Using Department-Level Social Networks to Inform Instructional Change Initiatives

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Abstract

Many change initiatives aim to improve undergraduate instruction by focusing on individual instructors. Recently, it has been suggested that the academic department is the most productive unit of change in higher education. To work at the departmental level, it is important for a change agent to understand the social structure of the department. This paper describes how change agents can identify this social structure through the use of social network analysis of self-reported teaching discussions. As the preliminary analysis of a larger project, we present a case study of academic departments that were involved in a multi-year, multi-department change initiative. We demonstrate how social network analysis can identify features of the overall structure, subgroups within a network, and well-connected individuals. Information from these analyses can be used to triangulate information gained through other data sources and to inform the change process of the department with respect to recruiting individuals for participation and anticipating the spread of the innovation. Results indicate that department-level social network analysis shows promise as a technique for providing important insight into instructional change initiatives.
Using Department-Level Social Networks to Inform Instructional Change Initiatives

Science, Technology, Engineering, and Mathematics (STEM) subjects have been the focus of calls for improvement in higher education (e.g. Association of American Universities [AAU], 2011; National Research Council, 2012). Many times the plan for improvement of STEM education includes promoting the use of research-based instructional strategies (e.g. AAU, 2011). Although the individual instructor is often targeted as the unit of change, researchers suggest that the department is the most productive unit of change (e.g. Edwards, 1999; Gibbs, Knapper, & Piccinin, 2008; Wieman, Perkins, & Gilbert, 2010). The goal of this paper is to contribute to the development of tools to measure department characteristics that may help change agents design more effective change strategies. In particular, we focus on measurement tools based on social network analysis.

Recent developments in organizational dynamics (e.g. Nonaka & Takeuchi, 1995) have shown that innovations are developed within the social connections between individuals. Furthermore, social connections are the location of knowledge, skills, and innovation about teaching practices (e.g. Kezar, 2011; Senge, 2000). Social Network Analysis (SNA) is a method that has been used by researchers to uncover the structure of social connections and to understand how relationships can have an effect on the behaviors of an individual. SNA involves identifying a group of individuals (network) and the social relationships (connections) between these individuals (Prell, 2012). For example, Christakis and Fowler (2009) found that an individual’s choice to vote depends upon whether or not her friends had chosen to vote. Because social connections are the location of innovation and influence behavior, it is likely that this structure may be used to inform change initiatives. Therefore, the method of SNA was chosen to develop an understanding of the social structure of academic departments. This study took place...
within a larger case study analysis of five academic departments involved in a change initiative at a single research university. The research questions used to guide this investigation were: (a) what can be learned about the hidden structure of academic departments from social network analysis, and (b) how might this knowledge of the hidden structure be used to inform change initiatives.

Method

This study took place at a research/doctoral university. The social networks of five science departments were collected as part of a larger case study. The five departments were involved in a large-scale change initiative to improve the education experiences of freshman and sophomore science students. Some faculty of each department chose to participate in the initiative, while others did not. Faculty members who chose to participate took part in faculty learning communities focused on learning about and discussing research-based teaching practices, or participated in one-time events (such as poster sessions). This section includes the methods of the larger case study with a particular focus on the details of the social network analysis approach.

Change Initiative Design

The change initiative’s goal was to improve the science experiences of freshman and sophomore undergraduate students. The leadership of the initiative included a lead principal investigator (PI) and four co-principal investigators (co-PIs) from four of the five departments. One of the co-PIs was closely related with the fifth department (although not through formal appointment). Throughout the four-year initiative, five post-doctoral scholars worked, at different times, with three of the five departments to help facilitate change.
The approach to change taken by the initiative was to facilitate emergent change. Rather than require compliance to a set of pre-determined changes, the initiative partnered with members of the department to develop new ideas that fit the overarching goal of the change initiative. Each year, three to four faculty learning communities (FLCs) facilitated this interaction. These learning communities met about twice a month during the school year. Each community had a different focus. The FLCs topics included: laboratory changes (Research FLC), large-lecture changes (Introductory Lecture FLC), upper level courses (Upper Level FLC) or discipline-specific changes (Department-based FLCs). Each community had between six and fifteen members. In the final two years, a Graduate Teaching Assistant learning community (GTALC) was also included.

In summary, the change initiative had one PI and four Co-PIs. Four of the five science departments were represented in the leadership. This leadership facilitated emergent change through faculty and graduate student learning communities (FLCs and GTALC). The FLCs were facilitated by two faculty members. The GTALC was facilitated by the post-doctoral scholars. Learning communities’ membership included faculty, graduate students, and co-PIs. The PI made occasional visits to learning communities and met with facilitators throughout the process. Five post-doctoral scholars contributed to change in three of the departments. This paper was written during the fourth year of the change initiative.

**Case Study Data Sources**

The department level was chosen as the unit of analysis within the change initiative. Each unit included multiple sources of data (Yin, 2009). Data collection began during the first semester of the change initiative and continued into the fourth year. The data sources included: leadership artifacts (meeting minutes, year-end reports, presentations), Approaches to Teaching
Inventory (Trigwell & Prosser, 2004) administered to members of the faculty learning communities, semi-structured interviews with department members (both involved and uninvolved with the change initiative including: graduate students, post-doctoral scholars, laboratory coordinators, lecturers, and professors), registrar-collected faculty characteristics (gender, title, etc), co-teaching assignments, and social networks. Data source details are shown in Table 1. In particular, Table 1 describes when each type of data was collected and whether it was collected from the change initiative leadership, participants in the FLCs, or all members of the relevant departments. Because social network application is the focus of this paper, the following section provides more detail on collection of social networks.

Table 1 Data Sources and Collection Dates

<table>
<thead>
<tr>
<th>Source(s)</th>
<th>Date (Year of Change Initiative)</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership Artifacts</td>
<td>1-3</td>
<td>Leadership</td>
</tr>
<tr>
<td>Approaches to Teaching Inventories</td>
<td>1, 3</td>
<td>FLCs</td>
</tr>
<tr>
<td>Interviews</td>
<td>1, 2, 4</td>
<td>Leadership, All Department Members</td>
</tr>
<tr>
<td>Faculty Characteristics</td>
<td>2</td>
<td>All Department Members</td>
</tr>
<tr>
<td>Co-Teaching Assignments</td>
<td>1, 2, 3</td>
<td>All Department Members</td>
</tr>
<tr>
<td>Social Networks</td>
<td>2, 3</td>
<td>All Department Members</td>
</tr>
</tbody>
</table>

Social Networks.

The social networks of the five departments were collected through an online survey. The survey was sent to each member of the department (including lecturers, laboratory coordinators, and post-doctoral scholars that were involved with the change initiative). Because the interest of the study was teaching practices, the social relationship of teaching discussions and advice seeking with respect to teaching defined the networks. In the second year, the discussion
networks of the five departments were collected. In the third year, this was expanded to include advice networks as well as the discussion networks.

On the survey, individuals identified others within the department with whom he or she discussed teaching and how frequently (monthly, weekly or nearly every day) in year two and three. In year three, respondents were also asked to whom they would go for advice about teaching. Figure 1 is an example of a department survey form year three. In discussion networks, a department member is connected to another department member in the network if one of them reported that discussions about teaching occurred at least once a month (during the last academic year). In the advice networks, a directed connection from one individual to another is present if one individual seeks advice from another individual.
Figure 1 Example of a social network survey from year 3.

Figure 2 provides an example of an academic department discussion network and an advice network. The squares of the network represent the individual members of the department (nodes) with letters used as identifiers. The connections (lines) between the squares represent the
discussions about teaching that occur between two individuals. The arrows between the squares originate in the individual that seeks advice and terminate in the individual from whom advice was sought. For example, a tie is present between Node O and Node JJ (Figure 2, Window (a), top left) in the discussion network because at least one of them reported discussing teaching at least once a month in the last academic year. An arrow points from Node JJ to Node O (Figure 2, Window (b), top left) in the advice network because Node JJ seeks advice from Node O.

![Figure 2 An example of social networks of a science department. Individuals are indicated by squares and identified by letters. (a) The lines connecting individuals represent at least monthly discussions about teaching. (b) The arrows point to individuals from whom advice is sought. All images created with NetDraw (Borgatti, 2002).](image)

**Analysis**

The analysis of data sources guided the development of a narrative of change for each department. Each narrative described the context of the department, the efforts of individuals involved in the change initiative, and the changes made to department courses. To begin the process of writing the narrative, the data from each source were divided according to which department they addressed. For example, in meeting minutes of the advisory board, the board
discussed the change efforts of each department. This means that this single data source addressed multiple units. The meeting minutes would be divided among the departments depending upon which department was the topic of discussion. If a single episode of the meeting addressed more than one department at the same time, then the data source could be assigned to more than one department.

After all the data sources were assigned to departments, the narrative was written to describe each department’s change process. For textual data sources, the coding process of grounded theory identified the emerging themes and ideas within the narrative (Strauss & Corbin, 2008). The teaching inventory and social networks (non-textual data) were used to inform the narrative after it was developed. The following section provides details of how social networks were analyzed.

**Social Networks.**

The social networks were analyzed to identify network-level structures (basic metrics and subgroups), as well as to identify important individuals within the network. All analyses were completed using the UCINET computer software (Borgatti, Everett, & Freeman, 2002). Because this topic may be unfamiliar, this section describes the metrics that were used and gives examples of them in the five departments.

First, the network-wide characteristics of density and centralization were calculated. As an example of network-wide statistics, Table 2 provides a summary of these metrics in the year two discussion networks for the five departments (labeled A through E). The density of a network is calculated by counting the number of ties present in the network and dividing by how many ties are possible (Prell, 2012). A denser network has more ties, or conversations about teaching occurring among its members (department C). This indicates that new teaching ideas
could spread quickly. If the density of a network is very low (department A), ideas may not spread well within the department.

Table 2 Summary statistics of the five social networks in year two.

<table>
<thead>
<tr>
<th>Department</th>
<th>Density</th>
<th>Centralization</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (n=44)</td>
<td>0.06</td>
<td>13.2%</td>
</tr>
<tr>
<td>B (n=14)</td>
<td>0.18</td>
<td>24.7%</td>
</tr>
<tr>
<td>C (n=20)</td>
<td>0.22</td>
<td>28.7%</td>
</tr>
<tr>
<td>D (n=32)</td>
<td>0.12</td>
<td>25.4%</td>
</tr>
<tr>
<td>E (n=34)</td>
<td>0.11</td>
<td>14.4%</td>
</tr>
</tbody>
</table>

Centralization is a measure of the extent to which the ties of the network are concentrated in a few nodes (Prell, 2012). If a few nodes in the network are responsible for almost all the ties, then centralization is high. These nodes are likely to be very important in determining how information is spread in the network. Department D has a centralization that is nearly doubled that of department E, even though the two departments are nearly the same size and density. This indicates that a few nodes in Department E have many connections, while most other nodes only have a few ties. These very active individuals have high influence over what information is distributed through the network.

Second, the networks were analyzed to identify subgroups. A subgroup is a portion of a network that has many ties amongst its members but only a few ties to other portions of the network (Prell, 2012). Because of the many connections within a subgroup, it is likely that the individual members of the subgroups share ideas and opinions about teaching practices (Christakis & Fowler, 2009). On the other hand, because of the lack of connections to other portions of the network, it is possible that separate subgroups will not share opinions.
Social network researchers have identified several different methods for distinguishing subgroups (e.g. cliques, k-cores, lambda sets, etc.) (Prell, 2012). We have chosen the Girvan-Newman approach for identifying subgroups (see Newman & Girvan (2004) for algorithm details). A benefit of this approach is the assignment of each node to a unique subgroup and no predetermined number of subgroups. Figure 3 provides an example of Girvan-Newman subgroups indicated by the shape of the node.

Third, the networks were analyzed to find well-connected individuals. A well-connected person is someone with many ties (Prell, 2012). A sampling of the opinions and ideas of the network that is likely to be representative of the network can be done through conversation with well-connected individuals. However, if subgroups exist, this may be an indication of varying opinions between different areas of the network. In this case, the well-connected individuals chosen must be from each subgroup in the network. Figure 3 shows department A in year two (a network with many subgroups). Well-connected individuals in Figure 3 are indicated by the size...
of the node. The nodes identified by letters represent an example of a set of well-connected individuals that also represent the major subgroups of the network. It is likely that conversations with these individuals would give insight into the opinions of the network (and whether these opinions differ across subgroups).

Finally, the frequency of discussions was used to identify strong ties between individuals. In the survey, a discussion was defined as occurring monthly, weekly, or nearly every day. For most analysis, only monthly ties were considered. However, stronger ties may indicate individuals that are important in the network. Figure 4 shows the difference between ties in department C that occurred once a month as opposed to ties that occurred weekly. The nodes that are connected in the weekly conversations are more active in conversations about teaching.

<table>
<thead>
<tr>
<th>At Least Monthly</th>
<th>Weekly</th>
</tr>
</thead>
</table>

Figure 4 Department C (year three) networks based on frequency of discussions.

In summary, the analysis of social network included: overall characteristics, group structure, well-connected individuals, and the frequency of conversations. This analysis was completed for two years of discussion networks and one year of advice networks. The following section uses department B to demonstrate how this analysis can inform the change process in a department.
Results

Department B was chosen to provide an example of how the social network analysis methods described above can inform the narrative of change. This section begins with a summary of department B’s narrative of change. This is provided in order to give the reader important context for understanding the usefulness of the social network analysis. Special attention is given to the narrative portions that social networks will be used to triangulate or to make suggestions for increasing the impact of change in the discussion section. The narrative is followed by an overview of department B’s social network characteristics. In the discussion section, the social network analysis is combined with the narrative to provide insight into the change process of the department and to suggest future directions for change in department B.

Department B Change Narrative

Participants.

Department B had twenty-five members during the fourth year of the initiative. (The department hired two new faculty members during the four years.) The department combines two primary disciplines (labeled 1 and 2 in Table 3). Large-scale curriculum changes in two of department B’s courses were directly related to the change initiative (B100L and B300). One course was based in each of the disciplines of the department. Six members of department B participated in change initiative activities. Table 3 provides a summary of change initiative participants’ demographics and the following section presents short biographies of each individual.
Table 3 Department B members’ titles and change initiative roles

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Title</th>
<th>Change Initiative Role(s)</th>
<th>Discipline</th>
<th>Interview Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cora</td>
<td>Graduate Student</td>
<td>FLC member (Research), Evaluate B100L</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hannah</td>
<td>Professor</td>
<td>Co-PI, FLC member (Research), Teach B100L</td>
<td>1</td>
<td>1 (2 times), 4</td>
</tr>
<tr>
<td>James</td>
<td>Senior Lecturer</td>
<td>FLC Member, Teach B300</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Tim</td>
<td>Professor</td>
<td>FLC Facilitator (Research)</td>
<td>2</td>
<td>1,4</td>
</tr>
<tr>
<td>Everett</td>
<td>Professor</td>
<td>FLC Member (Introductory Lecture)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wilson</td>
<td>Assistant Professor</td>
<td>FLC Member (Upper Level)</td>
<td>1</td>
<td>NA</td>
</tr>
</tbody>
</table>

Cora. Cora was a graduate student in department B. She had previously received her bachelor’s degree from the same department. She was recruited by Hannah to evaluate the Nature of Science learning gains of students enrolled in B100L as her master’s thesis. She had previously taken B100L and provided insight into student perceptions of the course prior to change. By the fourth year of the initiative, she had graduated with her Master’s Degree and the department had hired her to teach a different course. She remains involved in B100L implementation, including TA training.

Hannah. Hannah is a Co-PI of the change initiative. She has been involved in college-wide change initiatives prior to the current program. She is in charge of B100L and was the faculty member in charge of changes to the course. She has been actively involved in the Research FLC throughout the change initiative.
James. James is a senior lecturer in charge of B300. He has been involved in the Research FLC throughout the change initiative and has discussed the course changes with Tim throughout the process.

Tim. Tim does not teach either of the courses that were changed due to the initiative. Prior to this change initiative, he had been involved in developing innovative teaching techniques with Hannah and other individuals from the institution. He has been involved in the Research FLC throughout the initiative.

Everett. Everett was involved in the Introductory Level FLC during the first year of the change initiative. This FLC focused on how to teach students to “think like a scientist.” Everett was not involved in the two large-scale curriculum changes of B100L or B300. However, Everett did add a Nature of Science lecture to a different course as a result of his involvement in the Introductory Level FLC.

Wilson. Wilson joined the Upper Level FLC during the third year of the change initiative. He is new to the department. His discussions about teaching have increased significantly during the year he was involved in the FLC.

Department Support for Excellence in Teaching.

Support for teaching excellence is a department-level characteristic that is important for understanding the success of change initiatives. Support for teaching excellence in department B varies considerably. Some aspects of the department are supportive of innovation in teaching while others are less accommodating. The following paragraphs will describe three possible sources of support for teaching excellence: the curriculum committee, the chair, and other faculty members.
The first source of potential support is the curriculum committee in charge of department majors’ courses. Hannah argues that the committee “never” meets. Tim agrees that teaching only comes up occasionally with the curriculum committee chair when the course catalogs need to be changed. None of the other interviewees mentioned the curriculum committee. Based on these accounts it is unlikely that instructors in department B feel influenced to change or not change their courses due to influence by the curriculum committee.

Department chairs are commonly mentioned as setting the tone for teaching improvement within their department. The chair of department B supports excellence in teaching, but is not as supportive of the pursuit of education research. Department B had two different chairs during the change initiative, but according to Tim, both chairs had similar views on the importance of teaching. First, Tim says that overall teaching is an important part of promotion and tenure review. He provides two examples as evidence. First, when he has undergone review, he notes that the chair has always been impressed with his teaching accolades. Second, when he has recently participated in a promotion review committee, the committee denied tenure to a faculty member based on poor teaching evaluations. Tim argues that this shows that teaching has been important to the chair (both the current and former chair). However, Tim (who speaks with Hannah frequently, both within the department and at FLC meetings) knows that she has found that the chair (as well as other faculty members) does not value education research as much as traditional research in the discipline. Hannah does not address this issue. Instead, she only speaks about her curriculum changes (as opposed to education research in general) and the response of the department as a whole (as opposed to specifying the chair’s response or other individuals). Her perception is that, in general, as long as she conducts curriculum changes on her own and it does not require resources, it is tolerated by the department.
Other instructors within the department might provide support for teaching improvement. Hannah says that she turns mostly to faculty from other departments for support. She does speak with James and Tim about her teaching innovations. Prior to the current program, Hannah had been involved in a learning community based on the Nature of Science. This learning community included many of the leaders of the current change initiative. She is also a Co-PI of the change initiative; therefore, she is connected with experts in teaching and learning in other areas of the university. Hannah says that in her discipline she is the only instructor invested in the innovations that she is attempting. She believes James and Tim are invested, but they are both experts in the other discipline, which makes her feel isolated in her efforts. Tim agrees with Hannah. He says that only James, Hannah, and he have active interests in teaching.

Despite the claims of Tim and Hannah, there is some evidence that other people are interested in teaching. Everett and Wilson both have participated in FLCs. Their participation was not as involved as Hannah’s and Tim’s participation. This may be the reason that Hannah and Tim do not see them as “actively” interested. Another member of department B indicated on a survey that she participated in an FLC that was associated with a different campus program interested in improving teaching. She was a new hire in the department as well as Wilson. This may mean that Tim and Hannah are not aware of their interest in improving their teaching. This discrepancy is discussed with respect to the social networks in the following section.

In summary, teaching excellence in department B is recognized and plays a role in tenure and promotion considerations. The three main individuals involved in the initiative believe they are the only faculty members interested in improving teaching. However, at least three other members of the department have shown an interest in teaching improvement opportunities.
Department B Social Networks

The social networks were analyzed for density, centralization, well-connected individuals, and discussion frequency. For department B, three networks were collected: discussion network year two, discussion network year three, and advice network year three. The advice network of year three does not include discussion frequency, either a person sought advice from an individual or he did not. Figures 5-7 are summaries of the results of department B’s social network analysis. Letter identifiers (such as B_R) instead of names are used for individuals who are members of the department but not involved in the change initiative. The networks have less than twenty-five nodes because some individuals did not respond to the survey and were not named by any of the respondents.
In year two, the centralization of department B was relatively high (compared to networks of other departments.) This means a few key people (Everett and B_A) have access to the most information in the network. If either of these two individuals left the department, there would be very few discussions about teaching. Two subgroups dominate the network’s monthly discussions. Four disconnected groups are formed when weekly discussions are considered.
Hannah and B_R are married which explains why they speak daily about teaching. Overall, in year two, teaching discussion were not very frequent and were dominated by a subgroup that contained the former and current chair.

![Discussion Network Year Three](image)

**Monthly Discussion Network Characteristics**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.22</td>
</tr>
<tr>
<td>Centralization</td>
<td>18.6%</td>
</tr>
<tr>
<td>Well-Connected Individuals</td>
<td>Current Chair, B_L, Wilson</td>
</tr>
</tbody>
</table>

Figure 6 Result summary of department B’s discussion network in year three.
In year three, department B saw an increase in the discussions about teaching. In year 1, respondents named an average of 2.5 people with whom they had discussions about teaching. In year 3, this average increased to 4.7. This resulted in an increase of density from 0.18 to 0.22. Furthermore, the centralization was lower, meaning that the discussions about teaching were spread throughout the network, instead of concentrated in only a few nodes. Department B still has multiple subgroups and subgroup membership remained relatively stable. The formal leadership subgroup remained relatively unchanged. In addition, the change initiative leaders formed a subgroup. In year three, more connections across subgroups existed. Also, when considering weekly discussions, the subgroups do not become disconnected. Overall, in year three, department B has become more connected with more people involved in discussions about teaching.
The advice network of department B has three subgroups. These subgroups are quite similar to the discussion network subgroups. One subgroup contains both of the current and former department chairs, one subgroup contains the change initiative participants, and one other subgroup represents a discipline of the department. Two individuals, Everett and Tim, name the same outside source (Node C_CC from department C) as someone they would seek out for advice. The well-connected people are the people from whom others seek advice. In this case, many people list the former and current chairs as people they go to for teaching advice.
In summary, department B’s social network became less divided into subgroups from year two to year three. However, the individuals involved in the change initiative are continually separated from the subgroup containing most of the department members. Many people talk to the current and former chairs about teaching and also go to them for advice, but the members of the change initiative do not. In year two, removing a few individuals from the network would cause components to become disconnected. In year three, the network became more robust so that no single person could cause a major change in teaching discussions across the network. The following section will discuss these features with respect to department B’s change narrative.

**Discussion: Department B’s Change Informed by Social Networks**

The social network analysis clarifies the change process and provides insight into future directions of the change initiative for department B. This study was guided by the research questions (a) what can be learned about the hidden structure of academic departments from social network analysis, and (b) how might this knowledge of the hidden structure be used to inform change initiatives. First, the social network analysis can be used to identify otherwise hidden structural features of the department. As we have demonstrated, social network analysis can be used to identify influential (well-connected) individuals, identify subgroups, as well as identify changes over time. These data can be used on their own. For example, having the department members who are most active in the change initiative in a separate subgroup that is relatively isolated from the departmental leadership suggests that additional interventions may be necessary in order for the change initiative to continue making inroads into the department.

We have also shown that social network analysis data can be extremely helpful in understanding departmental context to better interpret other data collected. For example, the
social network analysis of department B supported Tim’s and Hannah’s claims of isolation. In interviews and on surveys, Tim and Hannah explained that they only spoke to each other about teaching because they were the only faculty members actively interested in pursuing teaching innovations in department B. The first claim by Tim and Hannah is supported by the social networks. In each discussion network and the advice network, Tim, Hannah, and James were in a subgroup that was removed from the rest of the department. This would explain why they felt that they were the only members interested in change.

The social network analysis could also explain why Tim and Hannah did not mention having knowledge of other individuals who were interested in teaching, (even though evidence exists that other members of the department are interested in innovative teaching). First, the evidence that others are interested in teaching is based on the involvement of several other department members in FLCs. For example, Everett reported adding Nature of Science lectures to his course after participating in the Introductory Lecture FLC. Furthermore, Everett is involved in many discussions about teaching indicating that he has interest in it (although these discussions are not with Tim, James, or Hannah.) Here, social network analysis has helped explain why some people report participating in change efforts but Tim and Hannah claim that there is no one else who is interested. Because Tim and Hannah do not have discussions with these individuals about teaching, they are unaware of what interests these individuals have.

In response to the second research question, remedying this isolation of change initiative participants might encourage the spread of change throughout the department. The well-connected individuals in the network are useful in spreading information throughout the network. Everett, the former chair, the current chair, and Wilson have filled these roles in department B. None of these key individuals are in the subgroup with Tim, Hannah, or James. The spread of
change throughout the network could be facilitated by connecting Tim, Hannah or James to these individuals. Enlisting the chair (who has many connections) to connect otherwise disconnected individuals would help information spread across subgroups. This could also be facilitated by including education topics in faculty meetings. For example, by asking different instructors to make brief presentations about teaching methods they are using for particular classes or changes they are considering. The chair is generally supportive of teaching, therefore, he may be willing to increase the connections between individuals involved in teaching innovations and the rest of the department. The more connections that go between subgroups of the department, the less likely it is that individuals will feel isolated in their attempt to change their teaching practices. These connections will also facilitate the flow of information throughout the network.

In summary, the social network analysis of department B had two purposes. First, it helped illuminate evidence that was found from other data sources. Tim and Hannah reported feeling isolated in their attempt to change teaching practices. The social network confirmed this isolation and identified well-connected people that could be used to connect Tim and Hannah to other faculty members who are interested in innovating teaching approaches. Connecting these individuals would support Tim’s, Hannah’s and James’s change activities and also increase the number of individuals discussing teaching in department B.

**Conclusion**

The social connections of individuals are important in the development and spread of innovations and the behavior of individuals. A short survey of faculty members can identify the structure of these connections in academic departments. This structure can be used to identify key individuals and subgroups from relationships based on discussions or advice seeking about
teaching. Next, this information may be used to inform the development of change initiatives by clarifying information gathered from other data sources and identifying individuals to recruit for change initiative advancement. Although we have demonstrated several ways that social network analysis can be used to understand and support change initiatives, these techniques are still very new in the study of academic departments and change initiatives. Thus, there is still much to be learned. For example, with data from larger numbers of departments, we expect to be able to identify ranges of particular metrics that are indicative of certain important department characteristics. Given the relative ease of measurement and the potential for gaining significant insight, we expect to see increased use of these methods to better understand academic departments.
References


