Social Networks and the Teaching and Training of Important Skills: A Pilot Study of Educators and Employers in Southern Wisconsin and Western New York

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Introduction and Background

Research has consistently shown that social ties shape an individual's access to valuable information, knowledge, and advice in schools (e.g., Borgatti & Foster, 2003) and the workplace (e.g., Carpenter et al. 2012; Cross & Parker, 2004), relational resources often theorized as "social capital" (Bourdieu, 1986; Lin, 1999). In recent years, scholars using social network analysis (SNA)—a research perspective and set of techniques studying relationships or social ties to better understand how interactions influence behavior (Wasserman & Faust, 1994)—have helped advance this line of inquiry in significant ways.

SNA is based on three key assumptions: first, that actors and the actions they take are interdependent; second, that social ties between individuals, compilations of which are referred to as "social networks," are a conduit for material and nonmaterial resources; and, third, that the social networks in which actors are nested confer constraints and affordances on their actions (Wasserman & Faust, 1994: 4). SNA analyses typically rely on precise data gathered from respondents on the characteristics of their social ties—including who respondents speak to about certain things, how often they speak with or how close they feel to these contacts, and the contacts' professional or demographic attributes (Halgin & Borgatti, 2011).

In educational field settings, SNA research has linked advice-seeking through social networks to improved teaching practices (Borko 2004; Lieberman 2000), the ability to cope with change (Spillane & Louis, 2002), professional development (Lieberman, 1995), and even student learning gains (Goddard et al. 2007; Yasumoto et al. 2001). In industry field settings, advice-seeking through social networks has been linked to higher levels of individual (Burt, 2004) and organizational innovation (Miles et al., 2005; Nelson, 1993), the increased transfer of training (e.g., Van den Bossche & Segers, 2013), as well as knowledge creation and increased

individual professional prospects (Aviv et al., 2003; Ibarra, 1995; Singh, 2005; Staber, 2004). SNA has also established that particular patterns within individual personal social networks based on network size (e.g., Burt, 1992; Smither et al., 2005), inter-organizational contact (e.g., Mehra et al., 2001), and strength of ties (Baer, 2010; Granovetter, 1973, 1983) confer constraints and affordances on a person's social access to material and nonmaterial resources.

Interestingly, though inter-organizational social network research has been an area of interest in SNA scholarly circles for years (Aviv et al., 2003; Lahtinen, 2013; Powell et al., 1996; Staber, 2004), there have been few if any SNA studies studying the social ties of postsecondary educators and employers in regards to teaching and training important skills such as communication, problem solving, self directed learning, and teamwork. Such comparisons, we believe, are of growing significance not only in light of recent discussions surrounding the importance of instruction in particular "21st century" skills for school, work, and life (e.g., Pellegrino & Hilton, 2012), but also in terms of the "alignment" between educational and employer interests in helping students and employees acquire these skills (e.g., Cleary et al., 2017). Considering the importance of instruction-focused social ties to the professional practice of educators and trainers, this raises a few important questions that, to our knowledge, have not been explored in the literature to date. First, do postsecondary educators and training professionals discuss techniques or strategies for helping students or employees acquire important 21st century skills and, if so, with whom? Second, how, if at all, do educators and employers believe these kinds of teaching- and training-related discussions influence their teaching and training of important skills?

It is with these questions in mind that this study gathers "ego" network data (Halgin &

Borgatti, 2011) from postsecondary instructors and employers with training responsibilities to better understand whether educators and employers discuss how to teach and train important skills, if so, how they perceive such networks influence the teaching and training of four important, "21st century" skills: communication, teamwork, problem solving, and self-directed learning.

Theoretical Framework

Our formulization and analysis of these questions is based on the concept of social capital, defined as valuable, actionable resources accessed through social ties (Bourdieu, 1986; Coleman, 1988; Lin, 1999). These resources, which SNA scholars envision are embedded in certain social networks, come in many different forms, whether through a friendly tip on a job opening, the trust of a supervisor during contract negotiations, or, importantly for our purposes, another trainer or educator's insight on the effectiveness of a particular instructional or training method to teach an important skill (e.g., Frank et al., 2004). While social capital allows individuals to develop skills and practices that can be socially or professionally advantageous (Coleman, 1988), it is also unequally distributed from individual to individual and by no means "a natural…or even a social given" (Bourdieu, 1986: 286). Instead, ties that facilitate the flow of beneficial information, knowledge, and advice—which we focus on in this paper specifically in regards to teaching and training—are differentially accessed and mobilized depending both on an individual's social position and broader, structural norms (Lin, 1999: 41-42).

The operationalization of this concept, of course, depends on established theories regarding what specific social network characteristics give individuals access to beneficial advice, information, knowledge, or support from contacts. As a first step in exploring and comparing educator and employer teaching- and training-focused networks, then, we measure

three important network characteristics associated with social capital accrual in the literature. The first of these social network measures, *network size*, or the number of contacts in an individual's social network, is well correlated with the opportunity and desire to improve instruction through innovative practice (Roxa & Martensson, 2009; Van Wies et al., 2015). Research also shows that *network diversity*, our second network indicator represented here by whether individuals discuss teaching and training practices with others across organizational boundaries, offers access to a wider variety of information and resources (Burt, 2004; Mehra et al., 2001; Reagans & McEvily, 2003). Finally, studies show that higher network *tie strength*, representing a scaled measure of how often an individual speaks with members of his or her social network, relates to the more efficient exchange of complex, nonroutine information (Coburn & Russell, 2008; Reagans & McEvily, 2003). Conversely, it has also been shown that stronger ties represent greater network overlaps between respondents and their contacts, which in turn limit one's access to new, nonredundant information (Granovetter, 1973).

Methods and Data Sources

We rely on a mixed-methods case study approach (Creswell, 2014; Yin, 2013)—distinguished by the investigation of a specific bounded issue or concrete problem using multiple data sources—to answer our research questions. Based on data collected as part of a pilot study on workforce-oriented postsecondary instruction and training in southern Wisconsin and western New York, our analysis focuses on social network-oriented questions and open text responses on online surveys collected from educators (n=192) and employers (n=70) in linked technology and engineering fields.

Sampling

Using Bureau of Labor Statistics (BLS; 2016) data on employment and national occupational projections, the U. S. Department of Labor's Employment and Training Administration or "O*Net" system (Occupational Information Network [O*Net], 2016), as well as state-level workforce information, we sought specific STEM-credentialed associate's-level ("2-year") and baccalaureate-level ("4-year") occupations in information technology and manufacturing to link companies and college programs in southern Wisconsin and western New York. We began this task by finding the most populous college-credentialed STEM occupations in southern Wisconsin and western New York using employment analyses of BLS-specified "metropolitan statistical areas" (MSAs), which show the number of particular jobs in specific MSAs, and O*Net profiles of particular jobs, which describe what knowledge, skills, and training people need to perform these jobs. In 2016, for instance, BLS data shows that 4,830 "computer systems analysts" were employed in the Milwaukee-Waukesha-West Allis MSA (BLS, 2016), an occupation that O*Net describes as needing a 2-year or 4-year college degree as well as advanced technical and mathematics skills (O*Net, 2016).

With several of the most populous information technology and manufacturing STEM-credentialed occupations in hand for each region, we next used O*Net, which lists education and training programs in each region for specific occupations, and BLS employment projections, which show how specific occupations are clustered in specific kinds of businesses, to identify (1) target 2- and 4-year credentialed STEM programs for each occupation and (2) North American Industry Classification System (NAICS) code categories representing companies in these industries that employ clusters of people in these populous information technology and manufacturing STEM occupations. With lists of 2-year and 4-year degree programs in southern Wisconsin and western New York, we gathered college instructor email contact information

from publicly available websites linked to these educational programs. For employers, we used state-level workforce websites in Wisconsin (Wisconsin Department of Workforce Development, 2016) and New York (New York State Department of Labor, 2016) to obtain lists and contact information for companies fitting these particular NAICS codes in which these occupations are most highly clustered, specifically focusing on human resources and instructional professionals at each company who trained employees in the focal STEM occupations (Table 1).

Table 1. *Southern Wisconsin and western New York education and industry sampling*

STEM Macro Industry	2- and 4-year credentialed occupations	Selected NAICS Designations	Possible 2- and 4-year College Program Sites	Possible Company Sites
Information Technology	Computer user support specialists / Software developers, applications / Computer programmers / Computer systems analysts	Computer systems design and related services / Software publishers	University of Wisconsin-Madison / Rochester Institute of Technology / Madison College / University of Rochester	Johnson Controls / Raven Software / Fiserve, Inc. / Epic / Zebra Technologies / Strategem Inc. / Paragan Development Systems
Manufacturing	Industrial machinery mechanics / Computer-controlled machine tool operators / Electrical engineers / Mechanical engineers	Machinery manufacturing / Computer and electronic product manufacturing / Transportation equipment manufacturing	Milwaukee Area Technical College / University of Wisconsin-La Crosse / Western Technical College / Syracuse University / Erie Community College	Absolute Precision / Sydor Optics / Riverside Automation / Commodore Technology / Marathon Electric / Professional Power Products

With lists of individual educators and employers thus identified, researchers emailed letters with online surveys in November 2016 to 763 educators and 663 workplace trainers and human resources representatives across southern Wisconsin and western New York. A total of 192 educators completed the survey for a response rate of 25.16%, while a total of 70 employers completed the survey for a response rate of 10.56%. The overall response rate across both groups was 18.38%. Descriptive statistics for both groups are displayed in Table 2.

Survey Instrument and Analysis

Online surveys included a number of questions collecting data for the wider study as well one section gathering simple social network indicators for the size and diversity of respondents'

teaching- and training-focused social networks. These items followed established SNA "ego" or "personal" network techniques (Burt, 1985; Halgin & Borgatti, 2012) that allow respondents to

Table 2. *Descriptive statistics for survey sample*

Variable	Educator			Employer		
	N	Mean	SD	N	Mean	SD
Gender						
Female	29	0.16		16	0.23	
Male	147	0.83	0.42	55	0.77	0.42
Transgender	2	0.01		0	0	
Race						
White	142	0.80	0.40	64	92.75	0.26
Non-white	36	0.20		5	7.25	
Discipline						
Manufacturing	67	0.63	0.48	33	0.47	0.50
IT	116	0.37		37	0.53	
Institution or type						
Two-year	32	0.17	0.83			
Four-year	151	0.83				

characterize their own social stimuli—formal or informal, within or outside their organizations—as they believe they are influential. We chose this approach because our goal is to better understand how patterns in individual respondent instruction-focused social networks associate with teaching and training techniques (Wasserman & Faust, 1994).

To capture respondents' personal networks related to cultivating important skills without overburdening surveys, we began with two name generator questions adapted from Burt's "important discussions" General Social Survey prompt (Burt, 1985). These prompts limited respondents to 6 contacts, which researchers have shown is the optimal maximum for focused, personal network prompts (e.g., Marsden, 1990). Respondents first answered, with a yes or no,

this question: “From time to time, employers/educators discuss with others what methods or techniques they can use to better train/teach their employees/students on important skills. Looking back over the last year, is there anyone with whom you have discussed this matter?” Those answering “no” skipped to the next survey section, while those answering “yes” were directed to this name generator: “Please type in the first names or initials of up to six people with whom you have discussed methods or techniques you can use to better train/teach your employees/students on important skills over the last year. If you have talked to more than six people about this matter, please choose the six people you have talked to most frequently.” The number of contacts instructors listed here acted as our measure for network size (Freeman et al., 1979). The next item asked respondents to indicate the organizational affiliation of each listed discussion contact, an important characteristic of diversity in instruction-focused networks (e.g., Baker-Doyle & Yoon, 2011), with respondent’s own institutions or companies as well as various educational, business, and governmental organization categories based on the North American Industry Classification System (NAICS; U. S. Census Bureau, 2016) listed as options. Respondents next were asked how frequently they spoke to each listed teaching- or training-focused discussion contact over the last year, a common SNA measure of the strength of ties (0=less than once a month, 1=at least once a month, 2=at least once a week, 3=almost every day) (Burt, 1985).

Table 3, which we present below, displays descriptive statistics comparing various social network indicators across educator and employer survey groups. The first social network measure, “Yes to contacts,” is a dummy variable indicating whether or not respondents reported discussing methods or techniques for training or teaching important skills. The next two rows on the table show the number of contacts listed across all respondents, and then just among those

who had reported the existence of a training- or teaching-focused social network. We created descriptive percentages of diversity measures in three ways. Taking all contacts listed by employers and all contacts listed by educators, we reported 1) the percentage of all contacts listed as being outside respondents' *organizations*, 2) the percentage of all contacts listed as being outside respondents' *fields* (i.e., employer contacts listed as affiliated with educational, governmental, or not-for-profit organizations), and 3) the percentage of employer discussion contacts listed as being educators and the percentage of educator discussion contacts listed as being employers. The final frequency measure reports how often respondents reported speaking to each teaching- or training-focused discussion contact over the last year. Because our sample size for employers did not support a multiple regression analysis allowing us to compare employer associations with educator associations, we employed a Welch's t-test and a binomial proportion test to compare variable means between employers and educators, IT and manufacturing employers, and IT and manufacturing educators.

The last question of the social network section on our survey asked respondents for an open-ended text response to this question: "How, if at all, do you think your relationships with these people have influenced your methods or techniques for training/teaching your employees/students communication, self directed learning, problem solving, or teamwork skills?" The lead author collected responses to these questions, separated them into educator and employer groups, and developed a few basic themes based on their content using coding at the manifest level (Charmaz, 2014) as well as the constant comparative method (Glaser & Strauss, 1967). Second cycle analytic methods based on repetition among educator or employer respondents, the co-occurrence of codes, and the association of emergent categories to our research questions and social capital framework followed (Ryan & Bernard, 2003), allowing us

to distill the textual data into a few prominent themes interviewees reported. Findings on this open ended item are presented below.

Findings

Educator and Employer Networks

As reported in Table 3 below, just over 46% of employer respondents reported having contacts with whom they spoke about techniques or methods for training important skills in the last year. The average network size for all employers was 1.58 contacts, while the average network size for those reporting training-focused contacts was 3.52.

Sixty-five percent of contacts listed by employers were affiliated with organizations outside respondents' own company, which represents a significant difference (at the .001 level) from the percentage of teaching-focused contacts educators listed as affiliated with outside organizations. Of employer training-focused contacts, 55% were contacts in other private companies and 15% percent were contacts affiliated with educational organizations. The average frequency of training-focused discussions reported among employers was 0.9, or just under 'at least once a month.' Almost 90% of educator respondents reported having contacts with whom they spoke about techniques or methods for teaching important skills in the last year, which represents a significant difference (at the .001 level) from the percentage of employers who reported having training-focused discussions. The average network size for all educators was 3.74 contacts, also a significance difference (at the .001 level) from employers, while the average network size for those educators reporting discussion contacts was 4.15. About 26% of contacts listed by educators were affiliated with organizations outside respondents' own educational organizations, significantly less than extra-organizational contacts reported by employers; of these, 27% were contacts affiliated with other educational organizations. In total, about 35% of

Table 3. *Descriptive statistics of social network responses*

Variable	All employers	All educators	Manufacturing employers	IT employers	Manufacturing educators	IT educators
Existence of social network						
Yes to contacts	0.46	0.90***	0.33	0.57*	0.84	0.93*
Network size						
Contacts (all)	1.58	3.74***	1.42	1.72	3.71	3.75
Contacts (yes)	3.52	4.15	4.28	3.10	4.42	4.02
Diversity						
% of contacts outside organizations[1]	0.65***	0.26	0.45	0.75	0.26	0.26
% of contacts outside organizations field[2]	0.55	0.38	0.40	0.60	0.53	0.30
% of contacts with educator/employer	0.15	0.27	0.20	0.13	0.47*	0.17
Tie strength						
Frequency of communication with contacts about teaching[3]	0.90	0.89	1.14	0.78	0.81	0.93
N	70	192	33	37	69	123

* p<0.05, ** p<0.01, *** p<0.001

[1] This row lists the percentage of employer or educator contacts that were reported as being affiliated with organizations *outside* respondents' organizations.
[2] This row lists the percentage of contacts that were reported by (1) employers as being affiliated with organizations that are not for profit companies or governmental or educational organizations, and (2) educators as being affiliated with organizations that are not educational in nature.
[3] "Frequency of communication with contacts about teaching" ranges from 0 (less than once a month) to 3 (almost every day).

listed educator contacts were affiliated with private companies. The average frequency of teaching-focused discussions reported among educators was 0.89, very similar to employers' discussions at just under "at least once a month."

Similar descriptive statistics are displayed in Table 3 for manufacturing- and IT-oriented employers and educators. Here, 57% of IT employers reported training-focused discussion contacts, a significant difference (at the .05 level) from manufacturing employers, while 93% percent of IT educators reported teaching-focused discussion contacts, a significant difference (at the .05 level) from manufacturing educators, 84% of whom reported discussion contacts.

Perceptions of Network Influence on Teaching and Training

Educator and employer survey respondents who reported having teaching- or training-oriented discussions were asked a final open-ended text response question regarding how, if at all, their reported relationships influenced their instruction. One hundred and twenty seven educators answered the question (about 73% of educator respondents reporting teaching-focused social networks) and 21 employers answered the question (about 66% of employer respondents reporting training-focused social networks).

Of the educators, five of those who answered this question reported that their relationships with their contacts *did not* influence their teaching at all. All other educators reported various ways their relationships helped them improve their craft. Typically, these respondents reported that their contacts provided them with an important outlet or "sounding board" to discuss challenges and opportunities regarding teaching valuable skills, which in turn allowed them to:

(1) learn new and more effective teaching methods (regarding course design, syllabi, assessment, class assignments and activities, content presentation, etc.),

(2) hear multiple perspectives on different issues, methods, or techniques,

(3) practice reflecting on and articulating their own teaching philosophy and reasoning,

(4) provide *and* receive feedback, and

(5) receive social support and inspiration through shared experiences and interests

Some educators reported that sharing teaching perspectives and experiences seemed to both improve their instructional technique and give them some perspective on similarities across classrooms. "Sharing classroom experiences helps confirm or deny things you might notice in your classroom," one college instructor wrote. "If others observe their students exhibiting similar behaviors, you begin to understand that what you're seeing is not unique." A few educators also mentioned that such conversations provided the motivation to continually improve their teaching. One instructor wrote of conversations with her contact in this way: "We both profit immensely from brainstorming together and sharing best practices as we continue to grow as educators."

While employer data offer less breadth than educator data, a general theme among the 21 employer responses was that training contacts provided respondents with new ways of viewing the training of important skills, filling gaps in the way respondents were thinking about training in their own companies. "[My contacts] provided additional perspectives that I was not aware of," one employer wrote, "and allowed me to develop the strongest course possible." These kinds of opportunities, other employer respondents suggested, made it easier to develop training experiences better crafted to specific professional or industry groups, including technology-focused employees or younger employees. With regards to the former, one IT employer pointed out the importance of tapping diverse viewpoints to keep up with developments in his/her field. "[My social network] allowed me to understand the challenges and some solutions of other IT professionals who also face a dynamic industry," he told us.

Implications and Conclusions

This preliminary analysis supports prior research showing that both college educators (e.g., Van Waes et al., 2015) and employers (e.g., Van den Bossche & Segers, 2013) talk to others about their teaching and training. Such discussions, research shows, help educators and workplace trainers gain social capital that can improve professional practice. While we cannot generalize our results beyond our sample to the wider population of postsecondary educators or employer trainers, findings here suggest that more educators engage in such discussions with more contacts than employers, though employers who do engage in such discussions speak with a more diverse array of people, organizationally speaking, than educators. Educators and employers in IT-connected programs and businesses in our sample reported more teaching- and training-discussion contacts than manufacturing-connected educators and employers, perhaps pointing to a more network-oriented field in technology than in manufacturing. Still, manufacturing educators, more than any other group of respondents in our survey, reported a higher proportion of connections to employers, suggesting that educators linked to manufacturing may benefit most from diverse, inter-organizational expertise. Furthermore, results show that educator and employer respondents in the sample speak to teaching- and training-contacts with about the same frequency, indicating a generally similar "tie strength" among discussion networks.

With these basic indicators of educator and employer social networks in mind, we also performed an analysis of respondent perceptions regarding how, if at all, such discussions influenced the teaching or training of valuable skills. Though a slightly higher percentage of educators than employers (73% versus 66%) described teaching- and training-focused social networks as a positive influence on their instruction, this difference was not significant; findings

therefore indicate the similar perception among most educator and employer respondents engaging in such discussions that they are beneficial to the teaching and training of communication, teamwork, problem solving, and self-directed learning. Respondent descriptions of how these social networks are beneficial also track somewhat with previous studies on the links between instruction and college teaching- and workforce training-focused discussions (Pataraia et al., 2015; Van den Bossche & Segers, 2013; Van Waes et al., 2016). Educators described such conversations providing them with valuable information, feedback, motivation, and social support, and both educators and employers described discussions that allowed them to benefit from others' experiences as well as provide contacts tips based on their own.

In light of these findings, administrators, executives, and other leaders hoping to encourage the development of social capital among postsecondary educators and workforce trainers—which in turn could lead to higher levels of communication, teamwork, problem solving, and self-directed learning skills in students and employees—may find more success in openly promoting the importance of teaching- and training-focused social ties as well as providing more opportunities for intra- and inter-organizational professional development which helps build stronger and more diverse instructional networks. While almost 78% of respondents in this study reported having teaching- or training-focused discussions of some kind over the last year, results indicate that there is room for further social network development among both educators and employers.

Limitations and Scholarly Significance

These findings should be interpreted with a few limitations in mind. First, our results were obtained from a two broad geographical areas and from STEM instructors and employers representing two broad industry-related groups, thereby limiting the generalizability of our

findings. Second, we had to limit social network data collection on surveys to reduce respondent burden, which prohibited us from using more advanced diversity, strength, and structural personal network measures in our analysis. Third, due to the sample size, especially on the employer side, we could not apply comparative regression analyses or adjust for a number of variables that could generate more powerful and sophisticated insights into how valuable social ties—and therefore social capital—associate with teaching- and training-practices among postsecondary instructors and training representatives in linked STEM fields. Considering that college educators and employer trainers and their personal social networks are nested within and across fields, units, departments, and institutions (Porter & Umbach, 2001), the application of hierarchical linear modeling to a much larger sample might also provide us with a better estimation of within- and between-group variations in future analyses. Future research can build on this study by expanding samples and data collection techniques to include more in-depth and robust social tie measures as well as variables that would allow scholars to test the association between patterns in teaching- and training-focused networks and particular aspects of professional practice, including, most importantly, instruction.

Still, as research from educational and employment contexts continues to show the connection between social networks and improved instruction and training, this study makes a unique contribution by drawing on empirical data to explore and compare educator and employer teaching- and training-focused ties in regards to important 21st century skills. Such analyses, we hope, will help scholars better understand the association between social capital, on the one hand, and student and employee engagement and achievement, on the other.

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