Let’s Talk About Teaching: Investigating Instructors’ Social Networks

Kathleen Quardokus Fisher, Naneh Apkarian, & Emily M. Walter
Florida International University; San Diego State University; California State University, Fresno

Researchers who evaluate efforts to improve STEM undergraduate education have recently begun to explore the importance of instructors’ informal teaching discussion networks. These informal networks allow for the flow of knowledge between instructors that can include information about how to implement research-based instructional practices and creative perspectives that lead to innovative solutions to address localized classroom challenges. In this report, we reanalyze the network data from three pioneering studies in this area to explore the features of mathematics department networks as compared to other STEM department networks at multiple institutions. We plan to discuss implications of these features on the design and implementation of change efforts.

Key words: Social Network Analysis, Instructional Change, Academic Departments

Numerous STEM-focused calls for enhancement of undergraduate education have been focused on improving instruction. These calls have resulted in the creation of evidence-based instructional practices that have been shown to improve student learning outcomes. However, many instructors remain unaware of these practices or face challenges in adopting these techniques to their unique classroom environments and student population. Change efforts have recognized these challenges and the importance of the networks of instructors that provide expertise and creative ideas to successfully implement and coordinate instructional practices. For example, Kezar (2014) specifically identifies the need for social network analysis to harness the power of these networks to inform instructional change.

Social Network Analysis (SNA) is an investigation of social phenomena via the techniques of graph theory. In SNA, the vertices of a graph are individuals, the edges are relationships between two individuals, and the graph is called a sociogram. In this study, the individuals are STEM instructors and the relationships that connect the individuals are discussions about teaching. Each graph consists of all of the instructors in an academic department and the discussions among them. Figure 1 provides a sample discussion network in a STEM department.

We use this preliminary report to begin to analyze datasets of networks from multiple departments. In particular, we are interested in investigating if mathematics departments have unique features when compared to other STEM networks. For example, mathematics departments often have comparatively large numbers of non-major students who take many lower and upper division courses. This results in large numbers of students per mathematics course and requires more instructors to support multiple sections. In other STEM departments, such as engineering, students are often majors and class sizes are smaller. Furthermore, mathematics departments are part of a larger disciplinary culture that influences how instructors are trained in graduate school and encultured into the discipline. We suspect that these disciplinary differences might manifest in varying department social network structures. Finally,

1 All images and analysis were completed using UCINET 6 and NetDraw software (Borgatti, 2002; Borgatti, Everett, & Freeman, 2002).
as many academic departments do have similar policies and purposes, we may uncover similar social network features that reproduce themselves despite institutional and disciplinary differences. This finding in itself would be insightful and imply that change efforts in any STEM department would have similar network-based advantages and challenges. Our final report on this study will discuss these implications.

![Figure 1: Discussion network sociogram where vertices are individuals and edges are discussions about teaching.](image)

**Theoretical Perspective**

The goal of instructional change efforts is to improve the practice of instructors in the classroom. Changing an individual’s practice requires addressing not only the individual’s knowledge and abilities but also the contextual environment within which the individual works. Thus, the development of curriculum and practices by external experts that are meant to be adopted directly by instructors are not likely to be successful. This process does not provide flexibility or insight into the specific context of the individual. Networks may be especially important in remedying this challenge by allowing for adaption and adoption of evidence-based instructional practice. First, network members will be familiar with the challenges of the context and provide opportunities for collective sensemaking to articulate the purpose and features of the practice (Kezar & Eckel, 2000). Second, network structures that have infrequent but trustworthy relationships connecting subgroups of individuals promote innovation because of the ability for an individual to hear and create novel ideas (Levin & Cross, 2015). Finally, changing behavior at the department level can create supports and pressure for even more individuals to change their practice, which in turn will increase the impact of the change efforts (DeHaan, 2005).
Three Studies on Discussion Networks in Departments

This preliminary report represents the cooperative efforts of multiple investigators to reanalyze datasets in order to identify trends across multiple departments and institutions. The datasets represent three different studies, with different methods and different purposes. In our reanalysis, we are challenged to reconcile as many differences as possible across the datasets and to acknowledge those that could not be remedied in both the methods and results. In this section, we discuss the similarities and differences in the methods of the three studies.

The first study investigated social networks of mathematics departments across multiple institutions. In this study, members of mathematics departments at six different institutions were given an online survey to report discussion networks. This study included graduate students as members of the department. The survey listed all of the members of the department and asked respondents to mark each person “with whom they discussed instructional activities” during the last term in which they taught courses. Other items of the survey measured advice networks, friendship networks, and collective trust measures.

The second and third study shared similar survey designs. In both of these studies, respondents were given the opportunity to list up to seven individuals within the department with whom they “discussed teaching-related issues at least once a month.” The members of the departments were provided in dropdown lists and the respondent also included the frequency with which the discussions occurred: nearly every day, weekly, monthly, and less than once a month. If the discussion occurred less than once a month, then no relationship was recorded between the two individuals. The second study included 15 STEM departments at a single institution. The third study was of six STEM departments at a single institution and included advice networks and data were collected twice (two years apart).

Reanalysis of Social Network Data

In order to analyze the data of the three studies, we made the following adjustments and choices. First, we added professional rank as an attribute for each individual. This allows us to remove graduate students from the sample, if necessary. Next, we chose to measure discussion relationships only if they occurred during a term in the first study, and at least once a month in the second and third study. We were unable to reconcile the difference in the nomination methods. In the first study, respondents could list ties with all individuals within the department. In the second and third study, this list was limited to seven people. We will need to discuss these differences when we are using measures that are likely to be greatly influenced by nomination approach, such as density of the network. Finally, we investigated if sample bias was influencing our results by comparing descriptive statistics of study one, study two, and study three before beginning our comparison of department-level network measures.

Preliminary Results and Lessons Learned

We begin by reporting descriptive statistics of each of the study’s networks. We are interested in determining if institutional and/or study-based characteristics influence metrics, and if so, which metrics. Table 1 displays the average values and standard deviation for network
degree centralization, average degree, density, average distance, and diameter. Because of the limited number of departments, we do not make statistical claims.

From this table, we can see that the studies have the most impact on the degree centralization of the network, and relatively smaller impact on the other metrics. Because study one also was only mathematics departments, we may consider if this difference in degree centralization was partially due to the disciplinary culture. However, recall that study one had nomination methods that did not limit respondents to seven entries. This may also be the cause of the difference. In the future we hope to investigate this finding with even more mathematics departments’ metrics and values. Future work will theorize what impact these metrics are likely to have on change efforts through sensemaking, creativity, and social norms.

<table>
<thead>
<tr>
<th></th>
<th>Degree Centralization</th>
<th>Average degree</th>
<th>Density</th>
<th>Average Distance</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study 1 Average</strong></td>
<td>40.1</td>
<td>4.3</td>
<td>0.13</td>
<td>2.2</td>
<td>4.5</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>(9.7)</td>
<td>(0.9)</td>
<td>(0.05)</td>
<td>(0.4)</td>
<td>(0.8)</td>
</tr>
<tr>
<td><strong>Study 2 Average</strong></td>
<td>25.4</td>
<td>3.3</td>
<td>0.14</td>
<td>2.6</td>
<td>5.3</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>(7.3)</td>
<td>(0.8)</td>
<td>(0.06)</td>
<td>(0.3)</td>
<td>(0.9)</td>
</tr>
<tr>
<td><strong>Study 3 Average</strong></td>
<td>20.4</td>
<td>3.6</td>
<td>0.13</td>
<td>2.4</td>
<td>4.9</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>(5.5)</td>
<td>(1.1)</td>
<td>(0.06)</td>
<td>(0.5)</td>
<td>(1.1)</td>
</tr>
</tbody>
</table>

These preliminary results give us confidence in pursuing our initial research questions regarding the differences or similarities among networks of various departments. We also stress the importance of coordinating research efforts in order to make large-scale impact on instructional change efforts. If each researcher has different survey designs and measurements with no standardization, then finding implications with broad application will be difficult. We therefore, call for a standard practice among network researchers in this area to produce studies that can build on the findings of one another and support the development of this area of research.

**Audience Discussion Questions**

The audience can help further this study be providing discussion around the following questions.

- Do audience members have anecdotal experience of large-scale differences of mathematics departments from other STEM disciplines?
- Do audience members believe that the data adjustments necessary for comparing networks are likely to challenge the validity of the study?

---

2 The degree centralization is a measure of the degree to which ties are concentrated among a few key individuals. Average degree is average number of edges each individual has. Average distance is the average number of edges that span the distance between any two individuals in the network. The diameter of the network is the shortest distance between the two most distant individuals. For calculations of these metrics see Wasserman and Faust (1994).
• What other features of networks do audience members expect to be important for improving instructional practices?

References


