

Session Title:

Monitoring Transformations in District-Wide Teacher Learning Networks through Social Network Analysis

MSP Project Name:

EnLiST – Entrepreneurial Leadership in STEM Teaching and learning

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Project Session**Strand 3****Summary:**

Internal factors in a school district greatly impact change and innovation, and social network analysis can be used to assess the effectiveness of efforts to mobilize resources and exchange ideas which foster reform. During a multi-year, large-scale National Science Foundation Math Science Partnership to enhance content knowledge in science teaching and develop entrepreneurial habits, researchers analyzed a partner school district's teaching networks in 2011 and 2012. Analysis indicated that at a time of teacher turnover and administration changes, many networks declined, especially those that exchanged learning about classroom management. Yet at the same time, networks around science teaching and learning grew, possibly as a result of the district's engagement with the EnLiST project and its focus on transformative collaboration.

Section 1: Questions framing the session:

Are EnLiST Teacher-Leaders more connected to the learning network of the district than non-EnLiST Teachers. Over time, would we observe a shift in the learning networks as a result of the EnLiST goal to create collaborative innovations. What are the characteristics of a typical rural K-12 school district's learning network? How does the district's K-12 science teaching and learning network compare to that of its overall network? What factors contribute to changes in a K-12 school district's network over time?

Section 2: Conceptual framework:

Social network research shows not only how resources are embedded, but how they are allocated and transferred from person to person across a network (Authors, 2010; Lin, 2001). The circulation and uptake of information, including learning, depends on the

social ties between people. Therefore, social network analysis can play an important role in understanding how information is exchanged, and who exchanges the information, in the context of learning.

A social network consists of connections among actors or egos that have social ties among each other. These ties create patterns, and regularities in these patterns generate structures (Wasserman & Faust, 1994). These relationships and structures are sometimes represented graphically with nodes representing actors, and lines representing ties, which create an overall network pattern. Teachers may have ties with other teachers based on a common interest in science, administrative meetings, and placement in a school system.

Ties between actors can be categorized as “strong” or “weak.” Strong ties are developed between actors such as friends, co-workers, and family, and those who know each other well and are more like each other in the local network (Marsden & Campbell, 1984). These ties are most likely to persuade an actor to adopt an innovation (Rogers, 1995), and provide social support. Weak ties are formed with those less known, and facilitate the transport of innovations and novel information. Social network literature holds that awareness to innovations (Rogers, 1995), access to novel information, and readiness to recognize new practices (Cohen & Levinthal, 1990), relies on a diverse communication structure, which includes weak ties.

Tracking and these ties can be useful for understanding the state of teaching and learning networks in a classroom, school, and/or school district, and the effectiveness of programmes to increase collaboration, foster the exchange of innovations and novel information, or adopt new practices. In this context, social network metrics such as density and centrality allow for the quantification, and therefore the evaluation, of the health of district-wide teaching and learning networks. When networks are assessed on an annual basis over several years, this data can quantify growth, contraction, and movement in teaching and learning interactions in an entire district. On a smaller scale, when individual connections are further quantified using Likert scales to determine the strength of the tie, additional insight is gained into the quality of interactions in teaching and learning networks.

It is possible to monitor the number and quality of teaching and learning interactions for an individual teacher who has undergone leadership training as part of a professional development programme. This would afford insight into how such training could affect the number and strength of connections the teacher has within the district.

Section 3: Explanatory framework:

An EnLiST partner school district in a Midwestern State in the US, consisting of an elementary, one junior, and one high school, participated in the study. Researchers invited 68 instructional and administrative staff members to complete an online survey for the study in April 2011, of which 54 (79%) responded. Approximately one year later, in May 2012, 72 instructional and administrative staff members were invited to complete the same survey and 43 (59%) responded. Respondents represented all school levels and almost all content areas (science, social studies, special education, art, physical education, and more).

In the survey, respondents provided biographical data and information about their education and role(s) in their building and/or district. The survey listed the full names of all instructional and administrative staff in the school district, and requested that

respondents consider interactions with those staff members over the last year. For each staff member, respondents indicated whether they had learned anything from that person about (a) classroom management, (b) science teaching and learning, (c) teaching and learning in other content areas (not science), and (d) mentoring or career advice.

Respondents specified the strength and frequency of those connections by indicating their overall level of interaction with other teachers on a five-point scale, from “few interactions of limited scope” to “frequent interaction of substantial scope.” Finally, respondents had the opportunity to add names of other people inside and outside the school district who were important to their learning. These names included teachers or administrators who did not appear on the provided list, potentially friends or family, other people they studied with, or those in other professions.

From 2011 to 2012, a number of changes occurred in the district. Firstly, both science and non-science teachers in the school district engaged in a comprehensive reform of the science curriculum, an endeavor which relied on establishing ties and leveraging resources, in a professional development project. This reform resulted in the creation of several innovative science courses. Secondly, 5 teachers received professional development from EnLiST in June 2011. This professional development opportunity encouraged increased collaboration across schools to marshal additional resources through expanded collaborations.

Finally, the district experienced a shift in its administration and its teaching staff. In 2011, the district selected a new superintendent and saw the departure of a school principal. Additionally, the 2012 district roster saw the addition of 10 new teachers, while 18 teachers did not return on the 2012 roster.

Analyzing social network metrics allowed researchers to numerically compare the strengths and weaknesses of each network. Data analysis revealed that between 2011 and 2012 the district experienced changes which caused the total number of connections to decline and the distance between teachers to increase, and saw teachers relying more on others who had few connections themselves. In particular, ties based on classroom management declined. Gatekeepers who had building-spanning connections left the district, and replacement teachers and administrators had not yet managed to build as many ties as their predecessors.

The network around “other” subject matter had the highest graph density in 2011, followed by classroom management and career advice, while the least dense network was science teaching and learning. In 2012, the science teaching and learning network experienced the largest increase in density out of all other networks, which brought its density more in line with the other teaching networks and changed its status from least-dense to second-least dense.

The science teaching and learning network had the greatest average geodesic distance out of all the networks surveyed in both 2011 and 2012, meaning fewer teachers in science teaching and learning had direct access to information, and likely relied on second, and third-hand sources for information. However, from 2011 to 2012, the science teaching and learning network shortened its average distance more so than any other network, showing that the science teaching and learning network became stronger and more similar to other networks in the district.

The clustering coefficient indicates actors in the 2011 science teaching and learning network relied on information from actors who had comparatively few connections

themselves, which limited opportunities for direct access to novel information. In 2012, that clustering coefficient increased enough to place ahead of classroom management, although classroom management had a drop in its average clustering coefficient that year.

Section 4: Discussion:

It is likely that turnover of teaching staff, at least initially, played a role in the decline of learning networks. Despite this, the science teaching and learning network improved, which could be a byproduct of professional development in science curriculum reform that bridged buildings and stressed collaboration. Given this evidence, it is reasonable to conclude such initiatives with similar approaches likewise can build networks that foster transformative opportunities for students in K-12 science classrooms.

One complication with our study, however, concerns the relatively low response rate compared to other social network analyses. Social network literature indicates that a high response rate is required for accurate analyses (Wasserman & Faust, 1994), and holds that missing data can distort the network graphs and social network metrics (Rogers & Kincaid, 1981; Burt, 1987). The response rates for this study were 79% in 2011, and 59% in 2012. In comparison, other studies have used response rates between 71% and 98% (Brass, 1984; Cross & Sproull, 2004; Gibbons, 2004; Haythornthwaite & Wellman, 1998). The 2011 response rate, while not ideal, is close to what has been used in other social network research. However the 2012 response rate was 20 percent lower than the previous year, which opens the possibility that the full extent of teaching and learning networks was not realized in the data.

We present several scenarios to describe how the response rate in the second year could have impacted the analysis. One such scenario is that the reduced response rate in the second year excludes possible connections that would otherwise have been included with a high response rate. In other words, while actors may have been represented on the social network graphs and in the social network metrics, their connections would have been omitted in the data. This scenario would have distorted metrics such as density and the averages of metrics, such that they appeared lower than are actually present in the real network. Comparing this network to the previous year, with its higher response rate, would lead to the conclusion that the network had a dramatic reduction in teaching and learning exchanges between 2011 and 2012, when this may not have been the case.

Another scenario holds that nonrespondents had a lower number of connections to other teachers on average than did respondents. In such a scenario, the inclusion of these nonrespondents would lower the density and average metrics of the networks. In contrast to the previous scenario, this instance would lead to an analysis that would describe the 2012 networks as being healthier than they are in reality, and would understate the impact of turnover in the district from 2011-2012.

It is also important to note that in both years, respondents were able to identify the connections they had with others in the teaching and learning network without those other teachers needing to respond themselves. Respondents were asked whether they learned something from another teacher, not whether they had instead taught another teacher. The questionnaire yielded directional social network data: records of one actor imparting teaching or learning knowledge to another actor. However, to eliminate the “star” effect of a highly-connected individual failing to recall connections, our graphs and metrics were generated in a nondirectional context.

Social network literature describes the process of reconstruction, where respondents provide data that helps fill in missing parts of the network (Stork & Richards, 1992). This process does not create connections that did not exist, but rather assumes that one actor out of a pair could reliably assume a connection between the pair. Our choice to pursue nondirectional graphs and metrics meant our study had a built-in process similar to reconstruction, that allowed us to infer connections between two teachers without needing both parties to participate in the questionnaire. Whereas our response rates were 79% and 59%, the data gathered from our respondents allowed us to account for the network presence of 100% of the teachers in the district. Given total inclusion of all teachers in the network, it is only possible that a higher response rate would yield more connections, higher density and higher average social network metrics across all networks surveyed. This leads us to conclude that the low response rate may not be completely illustrative of the quality of the data.

Despite the limitations of response rates, findings from this research have assisted EnLiST in understanding how professional development centered on entrepreneurial teacher leader training translates into real teaching and learning networks in school districts. Our indication is that EnLiST is affecting positive changes in the school district, even at times when adjacent networks might be in decline due to faculty turnover. The initiative will continue to survey teachers, and collect and analyze data pertaining to teaching and learning networks.

Other MSPs might find our methods useful for assessing the strengths and weaknesses of their own partner districts. Our methods can easily be replicated at other partnerships, and can allow researchers to understand how their efforts may or may not be shaping networks of teachers at the classroom, school, district, and across-district levels.

This research was conducted in a core school district in a rural setting. EnLiST is seeking social network data from two additional core school district partners, including a small urban and an urban school district. This would allow EnLiST to describe social networks in a variety of K-12 environments.

Section 5: How will you structure this session? What is your plan for participant interaction?

Presenters will make full use of the available 20 minutes by briefing the audience on the changes in the district's networks between 2011 and 2012 that occurred. Presenters will reserve time to answer questions from the audience.