An Exploration of the Transition to Graduate School in Mathematics

Preliminary Research Report
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In recent years, researchers have given much attention to the new mathematics graduate student as a mathematics instructor. In contrast, this study explores the academic side of the transition to graduate school in mathematics—the struggles students face, the expectations they must meet, and the strategies they use to deal with this new chapter in their academic experience. This talk will look at preliminary results and analysis from a qualitative study designed to explore these aspects of the transition to graduate school in mathematics from a post-positivist perspective. In order to explore the transition as fully as possible, interview data from a varied sample of graduate students and faculty members at one university are being incorporated to gain multiple perspectives on the transition experience. Potential implications for graduate recruitment, retention, and program protocols in mathematics will be discussed.

Keywords: graduate students, academic transition, semi-structured interview, case study

Research Problem

Students entering graduate programs in mathematics often experience an "abrupt change of status" during this transition (Bozeman & Hughes, 1999, p. 347). While their undergraduate records may be exemplary, these students often have trouble adjusting to the rigorous new environment of graduate school in mathematics. Setbacks, such as insufficient prerequisite knowledge or an inability to discern or meet a professor's expectations, may generate diminished self-esteem or even a desire to drop out of the program.

These issues impact departments as well: Students' struggles with the transition to graduate mathematics may negatively affect program recruitment as admissions committees are less likely to admit applicants with similar backgrounds in the future. Retention is also impacted across the discipline as promising students may incorrectly assume they lack mathematical ability and leave the field forever. Finally, these struggles can affect the representation of women and minorities in such programs, as these groups are less likely to find the support structures they need to survive graduate school (Bozeman & Hughes, 1999).

Literature. Several researchers have explored issues related to this transition. For instance, Duffin and Simpson's (2006) interviews with Ph.D. students explored the transition from undergraduate to graduate work in mathematics in the United Kingdom's educational system. The authors concluded that both undergraduate and graduate education could be modified to smooth this transition for different types of learners. Marilyn Carlson (1999) explored the problem-solving behaviors and mathematical beliefs of mathematics graduate students who were considered "successful" in their programs. Persistence, high levels of confidence, and the presence of a mentor during key periods of mathematical development (often as early as high school) all played a role in these students' "success." While much of the work in these studies was done with students already securely in a graduate program, they may still have implications for the transition to graduate school: Encouraging new graduate students to develop the good habits of thriving students in their program may help smooth the transition into graduate school in mathematics.

In 2002, Herzig qualitatively examined persistence specific to graduate school in mathematics by conducting a case study of one mathematics department. She interviewed both current students in the doctoral program and some who had left the program, as well as faculty members in this department, to investigate factors influencing doctoral student persistence and attrition. Herzig found that legitimate peripheral participation both in departmental life and in the field itself encouraged persistence in a doctoral mathematics program.

Useful work has also been done in recent years regarding the transition from secondary to tertiary mathematics as colleges and universities have tried to narrow the gap among various groups of incoming college freshmen. For instance, Selden (2005) discussed this transition to collegiate mathematics, noting that new college students must often reconceptualize ideas from previous mathematical training (such as the idea of a tangent line) in order to incorporate them into the new, demanding educational structure they have encountered. As another example, Kajander and Lovric (2005) detail McMaster University's efforts to address this transition through surveys of students' mathematical backgrounds, course redesign, and provision of a departmental review manual to enable students' voluntary preparation for their mathematics courses. They noted that students' motivation, ability to delve beyond surface learning, and secondary school preparation in mathematics were all key to the transition process. Transferring the ideas from these two studies to the transition to graduate school in mathematics identifies several relevant issues in this transition process: undergraduate preparation, ability to both reconceptualize prior knowledge and dig deeply into new mathematical material, and a "bridge" review process prior to graduate work.

Research questions. Building on the aforementioned work, I seek to establish a clear picture of what happens during the transition to graduate school in mathematics in the United States so that further research can be done on the impact of various aspects of or changes to this process. Accordingly, the purpose of this study is to explore the academic transition to graduate school in mathematics—the struggles students face, the expectations they must meet, and the strategies they use to deal with this new chapter in their academic experience. In particular, I am seeking answers to the following exploratory research questions: What happens during the academic transition from undergraduate student to graduate student in mathematics? How do professors' expectations of new graduate students' mathematical knowledge affect students' success? How do new graduate students in mathematics adjust to the rigors of graduate school and/or compensate for prior knowledge deficiencies? How do attitudes, beliefs, and relationships play a role in the success of new graduate students in mathematics? I hope that this research will provide a more accurate picture of graduate student preparation for and experiences in graduate school in mathematics; then, we can work to modify resources for prospective and current graduate students accordingly to help make the transition as smooth as possible.

Research Design

I have chosen to conduct an exploratory single-case study to delve into the in-depth meanings of one mathematics department's experiences with the transition to teaching. To fully explore these experiences, I am following Herzig (2002) and conducting interviews with both graduate students and faculty members in this department. In keeping with a post-positivist stance, I am striving for a rigorous, scientific approach to my research (Creswell, 2007) while allowing a place for intuition (Crotty, 1998). Furthermore, the "truth" derived from participants' experiences will not be absolute, but my data can still show how participants describe and perceive aspects of their transition experiences. These data can also help construct a valuable portrait of this experience to aid admissions, advising, graduate student life, and other aspects of

mathematics departments' and universities' preparation for and support of new graduate students in mathematics.

Both graduate student and faculty semi-structured interviews are centered around the research questions given above, with probing questions included as needed. The student interviews are allowing me to ask specific questions about my participants' experiences surrounding the transition to graduate school, while the faculty interviews will provide a new perspective on the same aspects of the transition experience. Graduate student interviewees are being selected from among those who had taken core courses in the Ph.D. track at this university and who were interested in participating in the study (as indicated in a brief online survey). Based on these survey responses, maximal variation sampling (Creswell, 2007) ensures that selected participants vary along characteristics such as gender, year of program entry, year core courses were taken, and degree sought to avoid highlighting issues specific to any particular subgroup. Faculty interviewees will be selected from those who had recently held positions related to graduate students—such as Chair, Associate Chair, Graduate Director, or core course instructor—and who are willing to participate. As interviews and transcription are completed, I will use an open coding procedure (Strauss & Corbin, 1990) to build a structure to this transition that is grounded in participants' views (Creswell, 2007). Preliminary codes will be merged to identify themes in the data; this analytic inductive process (LeCompte & Preissle, 1993) should help me discover areas of this academic transition that are impacting students' success, as well as recruitment, retention, and other areas.

Results and Implications

As of the submission of this proposal, data collection is still ongoing, so any statement of results would be premature. However, based on the literature, preliminary data collection, and personal experience, I expect to identify themes in the transition experience that have implications for recruitment, retention, and other graduate program protocols and policies. Also, the generation of a clear portrait of the transition experience can help inform future research questions and methods in this area. Preliminary results and implications based on student interview data will be complete in time for the conference. I hope to generate a conversation with other researchers interested in this topic to help me refine the themes and conclusions I am drawing from my data.

Questions

During the presentation of this preliminary research report, the following questions will be posed to audience members to generate discussion useful to the continuation of analysis and to other future work in this area:

- What other data might be useful to help complete a picture of this transition experience in this department?
- What other implications might the results hold for recruitment, retention, departmental policy, or other aspects of the graduate student experience?
- What other pieces of literature, frameworks, or research contacts might be relevant to or helpful for my work?
- Based on your experience, what things should I have considered (or reconsidered) in conducting this study? That is, what general feedback can you give for current or future work?

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