Emerging Instructional Leadership in a New Course Coordination System

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This paper reports on the instantiation of a coordination system in a university mathematics department, and in particular the transition of three faculty members into their new roles as course coordinators. Course coordination, characterized by uniform course elements and instructor meetings, is a programmatic feature that supports student success in introductory mathematics courses. When courses are coordinated, the person or people responsible for the coordination play a critical and complex role in ensuring that all students experience comparable, well-designed classes – but building such a system is complex and has not been studied in situ. In this report, I explore one coordinator's transition from a peripheral participant in discussions of teaching to a highly central figure with significant influence on instructors and colleagues in the department. Surveys and interviews with involved parties reveal nuance of this shift in leadership and shed some light on the process.

Keywords: Precalculus/Calculus, Institutional Change, Course Coordination, Leadership

This report is about the implementation of a course coordination system in an undergraduate mathematics department, situated in a broad change initiative, considering in particular how one coordinator in particular rose from relative obscurity to a strong position of instructional leadership – a result which has the potential to support student success in introductory mathematics courses. In recent years, numerous reports and recommendations have been published at the national scale calling for improvements in undergraduate STEM education, and mathematics education in particular (e.g., CBMS, 2016; National Research Council, 2013; PCAST, 2012; Saxe & Braddy, 2015). Critical to STEM majors, and so to improvement efforts, is the Precalculus to Calculus 2 (P2C2) sequence which is required for most upper division STEM courses. In particular, these documents have called for the implementation of evidence-based instructional practices (notably active learning) and resources to support students in social as well as academic aspects of their lives. In the same time period, research has identified particular programs and features that support student success in the calculus courses that are critical for STEM majors (e.g., Bressoud, Mesa, & Rasmussen, 2015; Bressoud & Rasmussen, 2015). However, these practices and programs are not widespread – lecture still dominates the classroom, and even those departments which have such programs do not feel they are as successful with their implementation as they would like (Apkarian & Kirin, 2017; Rasmussen et al., in review). Furthermore, change is difficult and little is known about best practices for initiating and sustaining change in undergraduate departments. The role of social and cultural factors is viewed as an important part of the puzzle, and this has been demonstrated at the K-12 level repeatedly (Borrego & Henderson, 2014; Daly, 2010; Henderson & Dancy, 2007; Penuel, Frank, & Krause, 2010). By investigating the process by which one department implemented a major change initiative, and in particular how one member of that department grew into a new and critical role, this project contributes to our understanding of the social factors that affect the instantiation of evidence-based change in undergraduate mathematics department.

Apkarian and Rasmussen (2017) report on a sample of successful programs with coordination, where the coordinators held both formal power, by way of their titled role, and informal power, by way of social influence and leadership. In light of their findings, this paper

considers three faculty members who were assigned the role of course coordinator, their social standing prior to this assignment, and how this shifted during the first two years of the new program. The analysis includes interviews with the coordinators and their colleagues in the mathematics department and social network surveys which capture informal power through interaction patterns and the nomination of expertise.

Theory and Literature Review

The choice to focus on course coordinators, in this report, is due to their potential to impact multiple elements of the P2C2 course experience. The Characteristics of Successful Programs in College Calculus (CSPCC) study identified course coordination as one of the features of successful Calculus 1 programs (Rasmussen & Ellis, 2015). Through management of uniform course elements (e.g., common textbook, common exams) coordinators affect the basic elements of course curriculum, and through regular meetings with instructors they can affect the culture surrounding teaching. Their position can be leveraged to nudge instructors toward specific practices, particularly powerful during a systematic change effort, and their actions have the potential to engender communities of practice. Apkarian and Rasmussen's (2017) further investigation of successful departments in the CSPCC study revealed that, at those institutions, the course coordinators were primary sources for advice and information about teaching, meaning that they have informal social influence as well as formal, official power from their position. Their work suggests that alignment of informal and formal leadership with regards to teaching is a feature of more successful course coordination programs. The departments in that study, however, have had coordination systems intact for many years. This study investigates the development of such a system, and in particular the shift in coordinators' informal roles as they adopt their new, formal roles.

Wenger (1998) defines the practice of a community of practices as "doing in a historical and social context that gives structure and meaning to what we do. In this sense, practice is always social practice" (p. 47). This report considers both the practice of the coordinators and the social context in which they practice – the interactions and attitudes they carry and those of their colleagues. To do so, I draw on social capital theory and social network analysis (SNA). Social capital refers to the "resources embedded in social relations and social structure, which can be mobilized when an actor wishes to increase the likelihood of success in purposive actions" (Lin, 2002, p. 24), and these resources are considered to be "the potential and actual set of cognitive, social, and material resources made available through direct and indirect relationships" (Bridwell-Mitchell & Cooc, 2016, p. 7). SNA is one productive way to investigate social capital and its distribution among members of a community, because "an actor's network of social ties create opportunities for social capital transactions" (Adler & Kwon, 2002, p. 24). Thus, I leverage the tools of SNA to investigate interaction patterns identify central and peripheral participants, based on their potential access to social capital. Interviews and observations are used to characterize the social capital resources that are accessible through that network.

Methodology

Data Collection and Participants

The data for this study comes from a three-year longitudinal mixed methods study of a single mathematics department at a large state university. The P2C2 courses in particular were considered a problem at the university due to low pass rates, low persistence, lack of preparation in future courses, and student dissatisfaction. A newly elected chair set out to improve the

situation using evidence-based practices, specifically considering the seven features of successful Calculus 1 programs laid out by the CSPCC project (Bressoud et al., 2015; Bressoud & Rasmussen, 2015). He determined that the P2C2 program had none of these characteristics and so, along with a task force, set out to implement them all. This report focuses on one of these characteristics: coordination systems for P2C2 courses that consist of regular instructor meetings and uniform course elements, organized by course coordinators. This department appointed three coordinators, one for each P2C2 course: Precalculus, Calculus 1, and Calculus 2. Data for this report comes from three major sources: (1) a survey to all people involved in the P2C2 sequences and changes therein; (2) interviews with instructors, coordinators, and the P2C2 committee; and (3) observations of P2C2 committee meetings. Data collection for this project has been completed.

A survey was distributed to all those involved with P2C2 courses at the university at three time points: before any changes occurred and at the end of the first and second academic year of the change initiative. It was distributed to all instructors (regardless of rank) all members of the mathematics and mathematics education divisions of the mathematics department, directors of faculty and student support programs, and selected administrators. Part of the survey consisted of Likert-style questions about the culture and climate of the department and P2C2 program, adapted from similar work in both K-12 and higher education contexts (Antonakis, Avolio, & Sivasubramaniam, 2003; Daly, Der-Martirosian, Moolenaar, & Liou, 2014; Moolenaar, 2012). These were aimed at measuring changes in attitudes over time. Another major part of the survey was a set of social network questions aimed at uncovering interaction patterns surrounding instruction of lower-division mathematics courses. Instructors were asked who they go to for advice, for instructional materials, and who they consider influential on their instructional practice. Everyone was asked with whom they discuss lower-division courses, they discuss their own research, discuss the ongoing changes in the department, and who they consider to be friends. This set of questions allows for an understanding of who opinion leaders are with regards to instruction, who is involved in conversations about what is going on and how things are changing, and to what extent this is or is not the same as who are friends. This selection is in line with standard approaches to social network data collection (Daly, 2010; Kadushin, 2011).

In order to understand the goals, implementation, and evolution of the change initiative in general, and the coordination system in particular, semi-structured interviews were conducted with a subset of the large pool that was surveyed. Particularly relevant to the coordination system are the interviews with instructors of coordinated courses and the P2C2 committee, which included all the new coordinators and the department chair. This group has been involved in the decision-making surrounding the change initiative, and so are primary resources for understanding the how and why of changes being made. Two rounds of interviews were conducted, toward the end of the first and second year of the change initiative. These interviews asked about the main goals of the change initiative, how it came into being, who the key players are, their role in the process, how progress toward goals will be assessed, and how well things seemed to be working in their view. Many of those interviewed in the first year were interviewed again in the second year, in which case the follow-up interview was tailored based on their first interview. The purpose of these interviews was to collect (potentially changing) information about and to assess participants' perceptions of P2C2 program, and the ongoing changes. All interviews were audio-recorded and the interviewer took field notes.

The final source of data comes from observations of P2C2 committee meetings. The committee consisted of the department chair, the Precalculus coordinator who is also director of

the new learning center, the Calculus 1 and 2 coordinators, a senior mathematics education faculty member, and the GTA professional development leader who is also a mathematics education researcher. This group met on a regular basis to discuss plans, concerns, and strategies for constant improvement. The intention of attending these meetings was to obtain real-time information about the evolution of the change initiative and any concerns that presented themselves, as well as how each member of the committee spoke about the program and the changes. In some instances, the observer was able to ask clarifying questions of the committee. These meetings were audio-recorded, any artifacts (e.g., agenda, official notes) were collected, and field notes were taken. While data collection is complete, following the end of the second year of the change initiative, the department is not finished with their changes. Therefore, committee meetings are continuing to be observed to monitor and document any further significant changes.

Data Analysis

The data for this project is being analyzed in a coordinated fashion, with each piece reflexively informing iterative rounds of analysis. Social network data is first being analyzed using basic graph theory ideas of degree and centrality. These measures allow for the identification of key figures (those with higher degree or in-degree) and distribution of ties: high centrality corresponds to a concentration of ties in a few key players, lower centrality corresponds to more even distribution. These results can then be used to identify important characters, and the interviews and observation notes can be used to better understand their influence or position. Likert data from the survey is analyzed to give each person a score for each scale (e.g., perceptions of students and teaching, individual innovative climate), and the department as a whole. This data is compared across time points to identify shifts in attitudes and/or departmental climate and individual perceptions.

Interview data is being transcribed in full, checked, and coded. A first coding pass identified all interview segments pertaining to the seven features from the CSPCC study, which the department hoped to implement. A separate round of coding identifies segments where participants talk about goals and evaluations of any aspect of the change initiative. In addition to this coding using *a priori* schemes, the data is being open coded for emerging themes in line with the principles of grounded theory (Strauss & Corbin, 1994). These codes will be used to ascertain attitudes, priorities, and goals of individuals and how those shift over time. Of particular importance to this report are the segments which touch on the coordination system and coordinators. Meeting observations are being selectively transcribed, omitting discussions of budget and minutiae. Again, the most relevant segments for this report are those which include discussion of the coordination system and the roles of the coordinators, particularly when the coordinators are commenting.

Analyses of the network, Likert-scale, and interview data will be combined to look for characteristics and attitudes that coincide with network connections (e.g., do conversation partners share attitudes about teaching; do those who discuss the change initiative have similar ideas about goals; what interview language coincides with Likert scale scores).

Preliminary Results and Discussion

Interview analysis and coordination has not been completed, but the social network analysis is well underway. This has revealed that two of the three new coordinators were quite involved in conversations about teaching, and their advice was sought after, before they were selected as coordinators. They retained and/or increased their prominence throughout the initiative, though

increased network activity (more involvement in discussions; higher maximum numbers of ties) altered the relative position of many members of the community. The third coordinator, however, was more peripheral, and nearly absent in those conversations. By the end of the second year of changes, he became highly involved and is now one of the most central members of teaching-related networks. This shift results in an alignment of formal position and informal influence, seen in Apkarian and Rasmussen's (2017) study of successful departments. This university's networks are somewhat more distributed than those in Apkarian and Rasmussen's study, but the shift is a sign that this coordinator has taken up the mantle of coordinator and others respect him as such. Further analysis of the interviews and observations, especially his views of the position and other's perception of him, will shed light on how this transition occurred. An understanding of this transition and coordinator may be able to inform future change agents who choose to implement coordination systems and select coordinators.

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