or traits that allow one to self-regulate and express and interpret messages to and from others (National Research Council [NRC], 2012, pp. 32–34); such noncognitive skills have been the subject of higher educational employability debates (e.g., Benbow & Hora, 2018; Fallows & Steven, 2013). Using SNA of survey (n=868) and interview (n=83) data from faculty across institutions in four large U.S. cities, we seek to answer two research questions (RQs):

RQ1. How, if at all, do faculty teaching-focused social networks associate with faculty use of evidence-based teaching methods?

RQ2. What do teaching-focused social network discussions entail, and how do faculty characterize the influence of these networks on their instruction?

To conceptualize the process through which faculty access, mobilize, and then benefit from teaching-focused social networks, we use a theoretical framework based on the concept of "social capital." Social capital is defined as the useful, relationship-based resources one invests in and gains access to through social ties (Lin, 2001). To answer RQ1, we use quantitative

methods to test the association between faculty use of evidence-based instructional techniques to teach the four noncognitive skills of written communication, oral communication, teamwork, and self-directed learning and established individual faculty personal network measures for *network size* (i.e., the number of contacts with whom a faculty member discusses teaching), *range* (i.e., the diversity of a faculty member's contacts according to organizational affiliation), and *tie strength* (i.e., how close a faculty member feels to these contacts). Research has shown that these measures allow individuals to access social capital in the form of beneficial information and support (e.g., Burt, 2000; Borgatti & Halgin, 2011; Lin, 2001; Reagans & McEvily, 2003). To answer RQ2, we qualitatively use both inductive and *a priori* coding analyses of interview data. We examine first faculty conversation partners and perspectives on network contours associated with social capital accrual; second, the mechanisms and objects on which teaching-focused discussions focus; and finally, the beneficial information, knowledge, advice, and support faculty report coming from these relationships.

We begin here with a discussion of faculty professional development in teaching through social learning as well as noncognitive skill instruction in higher education. We then move to a discussion of SNA, studies on faculty teaching-focused social ties, and the theory of social capital, which frames our work.

Background

Evidence-Based Instructional Development and Faculty Social Learning

Research has established that instructional practices centered on student interaction and engagement that utilize authentic problems, consistent formative assessment, and ample feedback, are most beneficial to student learning (e.g., Chi & Wylie, 2014; Fallows & Steven, 2013; Smith et al., 2005). However, years of reform designed to foster these teaching habits in faculty, who are typically content experts with little to no formal instructional training (e.g., Amundsen & Wilson, 2012), have yielded mixed results.

While a wide body of research has pointed to the instructional benefits of myriad factors, ranging from experiential learning to institutional structures supporting professional practice (e.g., Freeman et al., 2014), studies on faculty teaching development suggest that intentional efforts catering to local circumstances hold the most potential for change. In their systematic review of the literature in this area, for instance, Henderson and colleagues (2011) found that the most effective instructional change strategies not only leverage prevalent faculty norms, but also purposefully align with pre-existing systems within target colleges and universities (pp. 975-979). Prevailing social systems, in particular, that have been shown to play a significant role in faculty instructional reform within and across disciplinary and institutional contexts (e.g., Kezar, 2014) hold considerable opportunity for improved college instruction.

Research on the connections between faculty social learning and instructional development supports this contention, though this work is less developed than in K–12 studies, where researchers have found correlations between teacher social learning and student achievement (Goddard et al., 2007; Pil & Leana, 2009). For example, studies show that when college and

university faculty partake in interactions in which they are able to discuss teaching with others, they become closer to their colleagues, pick up new pedagogical knowledge, and often change their teaching approaches to accommodate what they have learned (e.g., Gast et al., 2017). Engaged *reflection*, in which discussion partners purposefully consider their own instructional methods, beliefs, and experiences (e.g., Schön, 1983), has proved especially beneficial, challenging faculty to reexamine their practices and modify their understanding of instruction (Kezar et al., 2017; Manouchehri, 2002; Roblin & Margalef, 2013). Further, research indicates that whether these kinds of interactions are fostered through organized "peer coaching" exchanges (Fletcher, 2018), "professional learning communities" (Hilliard, 2012), "communities of practice" (Gehrke & Kezar, 2017), or through more private, ad hoc discussions with colleagues or mentors (e.g., Martin & Double, 1998; Pifer et al., 2015), they allow faculty to iteratively improve instructional methods that can boost student achievement (Manouchehri, 2002).

Still, while faculty interaction across settings has been linked to instructional improvement, "decomposing" the constituent elements of these interactions—as is important to designing effective professional development interventions (Grossman et al., 2009; Osborne et al., 2019)—demands a better and more precise understanding of faculty teaching-focused relationships. It also demands an understanding of how these relationships work experientially, wherever and with whomever they take place, as well as how specific relational factors associate with teaching benefits. Though much work has focused on interaction outcomes in the business world (e.g., Cross & Sproull, 2004), most guidance in education, again, comes from research on K–12 teachers. Little (1990), who stressed the importance of "attending seriously and in detail to the content" of teacher interactions (p. 511), established several ideal types for K–12 exchanges, from "storytelling and scanning" to "joint work" (pp. 513-523). Building off Little's work but empirically focusing on primary school educators, Doppenberg and colleagues (2012) specified additional types of exchange as well as individual and group interactional learning outcomes, including "awareness" and "change models" in the former category, and "shared knowledge" and "improvement of culture" in the latter (pp. 559-560). Zwart et al. (2008), empirically focusing on high school teachers, also cataloged specific peer coaching interactions, including "requesting and receiving feedback" and "gathering of information," as well as outcomes, including "new ideas, conceptions, or beliefs" and a "changed idea of self" (pp. 990-993).

To our knowledge, Van Waes and colleagues' (2016) qualitative investigation of the activities and benefits of faculty teaching-focused interactions, among 30 faculty members in a Belgian university, represents the only detailed empirical investigation of this subject matter in higher educational institutions. Using the Little (1990) and Doppenberg et al. (2012) taxonomies as a jumping-off point, the researchers outline faculty teaching-focused interactions such as "listening and informing" and "observing." They also outline different kinds of value faculty reported taking from these interactions, including immediately applicable material, referred to as "applied value," and theoretically valuable goals and strategies, referred to as "potential value" (pp. 300–302). Findings suggest that faculty engage in a wide range of discrete teaching-focused

interactions in their day-to-day lives, and that more purposeful, interdependent forms of joint work can be extremely valuable to continued faculty development.

Though Van Waes et al. (2016) present a well-executed treatment of these issues, there are opportunities to carry this work forward by gathering statistical and experiential relationship data among larger numbers of faculty in multiple institutions. This work can also be advanced by focusing on the link between teaching-focused interactions and instruction among a wider range of discussion partners across departmental, organizational, geographical, and other formal and informal boundaries (e.g., Pifer et al., 2015; Niehaus & O'Meara, 2015). We next discuss an analytical perspective that allows for this type of investigation.

Social Network Analysis and Teaching-Focused Ties

As noted above, the research approach called social network analysis (SNA) studies relationships or "social ties" between people. SNA is based on three important tenets. First, individuals and the actions they take depend on one another; second, compilations of social ties, called "social networks," are a conduit for the flow of material and nonmaterial resources between linked individuals; third, the social networks in which individuals are embedded provide opportunities for, and constraints on, their behavior (Wasserman & Faust, 1994, p. 4). Rather than focusing on the individual actor, SNA focuses on the social ties among and around focal individuals as the primary unit of analysis. Findings are based, therefore, on data outlining different empirical and experiential facets of the relational networks and linked outcomes under question.

Social network studies take one of two investigative approaches. One approach, called "whole" network analysis, looks at the content and structure of social ties among bounded, formally delimited groups of individuals (Wasserman & Faust, 1994). In this paper we use the second approach, referred to as "personal" network analysis, which looks at distinct networks of social ties around unconnected individuals that can span any number of personal, professional, organizational, or geographic boundaries. Personal network analyses are usually based on data collected from a participant regarding the characteristics of their social ties, including how many people they speak to about specific issues ("network size"), the professional or demographic diversity of these contacts ("range"), and how close the participant feels to these contacts ("tie strength"). In essence, the advantage of this perspective is that it allows us to collect and analyze precise data on specific kinds of interactions across a variety of formal and informal contexts, wherever these interactions take place and as participants believe they are important (Perry et al., 2018).

SNA has informed teacher social learning research in a number of ways, showing that various network patterns among teachers allow them to access beneficial knowledge, information, and support that can improve their professional practice. But while a host of studies among K–12 teachers have shown, for instance, that strong social ties are important to policy enactment (Coburn & Russell, 2008; Daly et al., 2010), the ability to cope with accountability pressure (Wilhelm et al., 2016), and teaching (Pil & Leana, 2009), work on *faculty* social

networks has been comparatively uncommon. Early network research on faculty typically looked at publication collaboration networks (e.g., Small & Griffith, 1974), while later studies have used the network perspective to investigate various faculty issues and processes, including formal professional development interventions (Rienties & Kinchin, 2014), and the development of teaching-focused relationships (Benbow & Lee, 2019), among other subjects.

A few extent studies do provide guidance, however. In one of the earliest papers using the network perspective to look at faculty teaching-focused relationships, Roxå and Mårtensson (2009) gathered data on discussions among 106 participants to investigate to whom faculty talked about teaching and what forms these conversations took. They found that faculty teaching-focused networks often involved reflective, private interactions with a core group of trusted "significant others" (p. 214), and that faculty perceived such discussions—especially when supported by local institutional and departmental cultures—as beneficial to their instructional development. More recent research has supplemented these findings. For example, Pataraia et al. (2015) found that a wide range of local relationships, particularly those in which faculty could provide support to one another, strengthened faculty members' perceptions of their own learning and instructional practice. Further, in an important line of work exploring the structure and quality of faculty teaching-focused ties, Van Waes and colleagues (2015) found that beneficial network formation among faculty is often closely associated with teaching development, so much so that "experienced expert" instructors often have stronger and more diverse social ties than novices and experienced non-experts. As mentioned above, later work by Van Waes et al. (2016), using constructs developed by Little (1990) and Doppenberg et al. (2012), shed new light on the value of teaching-focused discussions as well as the activities of faculty engaged in them (pp. 300-302).

Detailing Faculty Personal Networks for Noncognitive Skill Instruction

Despite these findings, more detailed studies investigating the correlation between instructional practices and teaching-focused networks can add to the existing knowledge base, as can mixed-methods analyses centered on personal networks in which faculty discuss teaching with people *they* perceive as influential, not just other faculty members in their institutions.

In this paper, we sought to fill these knowledge gaps in regard to active learning strategies for teaching "noncognitive" skills that have been increasingly emphasized by scholars, faculty, and policymakers (e.g., Heckman & Rubinstein, 2001; Hora et al., 2016). Sometimes referred to as "employability" skills (e.g., Suleman, 2018) or "soft" skills (e.g., Hora et al., 2018), noncognitive skills include intra- and interpersonal competencies, abilities, or traits that allow one to self-regulate and express and interpret messages to and from others, such as persistence, conscientiousness, or teamwork (NRC, 2012, pp. 32–34). Studies indicate that faculty and employers see noncognitive skills as a requirement for the modern workplace (e.g., Benbow & Hora, 2018; Rios et al., 2020), and that these skills associate with a host of favorable educational, health, and professional outcomes (e.g., Blanden et al., 2007; Heckman & Rubinstein, 2001), promulgating an international movement to include noncognitive skill instruction in higher educational curricula.

Four noncognitive skills stand out in the research literature. Both *written* and *oral communication*, in which messages are conveyed in writing and verbally between people to generate meaning, have been shown to be crucial across employment fields where professionals need to relay information and decisions clearly through emails, reports, meetings, and presentations (e.g., Darling & Dannels, 2003). Research also shows that *teamwork*, or the ability to collaborate with others, fosters innovation and efficiency and allows subject matter experts to share technical, experiential, and intellectual resources to improve outcomes (e.g., Riebe et al., 2010). Lastly, *self-directed learning*, defined as the curiosity and drive to continually improve and manage one's own learning, is an increasingly essential skill in contemporary employment (e.g., Hammond & Collins, 2013). These four skills are important enough that various professional certification boards around the world require student development in all four areas for educational programs to achieve accreditation (e.g., Accreditation Board for Engineering and Technology, 2018; Engineering Council, 2014).

Though faculty across disciplines can provide students with information on these or other noncognitive competencies, the real transfer of learned skills, as noted above, demands interactive, hands-on, student-centered engagement (e.g., Fallows & Steven, 2013; Freeman et al., 2014; Smith et al., 2005). Written communication skills, for example, can be improved by asking students to take verbatim notes of classroom discussions or activities, write essays or report on class topics, or provide peers with written feedback (Poirrier, 1997; Troia, 2014; Vangelisti et al., 2013). Oral communication can be taught through recitations, discussions, presentations, or other activities that encourage students to articulate their understanding of the course material (De Grez et al., 2009; Kennedy, 2007; Rivard, 1994). Students can better learn teamwork skills not only through think-pair-share activities and groupwork, but also through supplemental instruction on the importance of set group objectives and continual assessments (e.g., Riebe et al., 2010; Sancho-Thomas et al., 2009). Self-directed learning skills, similarly, can be taught by encouraging students to actively consider, and monitor, their own learning in and outside of class. Faculty can initiate pop quizzes or clicker questions during class, for instance, or facilitate class discussions on which time-management methods and study strategies work or do not work for students as they learn the course material (e.g., Murad & Varkey, 2008; Regan, 2003).

In short, scholars from a range of disciplines understand what kinds of teaching strategies will most effectively instill these noncognitive skills in students. Few studies, however, have investigated faculty instruction of these skills across the curriculum, or how faculty are learning to better teach these skills in college. Our objective in this paper is twofold. First, it is important to quantitatively test correlations between teaching-focused personal networks and the use of evidence-based methods to teach noncognitive skills across a large group of faculty in multiple higher educational institutions. Second, building on the important work of Van Waes et al. (2016) and others, we qualitatively detail these teaching-focused relationships from the perspective of a smaller subset of faculty. We now move to describing how we theoretically ground this investigation.

Conceptual Framework

The Theory of Social Capital

We conceptualize the link between faculty teaching-focused personal networks and evidence-based instructional practices with the theory of *social capital*, defined as beneficial, actionable resources invested in, accessed, and mobilized through social ties. Utilizing Nan Lin's (1999, 2001) perspective on the theory, we envision social capital as potential resources that are cultivated when an individual "invests" in a personal relationship. As compilations of these relationships develop, social resources, or "capital," ultimately flow through social ties between connected individuals and provide people with various material (e.g., money) and nonmaterial (e.g., prestige) benefits.

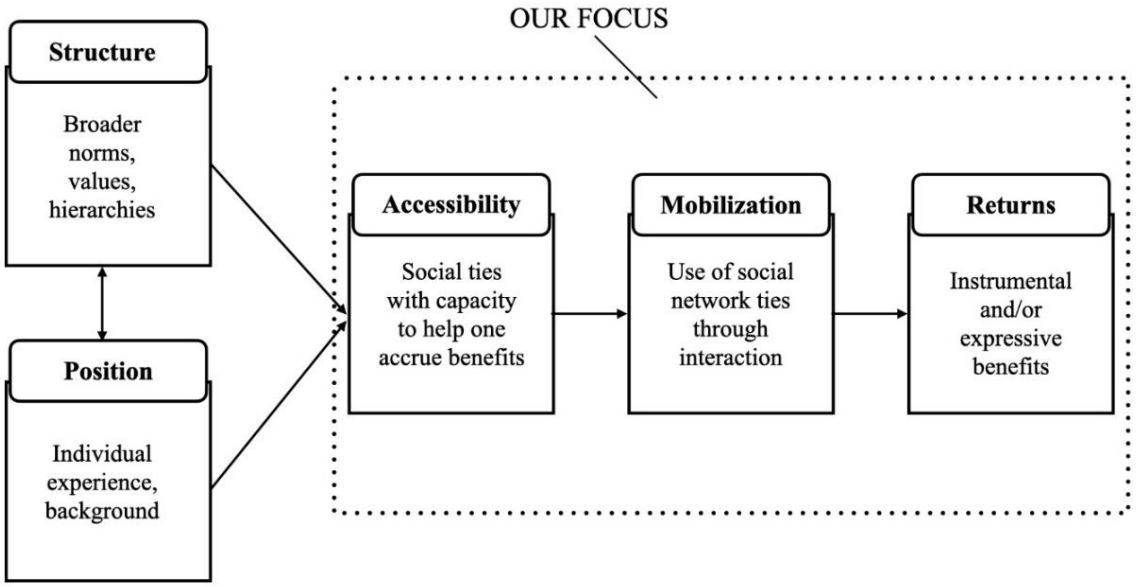
Indeed, Lin (2001) argued that beneficial social capital can come in innumerable forms, whether through an introduction, a loan, inside information, or, most significantly in this analysis, advice or guidance regarding the effectiveness of a particular instructional technique (e.g., Penuel et al., 2009). The important point is that these kinds of social resources are not "owned," but *accessed* by individuals who, after developing or investing in social ties, eventually utilize these ties to accrue benefits. While social capital can allow individuals to accrue advantageous resources, it is not always positive nor unlimited. Certain relationships may be more or less reciprocal or even perilous, as scholars have shown in the study of personal network influences on relapse among former substance abusers (Panebianco et al., 2016) or networks of sexual partners and HIV infection (Thornton, 2009). Social capital also is unequally distributed from individual to individual (Bourdieu, 1986), often in ways that both mirror and reinforce broader cultural and socioeconomic inequalities.

In fact, from Lin's (2001) perspective, whether and how valuable support, knowledge, or information flow among people depends on a causal process that begins with the interplay between an individual's *position*, or their hierarchical place based on life experience, credentials, or identity, and wider *structures*, or the broader systems that impose normative values and hierarchies on individuals and their interactions (e.g., Benbow & Lee, 2019). Based on these conditions, one develops *accessibility* to social capital, referring to the capacity (or lack thereof) of a person's social ties to provide possible benefit. As an individual acts to utilize valuable ties, Lin (2001) contended, they *mobilize* social resources that then can lead to benefits or *returns* on the investment they put into developing the relationships in the first place. Returns, Lin (2001) wrote, could be either "instrumental," including utilitarian benefits like wealth or reputation, or "expressive," including affective, physical, or psychological benefits (pp. 244–245).

The following example illustrates how this social capital development process might unfold in the context of a faculty member's daily life. First, certain *structural* and *positional* conditions, such as shared research interests, the physical proximity of two offices, or having the free time to talk, lead to the development of a social tie between a faculty member and a colleague with whom she can discuss teaching methods. The initiation of the relationship provides a possible, but not yet realized, point of *access* to social resources. In order for the faculty member to

mobilize the benefits that can come to her from this social tie, she must ask this colleague for feedback on an instructional idea, for example, an important facet of teaching-focused learning interaction (e.g., Henderson et al., 2011). Eventually, if she puts this feedback into action in her teaching, she may see *returns* on her social investment in the form of improved instruction (instrumental returns) or confidence (expressive returns). A model of this process—highlighting the *accessibility*, *mobilization,* and *return* phases on which our research questions focus—is displayed in Figure 1.

***Figure 1*. Modelling the Network Development of Social Capital (Lin, 2001, p. 246)**



Measuring Social Capital in Teaching-Focused Personal Networks

But what kinds of personal networks lead to positive, teaching-related returns? The answer lies in Lin's (2001) specific theoretical approach to social capital, which is based not only on several well-established, observable, personal network measures designed to gauge the beneficial capacity of certain social ties (see, for instance, Perry et al., 2018, pp. 159–173), but also years of empirical social network field research (Lin, 2001, pp. 77–79). With reference to this scholarship as well as studies linking faculty relationships to teaching-focused development (Pataraia et al. 2014, 2015; Roxå & Mårtensson, 2009; Van Waes et al., 2015, 2016), we operationalize our analysis using three specific personal network measures.

Size

Network size refers to the number of distinct contacts in an individual's personal network. Network size has been linked to several benefits, including increased social support, status, and mobility (Lin, 1999) as well as higher levels of faculty teaching expertise (Van Waes et al., 2015). Lin (2001) has pointed out that larger personal networks often increase access to original information or knowledge from a wider variety of contexts.

Range

Network range measures the heterogeneity of an individual's personal network, or how similar contacts are to one another according to various social or organizational attributes. In general, the more diverse the contacts in one's personal network, the more diverse the resources one receives through that network (e.g., Lin, 2001; McPherson et al., 2001). Studies on faculty, similarly, show that they benefit from network contacts who can help them look at issues from different disciplinary or departmental perspectives (Pataraia et al., 2015).

Tie Strength

Tie strength, referring to the affective closeness between an individual and their personal network contacts, relates differently to outcomes depending on the phenomenon under study. Closer ties lead to greater social cohesion as well as more efficient exchange of nonroutine information in business (e.g., Levin & Cross, 2004) and educational contexts (e.g., Coburn & Russell, 2008). Conversely, stronger ties have also been shown to limit one's access to new information (Granovetter, 1973). While little research on faculty teaching-focused networks illuminates the relative benefits of strong versus weak social ties on faculty social learning, Pataraia et al. (2014) do suggest that stronger faculty relationships often facilitate better instructional collaboration (pp. 63, 67).

These measures, and the social capital framework from which they derive, help us in two important ways. Quantitatively, the measures allow us to test the correlation between proxies for social capital accrual—representing the *accessibility* phase of the Lin's (2001) process—and measures of evidence-based instruction among a large sample of faculty, representing the *returns* phase. If results from previous studies translated effectively to this study, we would expect a positive correlation between all three measures and the use of evidence-based teaching methods to teach noncognitive skills. Qualitatively, we can use Lin's social capital development framework to organize open-ended interviewee descriptions of the content and influence of teaching-focused networks, allowing us to see what relational factors are considered important to faculty members through the "accessibility," "mobilization," and "return" phases of the social capital development process.

Methods

This case study, a deep exploration of a bounded process or phenomenon based on multiple data sources (Yin, 2013), takes a convergent mixed-methods approach to answering our research questions (Creswell & Plano Clark, 2018). The approach involves collecting quantitative and qualitative data simultaneously and analyzing the data sets to answer their attendant research questions; presenting the results of these analyses side-by-side; and, in discussion, integrating the quantitative and qualitative results to get a more comprehensive picture of the central phenomenon (also see Teddlie & Tashakkori, 2006). This method is appropriate to answer our two research questions. For RQ1, we use quantitative analyses to measure the correlation between social network and teaching variables among a large sample of faculty; for RQ2, we

conduct an in-depth qualitative analysis of faculty members' descriptions of the content and influence of teaching-focused networks in their daily lives.

Data for the present study come from online surveys and semi-structured interviews conducted as part of a larger study on college noncognitive skill instruction in several science, technology, engineering, mathematics, and medical (STEMM) fields. These fields, because of their supposed importance to national economic interests, have received attention from scholars, employers, and policymakers in recent years (e.g., Hora et al., 2016; Carnevale et al., 2011; PCAST, 2012). This study takes place in four cities, or "metropolitan statistical areas" (MSAs) delineated by the U.S. Bureau of Labor Statistics (USBLS, 2016). Each of these MSAs is characterized by proportionally high STEMM employment levels (Hecker, 2005; Rothwell, 2013): Houston, Texas; Raleigh, North Carolina; Seattle, Washington; and Denver, Colorado. Correlational analyses of quantitative survey data are used to answer RQ1, while inductive and *a priori* coding analyses of qualitative interview data are used to answer RQ2. Here, we describe quantitative and qualitative methods in turn.

Quantitative

Survey Sampling

We used purposeful, nonprobability self-selection sampling methods (Bernard, 2011) to identify and recruit local college and university faculty in programs educating undergraduate students to enter prominent college-credentialed occupations in the STEMM fields of computer and information systems, engineering, health care, the physical sciences, and science technologies (U.S. Department of Homeland Security [USDHS], 2014). We began this process by determining the two most populous occupations in these focal fields in each MSA. Defining "STEMM occupations" as associate's (two-year) and bachelor's (four-year) degree credentialed jobs that the U.S. Department of Labor's Employment and Training Administration Occupational Information Network (O*Net, 2016) lists as requiring science, technology, engineering, technology, health, or mathematics skills and knowledge, we established comparative STEMM occupational populations in each MSA using online USBLS employment estimates (USBLS, 2016). In Houston, for example, the most populous STEMM occupations in our focal fields included chemical equipment operators, petroleum engineers, and registered nurses, while in Raleigh the most populous occupations in our focal fields included computer user support specialists, software developers, machinists, and mechanical engineers.

Next, we checked O*Net (2016) listings, which provide job hunters with information on local two- and four-year college programs training students to enter each occupation, to find college programs in each MSA that provide education for these designated populous occupations. After searching the public websites of these listed college programs for course and contact information, we developed a survey sample frame of all instructors-of-record teaching students to enter our identified occupations in each MSA. This frame included 4,717 full-time, part-time, tenured, tenure-track, and adjunct faculty members across Houston, Raleigh, Seattle, and Denver. We collected mail and email address information for these faculty members and

administered the survey in four separate waves between March 2017 and October 2018, one wave per MSA. Following evidence-based practices, survey administration included sending a letter to each faculty member containing information on our study, a $2 survey incentive, and a personalized web URL linked to an online survey (see Dykema et al., 2013) with two follow-up reminders.

Across 71 two-year and 39 four-year institutions in the four MSAs, 868 faculty provided personal network quantitative data, a response rate of 18.4% (Table 1). On testing, significant differences were found between responding and non-responding faculty groups in regard to institution type and location (χ^2=12.662, $p < 0.001$ and χ^2=18.687, $p < 0.001$, respectively), suggesting the presence of a possible non-response bias. However, because the effect of using non-response adjusted weights is limited in situations where only a small amount of auxiliary information is available—especially in cross-sectional study settings (e.g., Little & Vartivarian, 2003)—we did not adjust the design weights for non-response in this study. For this reason, and in consideration of the low survey response rate, statistical conclusions should be read with caution.[2]

[2] Because range and tie strength cannot be measured nor replaced with neutral values when a respondent does not have a personal social network, this survey sample is limited to those faculty who reported engaging in teaching-focused discussions (i.e., faculty members with one or more contacts). To correct for this potential selection bias, we employed a Heckman (1979) two-stage selection model. This technique, which includes a selection equation, is frequently used in social network studies across disciplines to deal with this issue (Amuedo-Dorantes & Mundra, 2007; Carpenter et al., 2012; Kim & Schneider, 2005). Ultimately, the results of the test show little variation between models, as the coefficients in the Heckman selection model for focal independent and dependent variable correlations have similar significance levels as those obtained from the hierarchical linear model presented in our Results section below.

***Table 1*. Descriptive Statistics for Faculty Survey Sample**

Variables	N	Mean (*SD*)
Gender		
Female	276	
Male	577	-
Transgender	1	
Other	5	
Race		
Asian	79	
African American	37	-
Hispanic	31	
White	676	
Teaching-focused personal networks		
Network size	868	4.0 (1.6)
Range	868	0.1 (0.2)
Tie strength	867	3.0 (0.5)
Class size		
1–24 students (0)	374	
25–49 students (1)	221	
50–74 students (2)	120	1.1 (1.3)
75–99 students (3)	62	
Over 100 students (4)	73	
Time spent on preparing to teach		
1–4 hours per week (0)	100	
5–8 hours per week (1)	275	
9–12 hours per week (2)	225	2.0 (1.4)
13–16 hours per week (3)	118	
17–20 hours per week (4)	85	
Over 21 hours per week (5)	64	
Teaching experience		
Less than 1 year (0)	24	
1–5 years (1)	181	2.3 (0.9)
5–10 years (2)	152	
Over 10 years (3)	506	
Discipline		
Computer and information systems	192	
Engineering	516	
Health care	81	-
Physical sciences	56	
Science technologies	23	
Evidence-based noncognitive skill instruction		
Written communication instruction	862	50.8 (18.2)
Oral communication instruction	862	56.5 (18.2)
Teamwork instruction	865	59.6 (23.2)
Self-directed learning instruction	863	52.2 (19.2)

Note. Figures in Table 1 were reported based on the original data set with missing values.

Quantitative Data and Measures

The online survey instrument used in this study was newly developed for the larger research project of which it was a part. To check the instrument's face validity, we shared it with several faculty members and colleagues and used their feedback to gauge item phrasing and order. After refining the instrument, we administered a pilot version, which we further revised with a focus on item phrasing and ordering.

In particular, this paper uses independent variables from the survey focused on the three teaching-focused personal social network measures described above; control variables focused on faculty time allocation, teaching experience, class size, gender, race/ethnicity, institutional type, and discipline; and dependent variable measures focused on evidence-based, active learning-focused instructional practice. Here we describe each set of variables in more detail.

Personal Network Independent Variables

We measured the teaching-focused personal network variables of network size, range, and tie strength using four survey items founded on years of social network research and social capital-oriented theory (Borgatti & Halgin, 2011; Lin, 2001). The first question, based on Burt's (1984) seminal General Social Survey social network prompt, asked faculty whether they discussed "methods or techniques they can use to better teach their students important skills, knowledge, or abilities" with others. Participants choosing "yes" were asked to list up to six people with whom they typically discussed these matters. We chose the limit of six alters in keeping with the typical contours of teaching-focused faculty personal networks described in Roxå and Mårtensson (2009, p. 214) as well as methodological research showing six to be an optimal alter maximum balancing "core" network measurement accuracy with the need to reduce participant cognitive burden (Marsden, 1987). The number of alters listed in answer to this question, between one and six, constituted our measurement for each participant's teaching-focused network *size* (Freeman et al., 1979). Next, participants were asked to pick the organizational affiliation of each listed alter from organizational categories based on the North American Industry Classification System (U.S. Census Bureau, 2016). With data from this question, we calculated a measure for *range* meant to gauge the diversity of organizational sources from which each participant was channeling teaching information, knowledge, and advice (Baker-Doyle & Yoon, 2011). This measure, based on Blau's (1977) index of heterogeneity, is equal to

$$1 - \sum p_i^2$$

where p_i^2 is the proportion of alters in the *i*th group category with categories being alters affiliated with (1) preK–12 schools, (2) technical or community colleges, (3) universities or professional schools, (4) businesses, (5) government, or (6) advocacy organizations. The greater the number of organizational categories represented among each participant's listed teaching-focused alters, the greater the range of the teaching-focused network. The section concluded by asking each participant to characterize their relationship with each listed alter as distant, less than close, close, or very close, a question designed to best represent the theoretical concept of tie

strength using only one survey item (Marin & Hampton, 2007). We created our *tie strength* variable by averaging each faculty member's responses to this question on a 4-point scale from 0 (distant) to 3 (very close), following Morrison (2002).

Control Variables

We included several variables in the analysis to adjust for other faculty-, department-, and institution-level factors research has shown to associate with faculty teaching practices. At the faculty level, participants were asked to list one course they had recently taught that they were familiar with "in terms of course curricula and instructional methods." Next, they were asked how many students were enrolled in this class, on a scale between 1 (1–24 students) and 5 (100 or more students), which acted as our measure for *class size*, shown to be an important influence on teaching practices (e.g., Booth et al., 2003). Research has also suggested that faculty instructional practices may vary due to *time spent preparing to teach* (e.g., Milem et al., 2000). For this measure, our survey asked faculty how many hours per week they spent preparing to teach, on a scale from 0 (1–4 hours per week) to 5 (more than 21 hours per week). Another factor shown to influence instructional practice, *teaching experience* (e.g., Fleming et al., 2016), was measured on a scale from 0 (less than 1 year) to 3 (more than 10 years teaching). *Gender* (e.g., Goodwin & Stevens, 1993) and *race/ethnicity* (e.g., Stanley, 2006) were also included as faculty-level control variables. Our department-level predictor is the academic *discipline* of each participant (e.g., Gehrke & Kezar, 2017), while the institution-level predictor is each participant's *institution type* (e.g., Leslie, 2002). We used classification categories from the U.S. Department of Education's (USDOE) College Scorecard website (2016) and the USDHS STEM-Designated Degree Program list (2014) to create academic discipline categories (computer and information systems, engineering, health care, physical sciences, and science technology) and a dichotomous measure for institutional type ("2-year" and "4-year" institutions).

Evidence-Based Instruction Dependent Variables

Survey questions meant to measure faculty use of evidence-based methods for teaching four focal noncognitive skills in a designated course were generated using research focused on instruction in written communication (Poirrier, 1997; Troia, 2014; Vangelisti et al., 2013), oral communication (De Grez et al., 2009; Kennedy, 2007; Rivard, 1994), teamwork (Astin, 1987; Riebe et al., 2010; Sancho-Thomas et al., 2009), and self-directed learning (Murad & Varkey, 2008; Regan, 2003; Wilcox, 1996) as well as Chi & Wylie's (2014) Interactive, Constructive, Active, and Passive (ICAP) framework for teaching engagement. The ICAP framework contends that the effectiveness of instructional tasks can be measured along a continuum from "passive" activities, where students are minimally engaged in active learning, to "interactional" activities, where students are working together with concepts and material and fully engaged in learning (Chi & Wylie, 2014).

First, we used the noncognitive teaching literature to outline concrete evidence-based practices for teaching each of the four focal skills (i.e., providing students with written or web-based resources for improving their oral communication). Then, referring to ICAP category

definitions, four research team members worked together to classify each teaching practice as passive, active, constructive, or interactive, further discussing methods on which there was disagreement among researchers until consensus was reached on the proper ICAP category. From this process, we developed a list of discrete practices for teaching each of the four skills, 31 in total, which we then used as the basis for survey items meant to gauge whether participants used evidence-based methods in a recently taught course they had designated earlier in the survey. Items asked participants to assess their use of each of these practices on a five-point Likert-type scale, borrowed from the Postsecondary Instructional Practices Survey (Walter et al., 2016), ranging from "not at all descriptive of my teaching" to "extremely descriptive of my teaching." After refining the items based on reviews and feedback from several teaching and noncognitive skill experts, we constructed and piloted an online survey instrument among 192 local STEMM faculty members in two- and four-year colleges and universities. After refining existing items based on survey participant feedback and dropping other items based on further expert advice, we finalized 16 teaching items, four for each noncognitive skill, with one gauging the use of a passive teaching practice, one an active practice, one a constructive practice, and one an interactive practice. Table 2 displays all noncognitive skill teaching items along with their ICAP categorization.

Following research suggesting a pretest/posttest improvement of between 8–10% from each successive ICAP category to another—for example, from a passive practice to an active practice (Menekse et al., 2013)—we calculated weighted dependent variable scores for these items. While "not at all descriptive of my teaching" responses garnered a 0 for all items, weighted scales for passive teaching items began with 1; for active teaching items, scales began with 1.09; for constructive teaching items, scales began with $(1.09)^2$; and for interactive teaching items, scales began with (1.09).[3] Scores were added together and, as a final step, totals were linearly transformed to a range of between 0 and 100 to ease interpretation. Descriptive statistics for faculty in the survey sample, including independent variable measures and weighted scores for evidence-based noncognitive skill instruction, are displayed in Table 1.

To handle 60 (=4.7%) cases with incomplete data, we used a multiple imputation (MI) based on the Markov Chain Monte Carlo Algorithm (Hox, 2002).

Quantitative Analysis

We describe first our unconditional model and then our conditional model.

Unconditional Model. To take into account the clustered nature of members of our sample within multiple institutional and disciplinary contexts, we began by calculating a fully unconditional model for all four teaching outcomes. To partition the variance explained by all faculty-, department-, and institution-level predictors (Bryk & Raudenbush, 2002), we begin with no predictor variables specified. As seen in Table 3, variances in faculty use of evidence-based teaching methods explained at Level 1 in the fully unconditional model are 91.8%, 90.6%, 92.6%, and 84.8% for instruction in written communication, oral communication, teamwork, and self-directed learning respectively. Variances explained at Level 2 are 7.6%, 3.1%, 0.5%, and 5.8% for each outcome in the same order, whereas variation in the same outcome occurring at

Level 3 were 0.7%, 6.3%, 6.9%, and 9.4%. These results indicate that 15.2% of the variance in evidence-based self-directed learning instruction is significantly attributable to either between-department- or between-institution-level differences, whereas only 7.4% of the variance in evidence-based teamwork instruction is due to non-between faculty-level differences.

These results show that even though a large proportion of outcome variance lies at the faculty-level—with the exception of self-directed learning instruction—statistically significant proportions of variation still exist either between departments (i.e., $p < 0.01$ for written communication skills) or institutions ($p < 0.01$ for oral communication skills, $p < 0.001$ for teamwork, and $p < 0.001$ self-directed learning). With this in mind, we proceeded to fit a conditional model.

Conditional Model. We applied a three-level hierarchical linear model ([HLM]; Bryk & Raudenbush, 2002) by adding faculty-level, department-level, and institution-level predictors. First, our Level 1 faculty-level HLM model for each skill's instructional methods is constructed in this way:

$$Y_{ijk} = \beta_{0jk} + \beta_{1jk}(Network\ size)_{ijk} + \beta_{2jk}(Range)_{ijk} + \beta_{3jk}(Tie\ strength)_{ijk} + \beta_{cjk}(Faculty\ characteristics)_{ijk} + r_{ijk}$$

Here, Y_{ijk} represents the extent of evidence-based instruction for each skill for participant i within department j in institution k. β_{0jk} is the average descriptiveness of instructional methods for each skill in department j of institution k after controlling for social network predictors and faculty characteristics. β_{1jk}, β_{2jk}, and β_{3jk} indicate the coefficients for the relationship between each participant's social network predictors measured using network size, range, and tie strength and instructional methods for each skill. r_{ijk} is the residual term associated with within-department variability, while the vector of faculty-level characteristics encompasses teaching experience, time spent on preparing to teach, class size, gender, and race. Second, our Level 2 department-level model is constructed in this way:

$$\beta_{0jk} = \gamma_{00k} + \gamma_{0dk}(Discipline)_{jk} + u_{0jk}$$

γ_{00k} denotes the average estimates for each skill instruction in the discipline of science technologies for institution k, while γ_{0dk} represents the coefficients for each discipline regressed on faculty's each skill instruction. $Discipline_{jk}$ consists of a vector of department-level predictors such as computer and information systems, engineering, health care, and physical sciences. μ_{0jk} is an error term after adjusting for department conditions. In the next step, the Level 3 model is given by:

$$\gamma_{00k} = \pi_{000} + \pi_{001}(Institution\ type)_k + e_{00k}$$

***Table 2*. Evidence-Based Instruction Dependent Variable Survey Items**

Dependent variable	Survey items and ICAP category
Written communication instruction	Based on how you typically teach this course, how well do the following statements describe your methods for teaching *…written communication* competencies (skills, knowledge, or abilities)? *I provide students with resources for improving their writing competencies (e.g., how-to guides for writing a paper) [*Passive*] *I encourage students to take verbatim notes about the lecture and/or related activities [*Active*] *I require students to write essays, assignments, or reports about a topic related to the course content [*Constructive*] *I require students to provide written feedback to their peers [*Interactive*]
Oral communication instruction	*…oral communication* competencies? *I provide students with resources for improving their oral communication competencies (e.g., how-to guides for giving a presentation) [*Passive*] *I encourage students to recite written and/or memorized course material [*Active*] *I provide students opportunities to verbally articulate their own understanding of the material (e.g., Q&A session, class presentations) [*Constructive*] *I ask students to discuss, debate, or advocate their stance on a topic in smaller groups or as a class to an audience [*Interactive*]
Teamwork instruction	*…teamwork* competencies? *I provide students with resources for how to be an effective team member and collaborate with others [*Passive*] *I require students to work in groups (either in-class or outside of class) to accomplish course activities [*Active*] *When working in groups, students are required to create goals or objectives for the team's performance [*Constructive*] *When working in groups, I require students to discuss as a group how they would assess their group interactions and progress [*Interactive*]
Self-directed learning instruction	*…self-directed learning* competencies? *I introduce students to self-directed learning concepts (e.g., time management and/or study habits) [*Passive*] *I use in-class learning checks (e.g. pop quiz, clicker questions) to keep students actively monitoring themselves for whether or not they are learning the material [*Active*] *I require students to write or speak about their performance on an exam or assignment specifically regarding how well they prepared and how they can improve moving forward [*Constructive*] *I require students to discuss with a partner, in small groups, or as a large group what time management methods, study habits, or learning strategies work or do not work for them [*Interactive*]

Table 3. **Variance Decomposition for Faculty Evidence-Based Noncognitive Skill Instruction**

Random Effects	Written communication instruction	Oral communication instruction	Teamwork instruction	Self-directed learning instruction
Variance component				
Faculty-level (Level 1) variance	305.838	298.772	502.554	310.644
Department-level (Level 2) variance	25.258	10.225	2.962	21.412
Institution-level (Level 3) variance	2.23	20.842	37.447	34.417
Proportion of variance between faculty	0.918	0.906	0.926	0.848
Proportion of variance between departments	0.076	0.031	0.005	0.058
Proportion of variance between institutions	0.007	0.063	0.069	0.094

Table 4. **Faculty Interview Sample**

Measures	*Interviews*	
	N	***%***
Gender		
Female	26	31.3
Male	56	67.5
Transgender	1	1.2
Race		
Asian	9	10.8
African American	7	8.4
Hispanic	4	4.8
White	60	72.3
Discipline		
Computer and information systems	24	28.9
Engineering	19	22.9
Health care	11	13.3
Physical sciences	8	9.6
Science technologies	21	25.3
Institution type		
Two-year	36	43.4
Four-year	47	56.6
Location		
Houston	21	25.3
Raleigh	19	22.9
Seattle	19	22.9
Denver	24	28.9
Total	83	100.0

where the mean descriptiveness in institution k, γ_{00k}, is modeled into the type of institution, $Institution\ type_k$, and the institution-specific residual, e_{00k}. π_{000} indicates the descriptiveness across all two-year institutions, and π_{001} is the coefficient for the difference in each instruction outcome between two-year and four-year institutions. With the exception of binary variables, all predictors were centered around their grand means to ease the interpretation of the results.

Qualitative

Interview Sampling

As surveys were sent out, researchers recruited a subset of faculty members for interviews from the survey sample representing nine two-year and eight four-year institutions across the four MSAs. Using maximum variation sampling, we chose these colleges and universities for the range and variation in their programming, student demographics, and size to gain perspectives within multiple institutional and disciplinary contexts (e.g., Merriam & Tisdell, 2016). Once target institutions were identified in each MSA, researchers obtained IRB permission from the appropriate institutional and departmental authorities and then sent introductory emails to all faculty instructors of record teaching in focal programs, explaining the study and asking for interview participation. Eighty-three faculty members ultimately participated in interviews and provided qualitative, teaching-focused, personal network data (Table 4).

Qualitative Instrument and Data

One-on-one interviews with faculty volunteers lasted about an hour and were based on a semi-structured interview protocol exploring faculty perspectives on college instruction and workforce development in their disciplinary fields, with questions asking interviewees to describe their backgrounds, the students in their programs, teaching philosophies and instructional strategies, thoughts on noncognitive skills, and teaching-focused personal networks. Before taking the interview protocol into the field, researchers sent a preliminary draft of the instrument to several subject matter experts whose feedback was incorporated into a pilot protocol administered to more than a dozen faculty in the researchers' institutions.

The subset of interview questions and probes we focus on here were designed to elicit open-ended, detailed responses about teaching-focused social interactions as well as faculty perceptions of how network interactions influence their instruction. The teaching-focused network portion of the interview protocol first asked, "Do you typically discuss with anyone what instructional methods or techniques you can use to better teach your students important skills, knowledge, or abilities?" If the faculty member answered yes, researchers then posed several questions asking them to describe their teaching-focused discussion partners, what their teaching-focused conversations entailed, and how, if at all, these conversations and relationships influenced their instruction of written communication, oral communication, teamwork, or self-directed learning. Probes focused on eliciting details on specific teaching-focused interactions, including what matters faculty discussed, what conversational roles discussants played, and how these details connected, if at all, to interviewees' instructional practices.

Importantly, questions purposefully did not ask interviewees about the personal network elements of network size, range, and tie strength that were the basis of our quantitative analysis' focal proxy measures for social capital accrual (Lin, 2001). Our goal, instead, was to offer faculty open-ended questions regarding their teaching-focused social ties to better understand what details and factors from these relationships interviewees thought most important to their instructional practice. Interviews were audio recorded and transcribed verbatim into Word documents for digital and manual analysis.

Qualitative Analysis

Because multiple subjects were covered in each faculty interview and the corpus was quite extensive, researchers first organized transcript data by broad topic via a holistic coding procedure in NVivo 11 (Saldaña, 2015). This procedure was used to chunk transcript data according to the major issues covered, relying both on interviewer transition statements and the interview content to determine when interviewees were discussing teaching-focused personal networks. After being identified, coded, and separated, discrete personal network segments from 83 faculty interviewees were printed out in raw data reports for the initial coding phase. During this phase, the two authors read through network responses with a list of factors relating to social capital and network theory in mind—including network size, range, and tie strength as well Lin's (2001) social capital development process—to take margin notes on particular faculty open-ended responses aligning with these *a priori* elements and also to note other patterns they found in interviewee perspectives (Charmaz, 2014). Once the researchers had separately read through and commented on the data in this way, they met to read one another's notes, discuss impressions, and create a preliminary codebook incorporating several initial codes they agreed reflected theoretical and interviewee perceptions regarding teaching-focused relational content and influence (Saldaña, 2015).

The authors next focused on further developing this codebook and achieving inter-rater reliability. Each inter-rater reliability round consisted of the authors randomly picking four personal network transcript segments and coding each separately with the latest version of the codebook. Coding was performed by writing summaries in Word of each interviewee's statements for each code. After written summaries of each round's transcripts were complete, the authors met to closely compare, contrast, and discuss their code summaries for each transcript and then make changes to the codebook to further develop codes and interpretive consensus. After completing three such coding and revision rounds focusing on twelve interviewee segments in total, the researchers collaboratively finalized the first cycle codebook. This codebook included three broad code categories, each named after a focal phase in Lin's (2001) social capital process model. The first broad category, accessibility, included subcodes referring to faculty members' descriptions of their network makeup, which Lin (2001) conceptualizes as the potential beneficial capacity of one's social ties to provide social capital if utilized. Codes here described who faculty reported talking to as well as instances when faculty brought up network size, range, and strength factors in their interviews. The second broad code category, mobilization, which in Lin's (2001) model represents the utilization of social ties, referred to

interviewee-described interactions that took place within teaching-focused discussions as well as the subject matter on which these interactions or mechanisms focused. The last broad category, returns, conceptualized as benefits or profits gained from social capital mobilization (Lin, 2001), included interviewee statements on outcomes resulting from interactions with teaching-focused social network ties. With this codebook in hand, the authors divided up the corpus and proceeded to write code summaries of each category for all the teaching-focused social network data segments.

Second cycle coding consisted of the authors collecting summarized notes on the code categories and inductively analyzing the contents within each category for patterns based on continuing analytic memoing, interviewee repetition, and the association of emerging themes with previous literature on teaching-focused activities and interaction (Little, 1990; Doppenberg et al., 2012; Van Waes et al., 2016). From these patterns, we established several emergent themes and subthemes within each broad category, bringing together interviewee descriptions. During this stage, for example, the authors decided to split coded data in the *mobilization* bin into two first level or "Level 1" themes, the first called "mechanisms," referring specifically to relational actions taken by faculty with and through teaching-focused ties, and the second called "objects," referring to the issues or materials on which these interactions focused. Further, subsets of granular teaching-focused interactional *mechanisms* mentioned by faculty, which included "collaborative problem solving," "reviewing/going over together," and "coproducing," were combined with other granular codes to comprise a Level 2 theme under mechanisms, called "co-acting." Following Lin (2001), *returns* were divided into "instrumental," or performative, material, direct benefits, and "expressive," or psychological, affective, or health-related benefits (pp. 244–245). Analytic results are presented in tables, while we also report selected descriptive results for prominent themes and subthemes within each category.

Limitations

The results reported in this paper should be read with several limitations in mind. First, because these data were gathered as part of a wider study on college instruction and workforce development, network survey and interview items were truncated to reduce participant burden. This limited our ability to gather more sophisticated social network measures on the survey as well as to probe interviewees in more detail. Second, our survey and interviews come from a self-selected sample of faculty who may not represent the wider faculty population, and the survey's low response rate suggests limited generalizability to the wider college faculty population. Third, survey and interview data are based on faculty self-reports on interactional behaviors that we were unable to satisfactorily verify through direct observation. Quantitative teaching outcomes, measures for independent social networks and control variables, as well as interview descriptions of interactions and teaching practices, should therefore be read with caution. Finally, because we use cross-sectional observational data, our quantitative study does not reflect causality. Future studies based on data with experimental and longitudinal elements will provide real evidence of a causal relationship between specific personal network characteristics and teaching practice.

Results

In answer to RQ1, we report quantitative results to show the associations between faculty teaching-focused personal social network attributes linked to the accrual of social capital (Lin, 2001) and the use of evidence-based teaching methods to teach written communication, oral communication, teamwork, and self-directed learning. In answer to RQ2, we present qualitative results—including our exposition of prominent themes from interviews following Lin's (2001) social capital development process—focusing on faculty member descriptions of their teaching-focused personal networks and network influence on teaching.

RQ1: How, If At All, Do Faculty Teaching-Focused Social Networks Associate With Faculty Use of Evidence-Based Teaching Methods?

Table 5 presents estimations of the association between teaching-focused personal network indicators, control variables, and faculty self-reported use of evidence-based teaching methods.

Network Size

After controlling for faculty-, department- and institution-level characteristics, results show strong, positive associations between larger teaching-focused networks and faculty use of evidence-based methods to teach all four skills. Network size is positively correlated with written communication and teamwork instruction at the .01 level, and with oral communication and self-directed learning instruction at the .001 level.

Range

Network range shows much less predictive strength. A broader range of organizational representation among alters is not significantly related to the use of evidence-based methods for teaching written communication, teamwork, or self-directing learning skills. A significant increase in the use of evidence-based methods to teach oral communication skills, however, is evident among faculty with a broader range of social network contacts ($p < 0.05$).

Tie Strength

Our results show a significant and positive association between the strength of faculty teaching-focused social ties and faculty use of evidence-based methods to teach all four skills. In other words, the closer faculty members feel to teaching-focused discussion partners, the more often they report using evidence-based instructional methods to teach written and oral communication, teamwork, and self-directed learning ($p < 0.001$).

***Table 5*. HLM Models Predicting Use of Evidence-based Methods to Teach Noncognitive Skills**

Fixed effects	Written communication instruction	Oral communication instruction	Teamwork instruction	Self-directed learning instruction
Faculty-level				
Network size	1.06**	1.227***	1.54**	1.498***
	(0.388)	(0.362)	(0.481)	(0.382)
Network range	1.846	7.313*	4.304	1.922
	(3.159)	(2.951)	(3.877)	(3.151)
Network tie strength	4.608***	5.746***	6.561***	5.328***
	(1.161)	(1.066)	(1.394)	(1.143)
Class size	-1.305*	-1.879***	-1.711*	0.754
	(5.098)	(0.532)	(0.731)	(0.592)
Time spent preparing to teach	0.262	0.652	1.535**	0.645
	(0.456)	(0.423)	(0.55)	(0.450)
Teaching experience	0.309	-2.341***	-2.472*	-1.958**
	(0.695)	(0.665)	(0.858)	(0.71)
Female	1.275	2.444	-1.088	0.174
	(1.375)	(1.315)	(1.711)	(1.385)
Asian	3.871	1.293	2.277	2.21
	(3.706)	(3.516)	(4.656)	(3.709)
African American	8.466*	6.083	11.129*	4.539
	(4.264)	(4.033)	(5.29)	(4.332)
Hispanic	1.756	-5.295	-4.813	-6.285
	(4.426)	(4.193)	(5.539)	(4.474)
White	-1.942	-1.169	-2.07	-4736
	(3.232)	(3.065)	(3.968)	(3.258)
Department-level				
Computer and information systems	-1.744	-7.106	-12.787*	-0.231
	(4.204)	(3.707)	(4.935)	(4.182)
Engineering	4.06	-2.652	-7.346	2.143
	(4.106)	(3.605)	(4.784)	(4.029)
Health care	3.654	4.895	-1.837	11.7*
	(4.759)	(4.129)	(5.474)	(4.648)
Physical sciences	7.555	2.911	-9.602*	6.631
	(4.881)	(4.210)	(5.584)	(4.745)
Institution-level				
Four-year institutions	2.318	-0.746	-1.002	-6.897***
	(1.653)	(1.457)	(2.027)	(1.827)
Constant	47.196***	59.439***	69.696***	57.336***
	(5.073)	(4.637)	(6.13)	(5.113)
Random effects				
Level 1 (within-department)	283.53	273.672	464.411	288.453
Level 2 (between-department)	20.584	0.364	0.024	7.004
Level 3 (between-institution)	0.116	0.140	7.239	13.229
Number of observations	868	868	868	868
Number of departments	282	282	282	287
Number of institutions	110	110	110	110

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Control Variables

Results indicate that two faculty-level control variables are negative predictors for the use of evidence-based instructional methods. First, faculty in classes with more students use evidence-based practices less often to teach written communication, oral communication, and teamwork. Similarly, faculty with more years of teaching experience use evidence-based methods less often to teach oral communication, teamwork, and self-directed learning than those with less teaching experience. Both relationships are significant. In contrast, faculty time allocation is positively associated with the use of evidence-based methods to teach teamwork. Further, African American faculty use evidence-based instructional methods to teach written communication and teamwork more often than faculty of other races and ethnicities.

The results of our HLM regression also reveal some significant differences in noncognitive skill instruction according to departmental characteristics. For faculty in computer and information systems and the physical sciences, the expected mean for evidence-based teamwork instruction is lower than among faculty in science technologies. Faculty in two-year institutions or health care-related disciplines are more likely to use evidence-based methods to teach self-directed learning than faculty in four-year institutions or science technologies disciplines.

RQ2. What Do Teaching-Focused Social Network Discussions Entail, and How Do Faculty Characterize the Influence of These Networks on Their Instruction?

Here we describe what teaching-focused network discussions entail and how faculty perceive discussions influencing their instruction. As noted above, inductive coding was applied to bring emergent faculty perspectives on the salient content of teaching-focused discussions to the fore, but within broad *a priori* categories directly mapping onto Lin's (2001) theoretical frame. Though our results cannot speak to causation, we describe the three co-occurring network phases in the order in which Lin (2001) presented them: accessibility, mobilization, and returns. Because of space considerations we describe only Level 1 and Level 2 themes in detail.

Social Capital Development Phase: Accessibility

Accessibility represents the phase in which a faculty member constructs compilations of relationships whose content and form may help them accrue beneficial teaching-related social capital. To explore the form of networks in more detail, we first focus on faculty descriptions of who they talked with about teaching, which we term "know-who" (see Van Waes et al., 2015). We then focus on inductively derived faculty descriptions of the number of people they talked to about teaching (network size), the similarity or dissimilarity of discussion partners (range), and the strength of relationships (tie strength), three teaching-focused personal network measures that have been shown to be important to social capital accrual in past research (Lin, 2001) but that we did not expressly ask faculty about in interviews.

Know-Who. Faculty described speaking to a wide variety of people about methods for teaching important skills; we primarily divided people into those inside and those outside each faculty member's institution. Table 6 presents know-who thematic definitions and counts.

Table 6. **Reported "Know-Who" Accessibility Factors Within Faculty Teaching-Focused Personal Networks**

Social Capital Development Phase	Level 1 Theme	Level 2 Themes	Level 3 Themes	Level 4 Themes	Definition	N
Accessibility	Know-who	In-college	Faculty	Disciplinary	Faculty from the same program/department and discipline	56
				Non-disciplinary	Faculty from other programs/departments and disciplines	14
			Students		Undergraduate student social ties	10
		Out-college	Faculty	Disciplinary	Faculty from other higher education institutions within the same or a different discipline	23
			Business people		Employers, industry reps, and/or businesspeople in industry sectors connected to faculty teaching (e.g., advisory boards, job fair employers, alumni, clinical nursing administrators)	18
			Friends and family		Family members, friends, or acquaintances from outside professional life	9
			K–12 teachers		PreK to high school teachers	4

In-College. Most interviewees reported speaking with faculty colleagues from the same discipline, typically those teaching in the same program or department. Sometimes same-department discussion partners were formally conjoined through co-instructional, annual review, or supervisory assignments. Other times relationships were informal and based around break room conversations, common research interests, or the teaching of similar courses. For example, one four-year university computer and information systems faculty member explained a co-teaching relationship. "I regularly teach the 300 course, and if a faculty comes in to teach that course with me, they usually pick up some of the things that I'm doing and then I pick up some of the things they're doing," he said, describing the natural exchange that often takes place within co-teaching relationships.

Some teaching-focused personal networks consisted of people in a host of other roles and positions as well. For instance, inside interviewee institutions, 14 interviewees said they discussed teaching with faculty in other disciplinary areas, including teaching and learning experts in education, while a few interviewees reported talking to students and administrators. Though faculty generally agreed that teaching discussions with others outside the discipline could be fruitful, some suggested that the most applicable knowledge and support came from other disciplinary experts. "You have faculty from other disciplines and some of the things are

still related," a computer and information systems professor at a four-year university said, but "now you need to customize it to your discipline…it's not the same as having discussions with another person from computer science."

Out-College. Twenty-two interviewees also said they talked about teaching with disciplinary colleagues from other higher education institutions, usually people they met in graduate school or while attending local, regional, or national education events such as professional conferences. A moderate contingent of faculty also reported discussing teaching with contacts outside academia entirely. Eighteen faculty reported talking with employers, industry representatives, and/or businesspeople in industry sectors, often to better understand what noncognitive skills were important for students as well as to get suggestions for how to instill those skills. "We usually talk to more industry and company folks," one engineering faculty in a four-year university said, "about what they think is the best way to teach a certain skill." Other interviewees spoke to family, friends, or K–12 teachers, depending on the specific topic or information needed.

Network Measures. During the accessibility phase of the social capital development process, personal networks become positioned to be valuable or not according to their *capacity* (Lin, 2001). Because theory and past research tell us that personal network size, range, and tie strength offer a person greater potential access to beneficial resources (e.g., Coburn & Russell, 2008; Pataraia et al., 2015), we conducted an inductive analysis of interviewee mentions of these three important concepts. Themes from this analysis, by network measure, are displayed in Table 7.

Network Size. Faculty often referred to how many people they spoke to about instruction, using terms delineating a handful of discussion partners such as "a couple," "a few," or "some." However, relatively few interviewees talked further about whether or how network size related to instructional development. Two themes related to network size did emerge in the analysis. Seven faculty members spoke about small, specific, *core networks* of teaching-focused contacts, from two to six or seven people, with whom they exclusively discussed instruction and who provided them with advice, information, or perspective. As a health care faculty member said, "You get your little circle, three to five [people]." Some interviewees described a few individuals they considered essential, but these individuals were only a smaller part of a broader constellation of teaching-focused relationships. Often, interviewees referred to these people by name and mentioned returning to them regularly for discussions Six faculty members talked about having one primary discussion partner with whom they frequently spoke *one-on-one*, often suggesting that interpersonal interactions with a solitary contact could be conducive to more open, honest, and helpful communication.

***Table 7*. Reported "Network Measure" Accessibility Factors Within Faculty Teaching-Focused Personal Networks**

Social Capital Development Phase	Level 1 Theme	Level 2 Themes	Level 3 Themes	Definition	N
Accessibility	Network measures	Network size	Core networks	Small contingent of essential teaching-focused contacts, from two to several people, with whom faculty member talks consistently and who are the foundation of personal network	7
			One-on-one	Dyadic teaching-focused contacts engaged with separately, typically in private conversations	6
		Range	Years teaching	Instructors who have taught more years, sought out by novice instructors	12
			Disciplinary focus	Alternate focuses, from other areas of expertise within discipline or from outside discipline altogether	7
			Out-college	Information, knowledge, or ideas from an extra-institutional perspective	7
		Tie strength	Conversation frequency	The rate at which teaching-focused discussions take place, with regularity, accidently, or by necessity	28
			Intimacy or affection	Affective relationship descriptions reflecting tie closeness, familiarity, and/or trust	9

Range. While the concept of range was only mentioned by a moderate number of interviewees, range- and diversity-related factors did seem to resonate more naturally with the lived experiences of the study's faculty interviewees than did network size. Most who alluded to range among contacts referred to giving or asking for instructional advice based on how many *years of teaching* their contacts had. Unsurprisingly, they painted an overall picture of senior faculty providing junior faculty with teaching advice. Junior faculty, in turn, reported accruing information- and support-related benefits based on the experience of senior colleagues, in the classroom and in the department. "Some of them have been here for quite some time, so they have lots of expertise," one information technology faculty member at a four-year university said, referring to his tenured colleagues. Senior faculty interviewees expressed more ambivalence about the benefits of such exchanges. Other interviewees described new perspectives that could be accessed by talking with people from different content areas within their department (*disciplinary focus*), and/or from other institutions (*out-college*). One engineering faculty member at a two-year college told us about getting teaching advice from a social worker at a children's soccer game. The advice was related to teaching communication skills in what she described as a "millennial" classroom. "She wasn't an instructor," she reported of the social worker, "but she knew the social aspect of how to get across to this age group." Others reported similarly beneficial connections to individuals at local companies, or department alumni.

Tie Strength. Twenty-eight faculty members, the largest number speaking to an *a priori* network measure, described the frequency of teaching-focused conversations (*conversation frequency*), an alternate metric for measuring tie strength in the social network literature (Perry et al., 2018). In their statements on conversation frequency, interviewees often used various kinds of shorthand to convey the regularity (or lack thereof) with which they engaged contacts. Some, for instance, used terms like "a little," "not a lot," or "once in a while" to describe how often they discussed teaching. One four-year university engineering professor, for instance, said that he and his colleagues were so focused on advisees and research that they very seldomly talked about instruction. Others, however, described more continual interactions. When faculty described both their engagement in formal and in ad hoc interactions, they used phrases like "once a semester," "twice a week," "every day," "all the time," or "constantly," conveying the sense not only that teaching-focused discussions happened semi-regularly, but also that they found these conversations meaningful.

The second tie strength theme, *intimacy and affection*, represents descriptions of relationships with regard to longevity, familiarity, and trust. While the theme was only referenced by nine interviewees, it corresponds well with the concept of "closeness," which is considered the most accurate measure of tie strength (e.g., Marin & Hampton, 2007). Some faculty described the dependability of one or more discussion contacts, while others described close relationships that allowed more open and reciprocal exchanges. Relationship duration, which can also engender confidence in discussion partners, was another aspect of closeness mentioned by several faculty members. As one health care instructor at a four-year institution explained, she had "longstanding relationships" with multiple hospital educators in area. "We

work closely with them," she reported, so she and her colleagues could understand how to better instill the technical and noncognitive skills needed by students in the nursing field.

Social Capital Development Phase: Mobilization

Now, we focus on mobilization, the second phase of Lin's (2001) social capital development process. During this phase, faculty members act to accrue social capital by utilizing social resources within their personal network, which they have invested time and energy in forming, to draw on social ties' beneficial instructional knowledge, advice, or support. Since this kind of utilization takes place through social exchange, we explored in detail faculty descriptions of teaching-focused discussions. Using inductive coding, we broke these descriptions down into two categories, "mechanisms" and "objects." We present mechanism and object themes, definitions, and counts in Table 8.

Mechanisms. Mechanisms represent specific, semi-discrete, collaborative actions or processes in which faculty members and their teaching-focused social ties engage. Six themes emerged from our inductive analysis including "co-acting," or shared activities like co-teaching, problem-solving, or organizing curricular materials; "requesting," including asking questions or requesting materials; "observing and evaluating," or listening, watching, and formally or informally assessing what one hears or sees; "explaining," or answering questions, explaining or clarifying ideas, and providing feedback; "guiding," or giving directive advice; specific direction; and "personalizing," or shaping ideas or practices to fit one's own style or content. Here we describe in more detail the two most salient mechanisms according to how many faculty interviewees mentioned them: "co-acting" and "requesting."

***Co-Acting*.** Forty-six faculty interviewees described teaching-focused interactions that involved goal-oriented collaborations, including developing curricula, reviewing or sharing materials, brainstorming, or working together to solve problems. On one end of this spectrum were formal co-teaching arrangements in which faculty needed to build and/or instruct courses in concert, negotiating key details on structure, emphasis, assessment, and pace that either fostered or were the products of beneficial conversations. "Most of my teaching is done with other faculty," a two-year college engineering faculty reported. "So there are great discussions that happen in that arena." While these kinds of tight collaborative relationships could foster multiple opportunities for shared reflection, they could also impose constraints, as one physical sciences faculty member at a four-year university pointed out. "We are co-teaching and have to have a certain degree of similarity between us," he told us. "If he was like, 'I don't want to do anything interactive,' that would be a big problem." On the other end of the spectrum were more limited cooperative moments, exchanges, or gestures. Numerous faculty, for example, spoke of sharing ideas or materials with discussion partners, some of whom were teaching similar courses and looking to incorporate noncognitive skill instruction. One two-year college physical sciences instructor explained how he shared a formal student teamwork agreement with a colleague. "'What is this teamwork contract?'" he said his colleague asked him. "'Well, let me show you,'" he answered.

Requesting. Forty-one faculty members told us that their teaching-focused exchanges often involved actively requesting material (syllabi, assessments) and/or nonmaterial things (information, feedback, support) from others. Whether requests were for simple information or more significant assistance on teaching matters, faculty reported that explicit appeals to others often initiated valuable, in-depth social exchanges. Several faculty, for instance, talked about requests for information on teaching specific courses. "I hunt down everybody I can who has taught Mechanics," a four-year university engineering faculty member said. "I ask them, 'What are you trying to teach in Quantum?'" Others talked about simply sitting down with colleagues and asking multiple questions to better understand instructional approaches and strategies. "I just love picking their brain about how do you explain topic X or what do you do when a student comes and says, 'How do I do better on the exams?'" another four-year university engineering interviewee explained. Further, interviewees told us that those on the receiving end of requests could learn something as well. One four-year science technologies faculty member told us that he viewed questions from others about his teaching approach as a form of feedback. As he explained his methods, and listeners asked more questions, he was often forced to think through and articulate his reasoning more carefully. "Questions can be very helpful," he said.

Objects. Relational mechanisms do not fully explain how faculty mobilize their teaching-focused personal networks. We also need to refer to the subject matter or issues on which mechanisms center, what we call "objects." The eight object themes that emerged from our inductive analysis of faculty interviews include "nuts and bolts," or practical understandings of particular teaching methods; "experience narratives," including instructive stories or anecdotes about teaching; "ideas for improvement," or new instructional approaches or strategies meant to enhance instruction; "educational artifacts," referring to prepared curricular items such as syllabi, grading rubrics, or assessments; "content teaching," or information, advice, or support surrounding a specific course or content area; "solutions," meaning specific problems or concerns in the classroom to be solved by discussants; "skill value and cultivation," or specific skills that are important in graduates or how to more effectively teach them; and "practice principals," or personal values and belief structures around instruction.

***Table 8*. Reported "Mechanism" and "Object" Mobilization Factors Within Faculty Teaching-Focused Personal Networks**

Social Capital Development Phase	Level 1 Themes	Level 2 Themes	Definition	N
Mobilization	Mechanisms	Co-acting	Collaboratively constructing, reviewing, organizing, sharing, negotiating, brainstorming, or problem-solving towards an explicit and common goal	46
		Requesting	Asking for material, information, knowledge, or advice	41
		Observing and evaluating	Observing, listening, assessing, vetting, and/or verifying practices, materials, information, knowledge, or advice, either formally or informally	22
		Explaining	Modelling, narrating, answering, or otherwise relaying information to others to clarify idea or process; includes giving "feedback"	20
		Guiding	Providing suggestions and advice to support, mentor, or coach another person in a specific direction or toward a specific goal	20
		Personalizing	Molding practices, materials, information, knowledge, or advice to one's own circumstances and/or approach	4
	Objects	Nuts and bolts	Practical, mechanical understandings of instruction (e.g., what teaching methods, materials, or tools to use and/or how to use them) or the instructional environment (e.g., local policies, expectations, and/or priorities) meant to achieve specific results	38
		Experience narratives	Anecdotes and stories from previous experiences to learn from the past and improve teaching	25
		Ideas for improvement	New possibilities regarding instructional information, approaches/strategies, or processes, that can be utilized to improve teaching and student learning, sometimes brainstormed and/or unintentional	25
		Educational artifacts	Organized course lessons and materials including syllabi, exams, grading rubrics/systems, lab projects, assignments, etc.	19
		Content teaching	Specific content area (e.g., microbiology), course (e.g., Microbiology 304), and/or topic (e.g., microbiomes), usually by those who will be or are teaching in that content area, course, and/or topic	16
		Solutions	Specific teaching-related problems, challenges, or concerns	14
		Skill value and cultivation	Focus on what skills, competencies, or abilities are important and/or missing in students or graduates as well as how to more effectively teach these skills	11
		Practice principles	Individual teaching philosophy or rules, including reasoning, values, and/or perspective undergirding instructional approach	4

Below we detail "nuts and bolts" and "experience narratives," the two most salient object themes based on frequency they were mentioned by faculty.

Nuts and Bolts. Thirty-eight interviewees said their teaching discussions centered on useful, hands-on insights regarding methods, materials, tools and/or the contexts in which teaching takes place. Typically, nuts-and-bolts issues reflected conversations focused on results-oriented teaching techniques or approaches meant to achieve some specific result, as one four-year health care faculty member explained. "Most of my questions with colleagues aren't about how to improve my skills," she said, "but more about strategy to get the result I want." Discussions, then, often focused on exchanging information on how to implement certain strategies to achieve intentional goals. For example, a computer and information systems faculty member at a two-year college explained that she had been looking into using discussion forums in one of her courses. One of her discussion partners, a writing professor, had used forums many times before. "She's going to help me…kind of help them facilitate those discussions," she reported. While faculty interviewees most often described nuts-and-bolts conversations centering on practical teaching methods and techniques, sometimes discussion partners exchanged information on local, environmental factors or policies influencing instruction as well. "I'm going to a colleague about institutional policies, like can we change a textbook, can we change the curriculum," a recently appointed health care faculty member at a four-year institution reported. In these instances, most often reported by early career faculty, goals were both intentional and strategic.

Experience Narratives. Twenty-five interviewees reported discussions centered on experience narratives, which we define as anecdotes, stories, or impressions relaying previous instructional experiences. Narratives principally explained—from the storyteller's vantage point—what teaching methods or strategies worked or did not work and were used across informal and formal contexts. One four-year engineering faculty member told us, for example, that stories he told others were never formal. "It's just in passing, like, 'Gosh, you should have seen what happened today with my student." A four-year computer and information systems interviewee, however, described regular, formal meetings his colleagues would have with other local instructors. Here, he said, discussants would often tell one another stories. "We discuss our methods," he said, giving an example of how attendees would speak to their experiences. "What works for them… 'This was the exam question…and a lot of students liked it though it was challenging,' stuff like that." Faculty interviewees reported that stories could be shared to illustrate a point, allow reflection on teaching decisions and strategies, or help others learn from classroom experiences. The stories also provided discussion partners with a more comfortable, social-oriented way to talk through their instruction and learn from one another.

Social Capital Development Phase: Returns

Lin's (2001) social capital development process leads to a third and final phase in which benefits—conceived as valuable or advantageous "returns" on one's social investment—go to faculty who have successfully accessed and mobilized resources through their personal networks. Here, researchers asked faculty interviewees to report on how, if at all, their teaching-focused discussions had influenced their instruction. Inductive coding of responses was divided into two

categories proposed by Lin (2001): "instrumental" and "expressive" returns. Results of this inductive coding analysis are reported in Table 9.

Instrumental Returns. According to Lin (2001), instrumental returns include explicit utilitarian benefits such as wealth, power, and reputation (p. 194). In the case of faculty development, instrumental returns are represented by teaching skills or knowledge that increase professional effectiveness and student learning. Four instrumental return themes emerged from faculty interviews, including "insights and understandings," or increased knowledge, recognition, or awareness of teaching methods or approaches; "repertoires," meaning applied teaching practices or understandings; "collective competence," meaning benefits that accrue at the group- or organizational-level; and "matchmaking," or the increased social connections brokered by faculty teaching-focused discussions.

Here we describe in more detail the two most salient instrumental returns from our qualitative analysis: "insights and understandings" and "repertoires."

Insights and Understandings. Fifty-three interviewees explicitly reported that their teaching-focused conversations led to the accrual of information and knowledge on teaching, whether this new awareness was actively incorporated into their instructional practice or not. One two-year computer and information systems faculty member, for instance, told us that her discussion partners had "given [her] a lot of good ideas," while a four-year engineering faculty member said "having a bunch of people I can talk to…gave me a sense for what things might work in advance." Sometimes, benefits came in the form of a discussion partner helping a faculty member understand alternative approaches, as another two-year computer and information technology interviewee explained. "I would talk to him about, 'Students are really not getting this,'" he said, "and he would show me another way." Importantly, faculty also reported obtaining from discussion partners a better understanding of teaching noncognitive skills, including not only their importance but also how to teach them. Regarding the former, faculty reported that conversations with industry representatives often opened their eyes to the need to better instill noncognitive skills in students to prepare them for employment. "You talk with people in the industry about what they are looking for, they're looking for someone who is technically prepared but also someone who can work on high-performing teams," a four-year engineering faculty told us.

Repertoires. Thirty-eight faculty members spoke about putting the understanding they had gained from teaching-focused discussions into action, mostly by utilizing various strategies or practices they had picked up from others. Faculty action in this regard followed from conversations in different ways. Many interviewees told us, for instance, that they directly incorporated materials they had received from discussion partners. "These manipulatives are his idea," one two-year science technologies faculty said, referring to a problem set that had been

***Table 9*. Reported "Instrumental" and "Expressive" Returns From Faculty Teaching-Focused Personal Networks**

Social Capital Development Phase	Level 1 Theme	Level 2 Themes	Definition	N
Returns	Instrumental	Insights and understandings	A learned awareness, comprehension, and/or recognition of new instructional information and knowledge that could be applied in the future and/or across teaching situations	53
		Repertoires	Incorporated, practice-oriented teaching plans, methods, or materials that are being or have been applied	38
		Collective competence	Benefits accruing to larger group, program, department, and/or institution, including curricular alignment, improved department teaching cultures, or a more unified faculty	7
		Matchmaking	Bringing other people together through gained social connections, including other faculty, students, or employers	4
	Expressive	Reframing perspectives	Reconsideration and reformulation, through exposure to alternate viewpoints, of one's teaching perspective, beliefs, or values	22
		Common cause	Validation of teaching interests, beliefs, values, or efficacy through mutual interest, social support, and/or acceptance	8

given to him by a colleague. "I'm just stealing them." Some faculty mixed new ideas from conversation with ideas of their own, altering practices among several courses. Another faculty member, this one from a four-year engineering program, told us she had been integrating self-directed learning techniques she had heard about in online teaching discussions. "I've been using more and more of that…advocating that the students actually look answers up on their own." Other fully incorporated changes were course specific. For example, after participating with other instructors in several informal discussions focused on project-based learning, another engineering professor at a four-year university began incorporating the techniques in one class. "That's why I kind of dropped the homework and decided to go to projects," he said, referring to his participation in the discussion group.

Expressive Returns. While most faculty interviewees spoke about instrumental benefits accruing from teaching-focused personal networks, a group of faculty members reported expressive returns as well, defined as more affective, psychological resources such as health, satisfaction, or self-efficacy (Lin, 2001, pp. 244–245). Two themes, displayed in the bottom half of Table 9, emerged from these data. The first, "reframing perspectives," refers to recalibrating one's view or attitude about teaching. The second, "common cause," refers to mutual reinforcement, and validation, between discussion partners. Here we outline each theme in more detail.

Reframing Perspectives. Twenty-two interviewees explicitly told us that teaching-focused discussions caused a change in their teaching beliefs or perspective, a benefit often described in the research as when we develop relationships with people who are dissimilar to ourselves (McPherson et al., 2001). Here, faculty interviewees often mentioned discussions that allowed them to reach outside their department, organization, or discipline. One four-year engineering professor, for example, described working with a language arts faculty member on teaching communication skills. "He had very different perspectives. He would sort of say, 'Yeah, yeah, the technical stuff, but now let's come over here to the good stuff about communicating with people.'" Another faculty member in a two-year science technologies program described recent visits to local high schools. During these visits, the faculty member would discuss his program with a small group of students. They then would ask questions, often about teaching and learning, that he said made him look at his work in a new way. "As a teacher, you're always enlightened by the student, or in this case, potential students, as to what their needs are," he explained.

Common Cause. Eight faculty interviewees also spoke of the efficacy and connectedness they gained from teaching-focused conversations, reporting that discussions reminded them of their shared commitment to student learning. According to these faculty, the act of *sharing* interests, knowledge, information, and experiences—both good and bad—could be an important source of trust and fellowship. Remarking on what he had learned from discussions with other faculty, one four-year engineering faculty member said, "We're all kind of going through the same thing…it's very interesting to see that other educators…share similar pains." The resulting camaraderie could simply "feel good," as a few faculty members reported, or could be a source

of new energy, as one science technologies faculty member at a two-year college told us. The previous year, he said, his participation in a new campus teaching group had motivated him to become much more involved. "We actually have some really good discussions," he explained, "which is why I was inspired last year." Sometimes, the availability, and the openness, of discussion contacts could be a product of wider departmental norms based on a shared sense of reflection and professionalism.

Discussion

As educators and scholars continue to explore ways to improve faculty instruction, this study builds on and extends previous research regarding contours of teaching-focused personal networks as well as connections between these networks and teaching practice. With data from a nationwide sample of faculty across diverse higher educational institutions, we use a social capital theoretical framework and social network methods to explore these faculty relationships from two perspectives. Here we conclude with a discussion of triangulated results, findings from previous literature, as well as the paper's theoretical contributions and implications for faculty development and scholarship moving forward.

Faculty Network Measures, and Evidence-Based Instruction, at Multiple Levels

Though they should be read with caution, our quantitative findings provide evidence that network measures linked to beneficial social capital associate with the use of evidence-based instruction, empirically connecting faculty relationships with the use of active teaching methods that improve student learning (e.g., Freeman et al., 2014). These results fill an important gap in the faculty development literature that, until now, has seen few direct correlational tests between teaching-focused personal networks and teaching practices among such a large and diverse faculty sample.

Network size and tie strength are particularly significant in this regard. Larger networks, which network scholars link to increased access to social capital from more social locations (e.g., Lin, 2001), and stronger networks, which are associated with the more efficient exchange of complex information (Coburn & Russell, 2008), both significantly predict the use of evidence-based methods to teach all four noncognitive skills. Findings confirm previous exploratory research on faculty teaching-focused personal networks that show an association between network size and instructional expertise (Van Waes et al., 2015) as well as between tie strength and instructor teaching collaborations (Pataraia et al., 2015).

Considering these findings, our qualitative results are notable. Those in our interviewee sample seemed to pay little attention to the potential benefits of network size and tie strength as they described teaching-focused interactions. When there was discussion regarding the value in how many contacts one had, faculty interviewees noted the salience of *smaller* groups of important contacts (*core networks*), similar to Roxå and Mårtensson's (2009) findings regarding a "few significant others," and one-on-one interactions (*one-on-one*), ecologically disconfirming typical network size-oriented predictions (e.g., Perry et al., 2018). Tie strength was discussed among more faculty interviewees, but typically as shorthand in communicating how regularly

one spoke with contacts (*conversation frequency*) and the significance of certain contacts in one's professional life (*intimacy or affection*). Thematic results, therefore, suggest that more intimate interactions in smaller groups connect closely to relationship strength and affection, though initial correlational tests of survey data in this study showed a negligible association between network size and tie strength. Further research should more deeply explore the ecological and experiential connections participants might make between network size and strength, especially to effectively ground more often-used quantitative SNA approaches.

Network range, which can facilitate access to more diverse perspectives, advice, and information (McPherson et al., 2001; Pataraia et al., 2015), positively correlates with the use of evidence-based methods to teach only one noncognitive skill: oral communication. Interview results indicate a few possible reasons for range being a less robust measure in this study. In part, this could be the result of oral communication's elevated status specifically among social ties affiliated with private business or industry (*businesspeople*), where research suggests verbal acuity and presentation competencies are an increasingly valuable asset (e.g., Darling & Dannels, 2003; Rios et al., 2020). Several faculty members reported, for example, that employer contacts often provided advice (*guiding*) on the importance of effective oral communication instruction for graduates in the world of work (*skill value and cultivation*).

The lack of broader significance for range may also suggest that there are more pertinent ways to measure network diversity, and specifically the import of diversity on teaching behavior, than through the organizational affiliation of a faculty member's contacts. As reported, most interviewees said they spoke to other faculty members, so much so that interviewee descriptions of network diversity usually centered not on their contacts' broad organizational affiliation—which was typically two- or four-year higher educational fields—but on how long contacts had been teaching (*years teaching*), whether contacts were outside their institution (*out-college*), or whether contacts were outside their particular research area (*disciplinary focus*). The aspects of "range" that interviewees described as salient, therefore, were much narrower than our organizational affiliation-based quantitative measure suggests. This finding indicates that future research on faculty teaching-focused personal networks should measure much more specific range factors within and among faculty, including teaching experience, departmental affiliations, and disciplinary and research areas.

Joining Etic and Emic Perspectives to Detail Faculty Social Capital Development

Triangulating quantitative and qualitative research results to broaden interpretation is a hallmark of mixed-methods approaches (e.g., Creswell & Plano Clark, 2018). Still, the combination in this study is especially useful, not only because it combines SNA's traditional numerical precision with ecological, experiential detail that is often missing from social network studies (see Hollstein, 2014), but also because it offers a much more complete, theoretically attuned perspective on the social capital development process as it applies to faculty networks.

Indeed, though we cannot causally model how teaching-focused networks lead to teaching benefits, we can still form a more complete and detailed understanding of the co-occurring

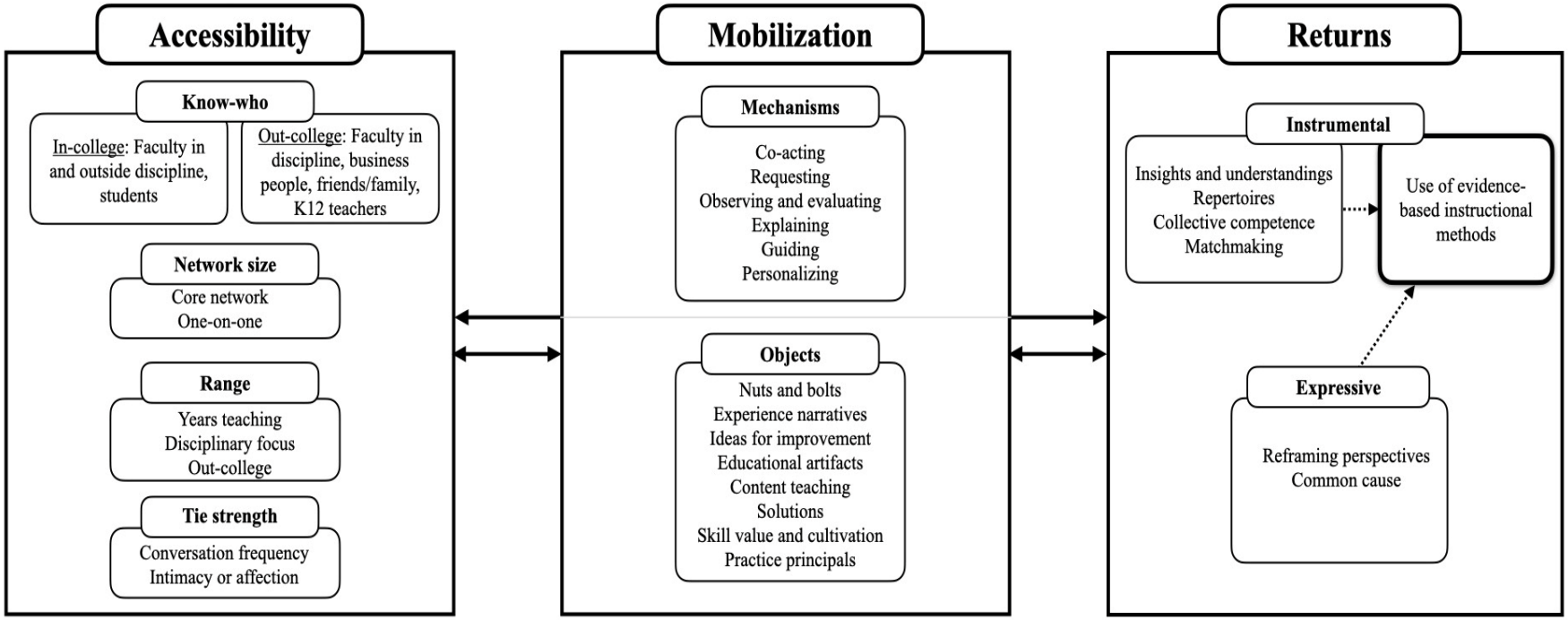
phases of this process, as Lin (2001) conceived of them, that helps explain faculty social learning and the utility of the theory. Our quantitative findings show a direct, statistically significant association between key aspects of participant network capacity, or the accessibility phase, and instrumental benefits, or the returns phase (Lin, 2001). Establishing this important association, however, serves only to link certain forms of accessibility (network size, range, and strength) to one kind of return (evidence-based teaching practices). The addition of *a priori* and inductive qualitative results, meant to give ecological and experiential meaning to this broader trend, illuminates key details of the social capital development process. Read together in this way, then, and mapped onto Lin's (2001) social capital development process, triangulated quantitative and qualitative results can give us a much more complete picture of how teaching-focused networks "work" among college faculty (Figure 2).

As we see, *etic* network size, range, and tie strength elements representing accessibility, positively correlated with the use of evidence-based instructional methods representing returns, are anchored on either side of the model with a connecting, bidirectional line. Co-occurring *emic* perspectives from interviewees, however, represented in part by listed themes within each phase and bidirectional lines connecting each of the three phases to one another, fill out the remainder of the model. These perspectives point to a rich and complex array of experiences and interactions through which faculty report accessing personal network ties with the capacity to provide benefits, mobilizing these ties, and gaining instrumental and expressive returns (Lin, 2001).

In the accessibility phase, faculty describe teaching-focused conversations across a broad array of contexts with colleagues, family, friends, and other acquaintances, reiterating the possible benefits that can come from both on- and off-campus interactions (*in-college, out-college*) in formal or informal situations (Pifer et al., 2015; Niehaus & O'Meara, 2015). Faculty also speak of the social capital potential in smaller group and individual relationships (*core networks*, *one-on-one*), the significance of *years teaching*, *disciplinary focus*, and institutional diversity (*out-college*) touched on in previous research (e.g., Benbow & Lee, 2019), and underline the cross-cutting importance of *conversation frequency* and *intimacy and affection* (Perry et al., 2018), sometimes over etic size, range, and strength constructs.

Faculty descriptions also demystify the mobilization phase, one part of which involves what we term mechanisms such as *co-acting*, linking to "joint work" (Little, 1990), and *requesting*, linking to "asking questions" (Zwart et al., 2008). The second part of the social capital mobilization process involves the subjects or objects of faculty interactions, some underlining previous research findings including the use of *experience narratives*, linking to "storytelling" (Little, 1990; Van Waes et al., 2016); *solutions*, matching Cross and Sproull's (2004) "solutions"; and *ideas for improvement*, linking to "new idea, conception, or belief" (Zwart et al., 2008) and "ideas" (Doppenburg et al., 2012).

***Figure 2*. Modelling the Network Development of Faculty Teaching-focused Social Capital**



The returns phase is also drawn out in detail. Here, faculty told us teaching-focused network interactions led to practical, instrumental returns. These included *insights and understandings*—similar to Doppenburg and colleagues' (2012) and Zwart et al.'s (2008) "awareness"—as well as actual, incorporated teaching practices, which we term *repertoires* and which are similar to benefits Van Waes et al. (2016) define by their "applied" and "realized" value. Faculty-described expressive returns confirm previous work as well. *Reframing perspectives* link closely to "problem reformulation" (Cross & Sproull, 2004), "change models" (Doppenburg et al., 2012), and "reframing value" (Van Waes et al., 2016); and *common cause* links to Doppenburg and colleagues' (2012) "shared targets." Indeed, though we cannot show direct causality, several of these themes associate with changes in teaching behavior in the literature, represented in the returns phase in Figure 2 by dotted lines pointing from interviewee expressive and instrumental themes to our quantitative outcome of interest, the use of evidence-based instructional methods. A number of specific instrumental *insights and understandings* and *repertoires* that faculty reported picking up through their teaching-focused networks, for instance, included evidence-based methods for teaching noncognitive skills, such as asking students to create goals for group work (e.g., Riebe et al., 2010) or encouraging students to provide peers with written feedback (e.g., Troia, 2014). *Common cause*, an expressive theme, also mirrors the concept of "collective efficacy" that has been shown to indirectly link to teaching skill (Goddard et al., 2007).

Implications for Faculty Teaching-Focused Development

The implications of this study, particularly with regard to training initiatives meant to encourage faculty to build and utilize teaching-focused networks, are significant.

First, this study confirms previous research showing the value of interventions based on one-on-one peer observation (Fletcher, 2018) and mentorship programs (Lari & Barton, 2017; Ma et al., 2018) in which departments pair colleagues for reflective discussions on one another's teaching practices. Interviewee descriptions similarly confirm the myriad benefits, well-established in the literature, of various iterations of "communities of practice" and "learning communities" (e.g., Gehrke & Kezar, 2017; Ma et al., 2019; Vescio et al., 2008) in which faculty members meet in groups or cohorts to talk through teaching concepts, methods, or strategies. Indeed, as such programs continue to help college faculty establish teaching-focused personal networks, this study offers a distinct analytical and theoretical perspective on how feedback, exchange, and collaboration with like-minded others in these kinds of established programs can be a boon to professional practice (e.g., Hilliard, 2012; Robin & Margalef, 2013).

Second, this study offers a foundation from which other, more social capital-focused faculty development programs can be built. Our documentation of the constituent parts of this process can be an important learning resource for teaching-focused trainers and trainees, helping faculty more effectively identify, practice, and enact the network-building practices and interactions interviewees describe in this study (Grossman et al., 2009; Osborne et al., 2019). By "decomposing" the elements of practice, this and other work on faculty teaching-focused networks can be used to foster greater "network intentionality" in faculty, defined as an increased awareness which impels one to purposefully seek out, build, and maintain beneficial compilations of teaching-focused contacts (Moolenaar et al., 2014). Recent

research by Van Waes and colleagues (2018), working from this premise, offers an informative example. Here, researchers gave faculty beginning a months-long instructional development program a short training session on teaching-focused network concepts, including what kinds of network contours (i.e., size, diversity, strength) research had tied to greater professional innovations and benefits. For the remainder of the program, faculty were encouraged to grow their networks through various network-focused discussions and exercises intermingled within the instructional curriculum. Post-tests of comparison groups suggested faculty undergoing the network component had an increased awareness of their own teaching relationships as well as larger, more diverse, and stronger teaching-focused networks from which to draw ideas and support (Van Waes et al., 2018). Whether trainers point trainees' attention to building network capacity, as they did here, or whether they choose to underline ways one can utilize the information or support they gain from contacts, this and similar social capital- and network-based models offer an additional path forward for those interested in effecting instructional change through social learning. The models also provide empirical guidance for the growing movement to increase social capital access among minoritized students and early career professionals (e.g., Basta, 2020; Charania & Freeland Fisher, 2020).

Lastly, a wide body of literature from the field suggests that faculty teaching development initiatives are most effective when they align with a college or university's existing systems, values, and sociocultural norms (Henderson et al., 2011). Building from this finding, other studies have used whole network analysis to demonstrate the utility of social network analysis for mapping the social typography of organizations in which new development programs will be founded. Studies show, for instance, that identifying well-connected or respected educators within departments or other units can help trainers spread instructional information more widely and efficiently (Quardokus & Henderson, 2015; Williams et al., 2013). Though we have expanded our focus across formal boundaries rather than document inter-connected faculty networks, our study can still provide a blueprint for more in-depth analyses—using the mixed-method, personal network perspective—that seek to better understand local systems, both by cataloging the numerical contours of faculty relationships and talking to faculty about their experiences, motivations, and viewpoints within these relationships.

We believe that a broader and more robust focus will be especially fruitful in future work looking to improve instruction of the communication, teamwork, and self-directed learning skills that we discuss in this paper. A growing body of literature points to the profoundly social and cultural nature of these and other noncognitive skills (e.g., Benbow & Hora, 2018; Hora et al., 2018). To build the intellectual groundwork for effective, equitable, teaching-focused faculty development interventions focused on these skills, we will need social network research centered not only on better teaching and learning. It must also seek to elucidate the ways social networks can produce, shape, reify, and disperse cultural meaning (McLean, 2017), particularly in ways that benefit those with power (Bourdieu, 1986).

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