UNDERSTANDING TEACHER LEADERSHIP IN MIDDLE SCHOOL MATHEMATICS: A COLLABORATIVE RESEARCH EFFORT

J.E. PUSTEJOVSKY and J.P. SPILLANE
Dept. of Education and Social Policy, Northwestern University
Evanston, IL 60208
j-pustejovsky@northwestern.edu

R.M. HEATON
Dept. of Teaching, Learning, and Teacher Education, University of Nebraska-Lincoln
Lincoln, NE 68588-0355

W.J. LEWIS
Dept. of Mathematics, University of Nebraska-Lincoln
Lincoln, NE 68588-0355

Abstract

We report findings from a collaborative research effort designed to examine how teachers act as leaders in their schools. We find that teachers educated by the Math in the Middle Institute act as key sources of advice for colleagues within their schools while drawing support from a network consisting of other teachers in the program and university-level advisors. In addition to reporting on our findings, we reflect on our research process, noting some of the practical challenges involved, as well as some of the benefits of collaboration.

Introduction

A sizable amount of literature addresses aspects of teacher leadership in schools, including how to develop the leadership skills of classroom teachers [1]. Educating and supporting Teacher Leaders for middle school mathematics is the central goal of the Math in the Middle Institute Partnership, a project developed at the University of Nebraska-Lincoln (UNL) and funded by a Mathematics and Science Partnership grant from the National Science Foundation. The Math in the Middle (M^2) project offers a 25-month master's program for outstanding middle-level mathematics teachers, referred to here as M^2 associates, helping them to become intellectual leaders in their schools, districts, and beyond. As the co-principal investigators of Math in the Middle have described in another article in this issue, the M^2 Institute focuses not just on providing professional development, but also on seeking evidence-based findings about learning, teaching, and leadership development [2].

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As part of the M^2 research initiative, the M^2 principal investigators have enlisted help from the Distributed Leadership Study for Middle School Mathematics Education (DLS). This project, centered at Northwestern University and also funded by a National Science Foundation grant, uses the theoretical and diagnostic framework of Distributed Leadership to study school leadership [3]. The project has designed a web-based survey instrument, the School Staff Social Network Questionnaire (SSSNQ), to collect empirical data about leadership practice in elementary and middle schools. Operationalizing leadership as social influence relations, the SSSNQ uses a social network approach to measure leadership interactions.

The SSSNQ captures data that is relevant to two of the M^2 Institute's primary goals. One of the goals of the M^2 Institute is to build teachers' capacities to become intellectual leaders for mathematics instruction in their schools. The SSSNQ social network data from within a school enables us to understand the extent to which M^2 associates act as sources of advice about instruction for their colleagues. In addition, by bringing participants together for intensive summer workshops and academic year courses, the M^2 Institute seeks to build an enduring support network among associates, and between associates and university-level faculty. The SSSNQ data on the social network among M^2 program participants allows us to understand advice seeking behavior that is prevalent outside the school building.

The alignment between the research goals of the M^2 Institute and the survey instrument designed by the DLS created a natural opportunity for collaboration. Working closely together, we administered the survey to all M^2 associates and to the entire staff of ten middle schools where M^2 associates work. In this report, we describe our research process and share some initial findings regarding how M^2 associates act as leaders within their schools. We also reflect on our collaboration, in the hopes that discussing the advantages of collaboration and the practical challenges we encountered might be helpful to others engaged in similar research.

Our report contains the following: a description of the design of the survey instrument and the process of administering it; a discussion of our approach to analysis and our report of the initial results; our description of how we were able to share some findings with the participating schools; and, our concluding remarks.

Instrument (Re)Design

The distributed perspective is a theoretical or diagnostic framework for examining the practice of leading and managing. In contrast to more conventional leadership perspectives, which tend to emphasize the heroic efforts and personal qualities of individual leaders, the distributed perspective emphasizes the practice of leading and managing. It views leadership practice as taking form in the interactions among leaders and followers, as mediated by aspects of their context, such as organizational routines and tools. Informed by the distributed perspective, the SSSNQ instrument is a web-based survey designed to collect data on interactions among leaders and followers, as well as aspects of the school context. The instrument used in the work reported here is the fourth iteration of the SSSNQ [4].

The SSSNQ operationalizes aspects of the Distributed Leadership perspective by capturing data on interactions between leaders and followers, measured from the perspective of the follower [4, 5]. Interactions are measured using social network name generators, which ask survey respondents to recall interactions where they sought advice from others. For example, respondents who teach mathematics are asked, "In the past year, to whom have you gone for advice or information about teaching math?" For each name that a respondent lists, follow-up questions ask the respondent to describe the role or job description of the person named, and to characterize their interactions with the person in terms of frequency of interaction, influence of advice provided, and content matter of advice provided.

The SSSNQ actually poses several social network name generator questions to differentiate between subject areas because our previous research suggests that the structure of relationships among teachers and the nature of their thinking about their work differ by school subject [6, 7]. All staff members are asked to name people to whom they go for advice about Mathematics and advice about Reading/Writing/Language Arts (RWLA). Teachers whose specialty subject is something other than Mathematics or RWLA are also asked to name people to whom they go for advice about teaching their primary subject.

In the analysis that follows, we focus on the social network name generator part of the instrument. However, the survey also contains several other types of questions that address aspects of respondents' situations. Respondents are asked about their positions or roles, their formal leadership designations (if any), and their participation in school committees. They are also asked a series of questions about the cultural climate of their school. Based on feedback from teachers who have taken the survey, we have found that the SSSNQ provides an opportunity for reflection about the past school year that many teachers welcome. In all, the survey takes approximately twenty to thirty minutes to complete. A sample version of the instrument can be viewed on our website [8].

The collaboration between the M^2 Institute and the DLS afforded us a beneficial opportunity for redesigning the SSSNQ. The M^2 Institute staff from UNL had been working with mathematics teachers in the middle schools we planned to survey, and therefore had a practical understanding of local school cultures and concerns. Drawing on this understanding, we worked together to tailor the wording of survey questions for ease of interpretation in the local school context. Conducting a pilot survey study or cognitive interview study is certainly the best way to field test a survey for reliability and validity [9]. Short of this, using our collaborators' understanding of local school cultures helped us decrease the likelihood that respondents would misinterpret questions in the survey instrument.

Data Collection

Social network survey items present some unique challenges compared to standard survey items, including the need for very high response rates, the need to define a network boundary, and the need to protect participants' confidentiality when using a research design that necessarily lacks anonymity [10, 11]. High response rates are imperative because many network measures, though defined at the level of the individual, are calculated based on peer reports that aggregate responses from many individuals. The reliability of a network measure suffers when response rates are low or even moderate by the usual standards of survey research [12]. In light of these requirements, our strategy for data collection included finding ways to encourage very high levels of participation.

Data collection entailed working with two partially overlapping study populations, each of which has a natural network boundary. First, we surveyed all M^2 associates in order to understand the social network operating within the program. Here, the network boundary is defined by participation in the M^2 program. Second, we focused on several schools in a single district (the "Target District") where a number of M^2 associates worked. For this population, the network boundary is defined by the school building. Using the SSSNQ, we conducted a census of the entire teaching staff in each school, providing peer-report data from the perspective of followers that allows us to understand how M^2 associates are situated within their schools.

Since the program began in 2004, Math in the Middle has accepted four cohorts of M^2 associates, with a new cohort beginning the 25-month program every summer between 2004 and 2007. Each cohort consists of approximately thirty-four teachers from both urban and rural school districts. In addition to middle school teachers, some fifth grade teachers (elementary level) also participate in the program.

Surveying all M^2 associates was straightforward because Math in the Middle project staff knew them personally and had extensive contact with them. During Summer 2007, Heaton contacted all M^2 associates via e-mail, inviting them to complete the SSSNQ and providing a URL link to access the survey. Associates who did not respond to the initial invitation were sent an e-mail reminder, or asked to complete the survey in the computer lab during the first day of the M^2 Summer Institute. Due to the overlapping nature of the study populations, some associates in the Target District had already completed the survey. These respondents were not asked to participate in the survey again; instead, the respondent's original survey response was included in the sample. In all, we received responses from 91% of M^2 associates; Table 1 details the response rates by cohort. As of this writing, we plan to survey all M^2 associates again during Summer 2008.

Table 1

M^2 Associate Survey: Response Rate by Cohort

Cohort	*Number of M^2 associates*	*Response rate (%)*
I	30	77
II	31	94
III	35	91
IV	35	100
Total	131	91

Conducting the census surveys in ten middle schools was less straightforward, and involved both participation incentives and the need for additional data. In order to achieve the high response rates necessary in social network surveys, we offered a combination of incentives: individual participants were offered a gift card for completing the survey, and schools where over 90% of the teaching staff participated were rewarded with an honorarium. In order to identify the sampling frame of relevant individuals to survey and to calculate response rates, we needed an additional data source. We used rosters of all school employees from the state Department of Education, which are updated periodically throughout the school year.

Math in the Middle project staff drew on existing relationships with district staff, including the director of curriculum, who is a co-principal investigator of Math in the Middle, to gain permission and endorsement to conduct our research. They then met with the school principals to invite their schools to participate in the survey. All ten principals agreed to participate. In Spring 2007, they were sent an e-mail message to distribute to their staff that described the purpose of the survey, outlined the incentives offered, and provided a URL link to access the survey. Over the next three weeks, follow-up e-mails were sent to the principals at least once per week, notifying them of how many staff had completed the survey thus far and allowing principals to monitor their school's progress toward the 90% participation goal.

In all, we received responses from 85% of all teaching staff during Spring 2007; response rates from individual schools ranged from 69% to 95% (see Table 2). During this round of data collection, M^2 project staff's existing relationships and knowledge of local context again proved very useful. Their relationships with district and school personnel gave us all an understanding of the rhythm of the school year and the competing demands on teachers' time, without which we could not have attained such high response rates in the 2007 survey of Target District staff.

Table 2
Target District Survey: Response Rate by School

	2007		*2008*	
School	*Number of teaching staff*	*Response rate (%)*	*Number of teaching staff*	*Response rate (%)*
1	55	89	60	85
2	64	73	66	53
3	68	69	70	56
4	61	80	61	51
5	57	91	58	52
6	73	84	68	43
7	72	94	70	69
8	73	86	72	72
9	59	95	60	92
10	57	89	57	93
Total	639	85	642	66

In Spring 2008, we contacted school principals and invited their schools to participate in the survey a second time. All schools participated, but we maintained less frequent contact with principals, and had less of an understanding of what else was occurring in the schools while we were collecting data. Perhaps as a consequence, we received responses from only 66% of teaching staff during the 2008 school year; response rates from individual schools ranged from 43% to 93% (see Table 2).

Reflecting on our data collection process, we recognize the importance of maintaining the support of the school principals over several rounds of data collection. During the first year, project members met face-to-face with all principals, who expressed curiosity about what they could learn from the SSSNQ. We observed that the principals encouraged their staff to participate in the survey, anticipating that they would gain some useful insights from the data. As we prepared to collect data during the second year, we did not meet face-to-face with the principals again. This may have influenced our response rate. It is also possible that some principals may have been skeptical whether participating in another round of data collection would be worthwhile, because they expected very few changes from the first year. It is possible that if there was less interest in the results of the survey, principals may not have encouraged participation to the same degree.

Data Analysis

For purposes of understanding the leadership roles and support networks of M^2 associates, we focus on data from one social network name generator question in the SSSNQ. The question asks school staff to list people to whom they have gone for advice over the past year about teaching mathematics. We take a twofold approach to analysis of the math advice networks, first using network visualization tools to gain intuition about the network positions of M^2 associates, and then calculating network centrality measures to quantitatively describe their network positions.

Graphical visualization techniques play an important role in the field of social network analysis, and computer algorithms now allow for sophisticated graphical encoding of information in diagrams [13]. We visualize the math advice networks within each middle school and among all M^2 associates using a graphical layout known as a sociogram. In a sociogram, each individual is represented by a shape such as a circle (a node) and a link between two individuals is represented by an arrow (a tie). By representing the relationships of a given type between all members of an organization, a sociogram allows one to see larger patterns or structural features of the social network that would not be apparent by studying the relationships individually.

Typically, layout algorithms such as spring embedding are applied to sociograms so that the shapes representing individuals are placed in such a way as to make the network structure more apparent [13]. Groups of individuals that have many common ties tend to appear near each other, and individuals that are central to the network—meaning that they connect many other individuals or groups—tend to appear in the center of the diagram. However, network layout algorithms are highly dependent on initial conditions, and produce sociograms that are arbitrary in many respects. Therefore, sociograms should be used to gain intuition about network structures, but not as a rigorous analytical tool. We used the program *NetDraw* to create sociograms for analysis [14]. To lay out the sociograms, we applied a force-directed layout algorithm with node repulsion and equal edge-length bias.

Figure 1 is a sociogram depicting the math advice network within one middle school. It contains additional encoding to represent the teaching role of each individual in the network (i.e., sixth grade teacher, mathematics teacher, administrator, etc.). Individuals who neither sought nor gave advice about math are not pictured.

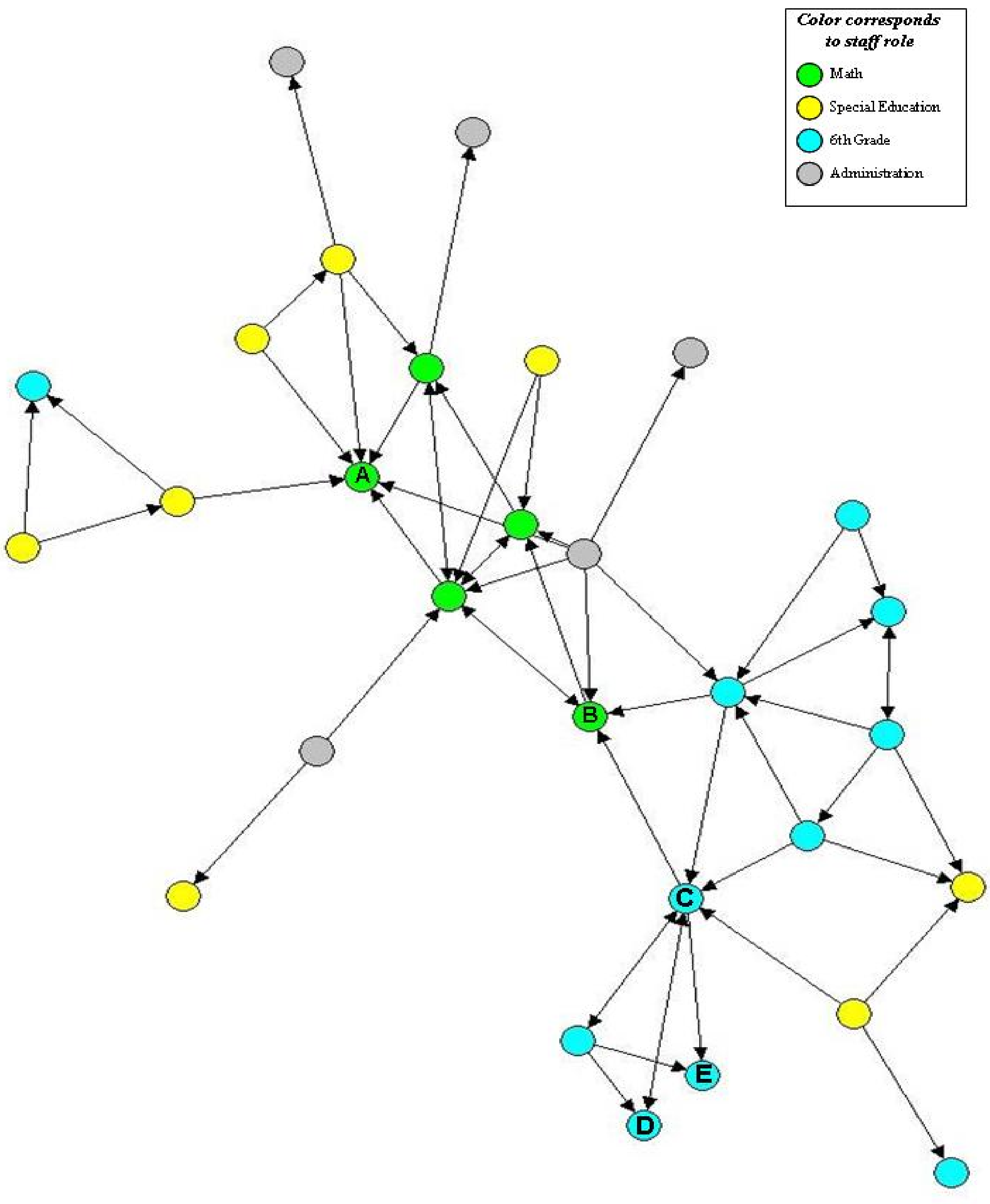

Figure 1. Sociogram of the math advice network within a school.

We have found sociograms to be a helpful tool for gaining insights about the associates with whom the M^2 Institute works. The sociograms provide rich detail about the network positions of the associates, which we interpret in combination with personal knowledge of the associates. For example, in Figure 1 nodes labeled A through E represent the five M^2 associates who work in a single school. Based on the sociogram, the M^2 associates appear to be connected to each other and sought after by their peers, indicating that they are a community among themselves and are seen as leaders within the school. However, some associates appear to have more influential positions than others. Nodes A and B, both from the second cohort, are both highly connected, but to different groups; node A provides advice to special education teachers, while node B provides advice to sixth grade teachers. Node C, from the third cohort, acts as a bridge, facilitating communication between the sixth grade team and the mathematics department. In contrast to these associates, nodes D and E are less connected to the rest of their school, seeking or providing advice mainly with other M^2 associates. Such detailed analysis of sociograms allows M^2 project staff to consider how to tailor the professional development of individual M^2 associates.

In addition to graphical analysis of sociograms, we compute several network centrality measures to quantify the network positions of M^2 associates in terms of their leadership roles. Among many network centrality measures that have been proposed, we focus on two simple measures: out-degree and in-degree [15].

Out-degree is a measure of the amount of support upon which an individual can draw. It is calculated by counting of the number of people *from* whom an individual *seeks* advice, based on an individual's self-report. We compute a more detailed measure of out-degree by differentiating between ties to individuals internal to the network boundary (e.g., other teachers in the same school) and ties to individuals external to the network boundary (e.g., ties to friends, relatives, university faculty, or teachers in other schools). In Figure 1, node C has four out-going arrows, meaning that she named four other teachers in her school as sources of advice about math; in social network terminology, node C therefore has an internal out-degree of four.

From the distributed perspective, in-degree is an operational measure of an individual's leadership position. In-degree measures the number of people *to* whom an individual *provides* advice. We compute in-degree based only on the reports of other teachers within the network boundary (e.g., within the same school). In Figure 1, node C has five incoming arrows, meaning that she was named by five other teachers as a source of advice about math; node C therefore has an in-degree of five.

In our analysis of schools in the Target District, we compare the M^2 associates to other teachers who fill similar roles. In the ten schools we study, sixth grade teachers are generalists, providing instruction in several subject areas to the same group of students; seventh and eighth grade teachers are subject-matter specialists, providing instruction in a single subject to several different groups of students. At the time of the survey, twenty-three mathematics and sixth grade teachers from the district middle schools had completed at least one summer of M^2 coursework. We study the role that these M^2 associates play by comparing the seventeen associates who are seventh or eighth grade mathematics teachers to the other mathematics teachers in their schools, and comparing the six associates who are sixth grade generalists to the other sixth grade teachers in their schools. Further, five of the M^2 associates in the Target District are in the most recent program cohort. At the time of the 2007 survey, these associates had been accepted into the program, but had not yet begun the M^2 training; we therefore treat them separately from associates in Cohorts I, II, and III.

Findings from the M^2 Associates Survey

One of the goals of the M^2 Institute is to foster a support network among the associates, and between associates and the university-level instructors involved in the program. We can understand whether this goal is being accomplished by examining the social network data from our survey of all associates.

In Figure 2, we present a sociogram representing the social network within the M^2 program. Associates are represented by circles colored according to their cohort in the program. M^2 Institute staff members, including university faculty and school district personnel, are represented by grey nodes. The nodes lining the upper edge of the figure represent associates and staff who neither sought advice from nor provided advice to other associates in the program; in social network analysis, these disconnected nodes are termed “isolates.”

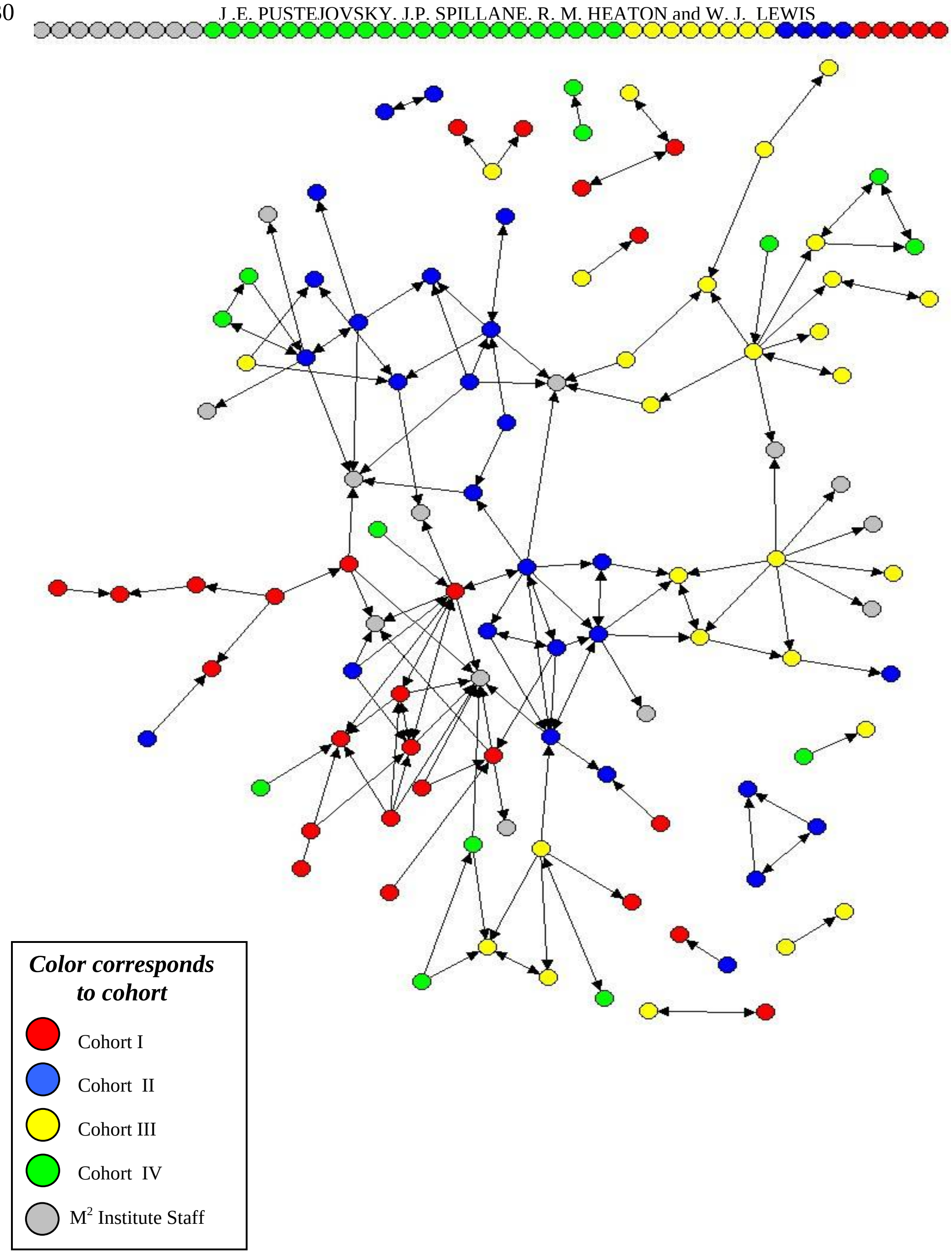

Figure 2. Math advice network among M^2 associates and M^2 institute staff.

Figure 2 suggests that many M^2 associates are participating in the support network of the M^2 Institute by seeking advice from other associates and from staff involved in the program. In

Figure 2, the nodes appear clustered by color, suggesting that associates tend to seek advice from other associates in the same program cohort. The individual who was most frequently listed as an advisor (by nine different associates) is a district curriculum specialist and M^2 master teacher. Several other M^2 staff and associates were listed by five respondents each, including three associates from the first cohort, one associate from the second cohort, one school district program consultant and high school mathematics teacher whose time is divided equally between teaching and working for the project, and one university faculty who is a principal investigator of the M^2 Institute Partnership.

To gain further insight into the advice network among associates and Institute staff, we calculate the number of other associates and M^2 staff whom a respondent lists as an advisor (the internal out-degree) and the number of individuals not involved in the M^2 Institute whom a respondent lists as an advisor (the external out-degree) for every associate who responded to the survey. Table 3 reports the mean internal out-degree and mean external out-degree by cohort, as well as the total out-degree.

Table 3
M^2 Associate Survey: Average Out-Degree by Cohort

Cohort	*Respondents*	*Mean internal out-degree*	*Mean external out-degree*	*Mean out-degree (internal and external)*
I	23	1.7	2.1	3.8
II	29	2.0	1.5	3.5
III	32	1.4	1.5	2.9
IV	35	0.5	2.3	2.8

Associates from earlier cohorts list more sources of advice in total. Associates from Cohort I list an average of 3.8 advisors, compared to Cohorts II, III, and IV who list an average of 3.5, 2.9, and 2.8 advisors, respectively.

Recall that at the time of the survey, Cohort IV had been accepted but had not yet begun the M^2 training. Associates in Cohort IV list mostly external sources of advice (2.3 advisors, on average) and few sources of advice from within the program (0.5 advisors, on average). In comparison, associates from the first three cohorts listed approximately equal numbers of internal and external advisors; the average internal out-degree and the average external out-degree are both 1.7. This suggests that as associates participate in the program, they make less use of outside sources of advice and rely more on advice from within the M^2 network.

While most associates participate in the M^2 support network, not everyone is involved. Out of twenty-three respondents in the first cohort, six (26%) list no advisors from within the M^2 program. In the second cohort, eight out of thirty respondents (27%) have an internal out-degree of 0; in the third cohort, eleven out of thirty-two respondents (34%) have an internal out-degree of 0.

Most respondents from Cohort IV do not list sources of advice from within the program. Only twelve of thirty-five respondents list one or more advisors from within the program, which is to be expected given that these associates answered the survey before beginning the M^2 professional development program. In fact, the evidence that associates from Cohort IV seek advice from others within the program at all suggests that we should be cautious about attributing connections in the M^2 network entirely to participation in the M^2 program. Instead, it might be that teachers learned about the M^2 program through their existing network of advisors, so associates may have been selected into the program partially due to their participation in the network.

Findings from the Target District Survey

The social network data from the ten middle schools in the Target District lets us address two questions. First, by comparing the subset of M^2 associates working in the district to teachers with similar roles, we can verify our findings from the M^2 associates survey. Second, we can gain insight into how M^2 associates act as leaders within their schools, again by comparing M^2 associates to teachers with similar roles.

To avoid confusion about terms, we should note that our analysis of the Target District survey makes use of a different definition of internal and external advisors. In the Target District survey, we define the network boundary by the school building. Therefore, when calculating a respondent's internal out-degree, only teachers from the same school are included; when calculating a respondent's external out-degree, all advisors from outside the school building are counted. Advice from other M^2 associates might appear in either category. If an associate seeks advice from another associate who teaches at the same school, it would be counted as internal advice. If an associate seeks advice from another associate at a different school, or from an M^2 faculty member, it would be counted as external advice.

The M^2 associates in the Target District report more sources of advice from outside their school buildings compared to teachers with similar roles. As Table 4 reports, M^2 associates who are mathematics teachers list an average of 2.1 external advisors in the 2007 survey, compared to other mathematics teachers who list an average of 0.7 external advisors. Associates who teach sixth grade and had participated in the M^2 institute for at least one year list an average of 1.2 external advisors in the 2007, compared to other sixth grade teachers who list an average of 0.5 external advisors. For both mathematics teachers and sixth grade teachers, the results are similar in the 2008 survey, though the percentage difference is not always as large.

Table 4
Target District Survey: Average Out-Degree of M^2 Associates and Other Teachers

A. 2007 Survey

	Respondents	*Mean internal out-degree*	*Mean external out-degree*	*Mean out-degree (internal and external)*
Math teachers				
M^2 Cohorts I, II, and III	17	2.5	2.1	4.6
Other teachers	26	2.8	0.7	3.5
Sixth grade teachers				
M^2 Cohorts I, II, and III	5	2.4	1.2	3.6
M^2 Cohort IV	5	2.8	0.4	3.2
Other teachers	83	2.5	0.5	3.0

B. 2008 Survey

	Respondents	*Mean internal out-degree*	*Mean external out-degree*	*Mean out-degree (internal and external)*
Math teachers				
M^2 Cohorts I, II, and III	11	3.4	2.1	5.3
Other teachers	20	2.9	0.7	3.3
Sixth grade teachers				
M^2 Cohorts I, II, and III	4	3.0	1.2	3.8
M^2 Cohort IV	3	2.0	0.4	2.3
Other teachers	60	2.2	0.5	2.3

While M^2 associates seek more advice from outside their school buildings compared to their colleagues, the evidence regarding internal advice-seeking is less clear. In the 2007 survey, M^2 associates list slightly fewer advisors within their school buildings compared to teachers in similar roles while in the 2008 survey, they list more advisors within their school buildings.

However, the lower response rates to the 2008 survey, in combination with the small number of teachers in each category, means that we should interpret these data with caution.

The Target District survey was administered to the entire teaching staff at ten middle schools, providing us with peer reports of leadership interactions. These data allow us to examine the leadership roles of M^2 associates in comparison to teachers in similar roles. We find that M^2 associates act as instructional leaders within their schools by providing advice to many colleagues. Compared to their colleagues, M^2 associates tend to be named as advisors by more individuals within their schools. In the 2007 survey, M^2 associate mathematics teachers are named as advisors by an average of 8.8 colleagues; in comparison, other mathematics teachers are named as advisors by an average of 7.0 colleagues (see Table 5). Results are very similar in the 2008 survey: M^2 associate mathematics teachers are named as advisors by an average of 6.8 colleagues, while other mathematics teachers are named by an average of 5.1 colleagues.

Table 5
Target District Survey: Average In-Degree of M^2 Associates and Other Teachers

A. 2007 Survey

	Number of staff	*Mean in-degree (within school)*
Math teachers		
M^2 Cohorts I, II, and III	17	8.8
Other teachers	33	7.0
Sixth grade teachers		
M^2 Cohorts I, II, and III	6	5.3
M^2 Cohort IV	5	3.2
Other teachers	92	2.0

B. 2008 Survey

	Number of staff	*Mean in-degree (within school)*
Math teachers		
M^2 Cohorts I, II, and III	17	6.8
Other teachers	32	5.1
Sixth grade teachers		
M^2 Cohorts I, II, and III	6	3.5
M^2 Cohort IV	4	2.5
Other teachers	92	1.4

In the 2007 survey, sixth grade teachers who are M^2 associates are named as advisors by 5.3 colleagues, compared to 2.0 for other sixth grade teachers. In the 2008 survey, the difference between M^2 associate sixth grade teachers and other sixth grade teachers is smaller in magnitude: M^2 associates who are sixth grade teachers are named by 3.5 colleagues, on average, compared to other sixth grade teachers who are named by 1.4 colleagues, on average.

We should note that the lower response rates to the 2008 survey lessen the reliability of the in-degree measures in that year, and also make it difficult to compare the results from the 2007 survey to results from the 2008 survey. Still, finding differences between M^2 associates and teachers in similar roles in two separate administrations of the survey lends confidence to the conclusion that M^2 associates are key resources for advice and information about teaching mathematics.

Share-Back

Though the SSSNQ is designed as a tool for scholarly research, many of the questions it poses are also of immediate interest to school and district leaders. We arranged to share results from the 2007 survey with principals and district officials in the Target District. We believe that "share-back" efforts are a beneficial step in research projects such as ours, because they force us to translate our academic findings into practical, immediately relevant ones. This process of presenting to research participants has sharpened our focus, while also providing us with an opportunity to check out theories and conclusions. Here, we describe our share-back process and note the competing concerns involved.

The share-back process involves striking a balance between the desire to provide helpful, relevant information to school leaders and the imperative of protecting the confidentiality of research participants. Confidentiality must be protected not only to comply with the requirements of Institutional Research Boards, but to maintain a relationship of trust with research participants. If participants feel that the promise of confidentiality has been breached, they are far less likely to participate in future rounds of research, certainly from our project and perhaps even from other researchers as well.

The SSSNQ contains a series of questions asking the respondent for opinions about the cultural climate of their school. The questions address topics such as the level of trust among faculty and levels of collective responsibility for student learning. Many of the questions are modeled on a bi-annual survey of schools conducted by the Consortium on Chicago Schools

Research (CCSR), results from which CCSR shares with the participating schools [16. We modeled our share-back of the cultural climate questions on the CCSR report, presenting aggregate climate measures as well as frequency distributions of individual items. For each item, we presented results aggregated across all respondents in a school in order to protect the confidentiality of the responses from individual participants. We also reported aggregate results from the CCSR survey, providing an external benchmark for interpreting the magnitude of the measures (a template for our analysis is available from the corresponding author).

Several of the questions on the survey ask respondents to evaluate the instructional leadership of school principals. Items in these measures could easily be construed as an evaluation of a principal’s performance. We shared results from these items with the principal of each school, allowing him or her to interpret and make use of the data, but we did not allow principals to see results from schools other than their own. We allowed district officials to see only the distribution of results across schools, but did not allow them access to results from any particular school.

The SSSNQ also contains several questions on social networks among teachers within each school. In our experience, social network data can be a valuable tool for engaging school staff in discussions about how the work of leadership and management actually happens in their schools, so we were eager to share results from our survey. Research on organizational social network analysis frequently involves a share-back component, but sharing social network data with participants raises particularly serious concerns about confidentiality [11]. Social network name generators necessarily involve identifying relationships with other individuals, but it is unclear how to consider the confidentiality of relationships involving multiple individuals. For example, if a teacher identifies another teacher as a source of advice, but that teacher has not consented to participate in the research, can that relationship be considered in analysis?

We shared our findings from analysis of the social network data by constructing categories of teachers that were large enough to make it impossible to determine the identity of any individual. Figure 1 is similar to the sociogram depictions used for share-back. Here, circles representing teachers are colored according to the teacher’s role, so that there are at least five individuals in any category. Similarly, in quantitative analysis of the network data, we reported averages across categories containing at least five individuals each.

We have observed that, when presented with a sociogram representation of the social network with their school, the immediate impulse of many research participants is to try to put names on each of the nodes. The principals from the Target District proved no different in this respect. While this may seem like a breach of confidentiality, we feel that such activity is speculative at best—the data do not reveal the identities of individual participants, even if they may provoke guessing games. To discourage misinterpretation of the data, we emphasized during our share-back presentation that the social network data, like all survey measures, contain measurement error, and should be interpreted only as a limited representation of relationships within the organization.

Discussion

Our collaborative research project has so far involved determining how the SSSNQ could be used to collect data that would address the goals of the M^2 program, adapting the survey to the local context, administering the survey to all M^2 associates and to the entire staff of ten middle schools, analyzing the data, interpreting the results, and developing methods to share results with some of the participants. Our analysis provides evidence that M^2 associates act as leaders within their schools by providing instruction-related advice to colleagues. Further, we have found evidence that M^2 associates both draw upon and contribute to a support network, the boundary of which is defined by participation in the M^2 program.

Taken together, our findings are an encouraging sign that the M^2 associates are a valuable resource for their schools, building a bridge between their organization and external sources of information and ideas. Research from many different disciplines has demonstrated that access to information from outside of an organizational boundary is beneficial for innovation and productivity [17-19]. By both participating in the M^2 support network and providing advice to other teachers within their schools, the M^2 associates spread the ideas of the M^2 program beyond their own classrooms, acting as instructional leaders within their schools.

However, it is important to recognize the limitations of our findings. As noted above, our research design does not allow us to support causal inferences about the effect of the M^2 Institute Partnership program. With the exception of the M^2 associates from Cohort IV, all of our data collection took place after the associates had begun their training, so we lack baseline data on the participants. Moreover, M^2 associates are selected via a competitive application process, making it very difficult to determine whether their leadership roles and involvement in the M^2 support network are truly the result of program participation, or are due in part to selection effects.

As a collaborative research project, we hope to make use of the data from the SSSNQ to pursue several further research questions regarding Math in the Middle. Social network analysts have been criticized for focusing entirely on the shape and structural properties of networks while disregarding their relational content, even though the type or quality of relationships is crucial to the validity of any claims about outcomes [20]. In addition to data on the existence of advice relationships among teachers, the SSSNQ also collects information on the topics about which teachers seek advice. We plan to study these data to understand whether M^2 associates are recognized as subject-matter specialists for particular areas of teaching practice, such as creating assessments or working with low-performing students. Such detailed information about the content of advice relationships may help M^2 project staff evaluate and improve their professional development curriculum.

We also plan to use data from a second survey of all M^2 associates, to be conducted during Summer 2008, to better understand the determinants of participation in the M^2 professional support network. Qualitative evidence suggests that participation is influenced by prior relationships, social proximity during M^2 Summer Institute sessions, and cohort membership. A better understanding of these factors would allow M^2 project staff to evaluate aspects of the program design in order to better facilitate participation.

Finally, we plan to extend the collaboration between Math in the Middle researchers and the DLS team by linking analyses of social network data to analyses of student achievement data from these same schools. We will begin to study possible relationships between patterns of leadership and student achievement. Certainly, much remains to be investigated.

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