Mathematics Faculty's Efforts to Improve the Teaching of Undergraduate Mathematics

Preliminary Research Report

In recent years, much attention has been given to the pre-service preparation and professional development of mathematics teachers at the elementary, middle, and high school levels. Researchers have concluded that strong content knowledge is not enough to insure effective teaching. Yet, many colleges require little to no professional development for their mathematics faculty. Without supports similar to those provided to K-12 teachers, how do college mathematics faculty members develop and improve their teaching of undergraduate mathematics? A department-wide survey and follow-up interviews were used to investigate if and how the mathematics faculty at one research university have acquired and honed skills for teaching undergraduate mathematics. Preliminary analyses of this data will be presented, and feedback for future directions will be solicited. Understanding if and how mathematics faculty currently seek supports for improving their teaching can inform the design of future professional development programs for college mathematics faculty.

Keywords: professional development, undergraduate mathematics instruction, teaching resources, mixed methods research

Learning and making sense of mathematics is a complex psychological, cognitive, and social process. Research suggests that mathematics content knowledge is not sufficient for teaching, even at the earliest stages of schooling (Hill, Rowan, & Ball,, 2005). Darling Hammond argues that "teachers who have more preparation for teaching are more confident and successful with students than those that have had little or none" (pg. 167, 2000). Why should college-level mathematics instruction be any different? New faculty members face the same challenges of developing, testing, and honing their teaching skills; more experienced faculty members may need to adapt their current skills to accommodate a new generation of learners who may have graduated from reformed and technology rich high school classrooms. Understanding if and how college mathematics faculty members pursue various supports when coping with these challenges can serve an important role in the design of future professional development materials. It is possible that without external supports some college mathematics faculty learn from their own teaching by planning, executing, reflecting on and revising lessons, a method similar to that described by Hiebert, Morris, Berk and Jansen (2007).

According to Lortie's notion of the *apprenticeship of observation* (1975), teachers develop beliefs, ideas, and images of the work of teaching as they observe their own teachers teach during their many years as school and university students. Analysis of interview data from a pilot study I conducted last year indicated that the same was true for many mathematics college instructors. Without formal training in education, it is not surprising that faculty members often rely on their own experiences as students in undergraduate and graduate mathematics courses to build a vision of how college mathematics instruction should or should not look. This can be problematic because faculty with advanced degrees in mathematics may not have ever

experienced the struggles their undergraduate students often encounter in "elementary" undergraduate mathematics classes.

My research investigates if, how, and where mathematics faculty find supports for developing and honing their skills for teaching undergraduate mathematics, and which faculty members are most likely to seek out this type of support. In particular, this research study was designed to pursue the following research questions, working with a population of mathematics faculty members at one research university: (1) What efforts, if any, do mathematics faculty at employ to improve their teaching of undergraduate mathematics?, (2) What ideas do mathematics faculty members have about what it means to improve one's teaching, and what do they take as evidence that one's teaching has improved?, and (3) What demographic trends, if any, exist among faculty members who report interest in improving their teaching? These questions lead to a mixed methods approach which is exploratory rather than evaluative in nature. In this study, I use a combination of surveys and interviews to understand what resources mathematics faculty at one research university have explored and which resources they have found most useful. In the first phase of the study, I sent an email invitation to all faculty in the mathematics department at one research university to participate in an online-survey. The survey consisted of four parts. The first part consisted of items designed to collect demographic data from the survey participants, such as their current position in the department, their years of teaching experience, and their education background. The second part consisted of eight Likert scale questions about their beliefs about teaching undergraduate mathematics courses and about improving teaching. The third section of the survey contained a few free response questions about their efforts and opportunities to learn about and improve their teaching. The final section asked participants if they would be willing to participate in a follow-up survey, and if so, to provide their contact information. At this point in time, I have sent the email invitation to the mathematics faculty members in the department to complete the online survey. Another e-mail will be sent approximately two weeks from now as a gentle reminder to those who have not completed the survey.

The second phase of the study consists of conducting follow-up audio-taped interviews with at least eight of the faculty members who completed the survey and agree to be interviewed. The faculty who are interviewed will be chosen to best represent the overall population of those who responded to the survey. The follow up interview will include three parts. The first set of interview questions provides an opportunity for the participant to reflect on and share information about their own teaching practice and their efforts to improve their teaching. The second part of the interview asks the participant to read and analyze a brief written vignette from a hypothetical undergraduate mathematics class. The third and final part of the interview provides an opportunity for me to follow up on specific responses the participant provided on the survey. The interviews will be completed no later than December of this year. Thus, by the time of the conference I will have gathered and conducted at least a preliminary analysis of all of my data.

The survey and interview data will be analyzed to explore trends observed through an initial review of the data. The majority of the analysis will be qualitative in nature, but some simple quantitative analyses may be performed to indicate frequency of particular types of responses or the mean and standard deviation of certain categories of responses to certain items. I will aim to develop group-level, sub-group level, and individual-level claims from the analyses.

For example, I hope to disaggregate participants' responses according to specific demographic features such as the number of years of teaching experience or amount of formal training in education. This will highlight major themes in the responses including which resources and strategies for improving teaching are most frequently mentioned and which strategies and resources faculty report as most helpful. The exploratory nature of this research makes it difficult to provide more specific details about the analysis.

Depending on the final response rate to the survey, I may choose to proceed beyond this study in multiple ways. Ideally I will have a large response and a rich data set which I can use as the basis of my dissertation research. There are several other options I am considering which I can pursue whether my data is as rich as I anticipate or not. One option would be to use the information from this survey to construct a more targeted and detailed survey to be used with the mathematics department at another research university. Another option would be to focus in on the practice of one faculty member as he/she endeavors to institute changes to improve his/her teaching practice. I also could repeat this data collection and analysis at a teaching-focused college or university and/or at a community college and then compare and contrast the responses.

Discussion Questions

- Based on the preliminary analysis provided, what additional queries would you have about trends in the data? What story about the data would you like to hear?
- If I were to conduct an additional interview with one or more of my participants, what kinds of questions should I ask? Which of my participants might be a good choice for targeted case studies?
- What journals might be a good fit to publish this research in? Would the results of my research would be useful to practitioners?
- How do the mathematics faculty members in attendance feel about the goals, methods, and results of this study? Do they relate to it? Object to it? Find it surprising or typical?
- How might the findings from this study and follow-up studies inform the development of future professional development programs for college mathematics faculty?

References

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