Panel on Doctoral Programs in Mathematics Education

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Abstract. This report summarizes the panel discussion on doctoral programs in mathematics education at the 2008 Conference on Research in Undergraduate Mathematics Education.

In September 2007, 150 mathematics educators from 92 institutions of higher education met in Kansas City, Missouri, for the conference, *Doctoral programs in mathematics education: Progress in the last decade*[1]. The goals of the conference were to exchange information and develop plans for improving the quality of mathematics education doctoral programs. The conference was organized around six themes: mathematics, curriculum, policy, teaching, diversity, and technology. These thematic choices were based, in part, on the core competencies proposed in the policy document *Principles to Guide the Design and Implementation of Doctoral Programs in Mathematics Education* (Association of Mathematics Teacher Educators, 2002). That policy document, in turn, was based on the discussions and documents generated by the predecessor to the Kansas City meeting, the 1999 *National Conference on Doctoral Programs in Mathematics Education*, including *One Field, Many Paths* (Reys & Kilpatrick, 2001). There will be an edited volume, tentatively titled *U. S. Doctorates in Mathematics Education: Developing Stewards of the Discipline*, to be published in 2008 or 2009 by CBMS. This book will contain papers by session leaders that capture the findings and suggestions for various aspects of doctoral mathematics education. Because of the above efforts, the field of doctoral mathematics education is situated well in terms of the data

sources and policy statements available. And, though the area within that field of doctoral programs in Research in Undergraduate Mathematics Education (RUME) has some work to do in developing discipline-specific documents, the general materials are useful for individual institutions in making improvements to their existing programs, including the comparison with other programs and with the larger field of doctoral mathematics education as a whole. One other valuable resource is the database of mathematics education doctoral programs hosted by the website[2] of the Association of Mathematics Teacher Educators (AMTE). As of this writing, the database contains information from 60 institutions about their programs: web links, numbers of graduate students and faculty, program requirements, typical scores of entering students, number of graduates in the past few years, and where graduates take positions. We encourage every program to designate a liaison with the site to enter and update information.

At the 11th annual conference on Research in Undergraduate Mathematics Education, we facilitated a discussion about issues from the Kansas City meeting relevant to the RUME community. In particular, the panel session addressed the national picture in doctoral mathematics education and the challenges facing RUME doctoral programs. The panel also raised questions that might be useful topics for future investigation. This report both summarizes the information about doctoral programs the panelists gleaned from the Kansas City meeting and presents suggestions and questions for further exploration that were important to the community of researchers in collegiate mathematics education at the RUME conference. Though the Kansas City meeting sessions were organized by the six topics listed above, the panel discussion at the RUME conference centered on the cross-cutting issues of doctoral program components (e.g., faculty, students, program focus) and induction experiences of program graduates (e.g., mentoring, job duties).

Doctoral Programs in Mathematics Education

Faculty. Reys, Teuscher, Nevels, and Glasgow (2007) prepared a report for the Kansas City meeting that provided information on 70 (of the 115) doctoral programs in mathematics education in the United States. According to their study, in 2007 there were 2 to 19 mathematics education faculty members per program, about half of whom were tenured. On the other hand, in 23 of the 70 programs surveyed, at least one mathematics education faculty position was *unfilled*. Of particular interest for the RUME community was the fact that approximately 10% of doctoral mathematics education programs were housed in mathematics departments.

Students. Another report prepared for the meeting, by Teuscher, Nevels, and Ulrich (2007), provided Kansas City attendees with information gathered from a survey of current doctoral students in mathematics education. The article was based on 111 completed surveys from students in 50 programs. On average, the students in doctoral mathematics education programs in 2007 were predominantly women (66%) and many students were married (60%). The majority of students held a baccalaureate in mathematics (54%). The master's degrees held by the vast majority of doctoral students (90%) were almost evenly split among degrees in mathematics, in mathematics education, and in other fields (e.g., curriculum and instruction, educational psychology).

Program Requirements. The prerequisite education for entry into doctoral mathematics education programs varied widely. About 50% of the doctoral programs required some form of master's degree in mathematics (M. Arts or M. Science), 30% of programs expected some form of bachelor's degree in mathematics (two-thirds of this group also expected at least 15 semester

hours beyond the B.A./B.S), and 20% of programs had no mathematics degree requirement (Reys, Teuscher, Nevels, & Glasgow, 2007).

A question of interest to the RUME community concerns the mathematics content graduate students encounter in their doctoral programs and the nature of their interactions with mathematics. We know from program web sites that many collegiate mathematics education doctoral programs have additional mathematics requirements beyond the master's and some include comprehensive or qualifying exams in both mathematics and mathematics education (SIGMAA on RUME, 2007). But, how is this mathematical learning connected (implicitly or explicitly) to students' mathematics education learning? Though this question was not central at the Kansas City meeting, it is a core one for RUME doctoral education. Also of interest to the RUME community is the potential to tap into the pools of people who enter research mathematics Ph.D. programs with the career goal of being a college mathematics professor (rather than the goal of being a research mathematician). A doctoral degree in collegiate mathematics education, particularly in a program with extensive advanced mathematics learning, is another path to that career goal. How many Ph.D. mathematics students (out of the 2,000 or so admitted to Ph.D. mathematics programs each year) have the college professor goal? How might they be made aware of the alternative path to that goal?

Program Strengths. Doctoral students in the study by Teuscher and colleagues (2007) noted several strengths of doctoral programs in mathematics education. Half of those surveyed remarked on the importance to them of collaboration with highly qualified and productive faculty members, while some (9% to 15%) mentioned the importance of being involved in research projects, clear course requirements and sequencing, opportunities for attending conferences, and writing manuscripts as strengths. The value to students of faculty who are

active in their fields foregrounds a question that arose at the Kansas City meeting. Though there were 115 institutions awarding doctorates in mathematics education between 1999 and 2005, more than one-third of these schools (40 of 115) had only 1 graduate during that time (Reys et al., 2007). The question was: in what sense did these 40 students have access to *programs* in mathematics education, including faculty and graduate student collaboration?

Programs and a "Common Core." The question of the existence of a common core of knowledge for all doctorates in mathematics education was a significant area of discussion at the Kansas City meeting. Associated with this topic were the corollary distinctions between professional and research degrees, between doctor of philosophy and doctor of education, and among program goals such as (to name just two) preparing graduates to be leaders who work with teachers to develop better teaching practice and programs that focus on preparing academics who will do basic research in education. Also, as was noted at the Kansas City meeting, there are many aspects of professional academic and non-academic work, such as grant writing or how to teach methods courses, which do not form part of many doctoral programs. Mathematics education is not unique in this regard, as the diversity of professional-research purposes in our field echoes conditions across all disciplines in doctoral education (Golde & Walker, 2006).

Mentoring. One way of responding to the multiplicity of purposes in doctoral education that arose at the Kansas City meeting was to view the completion of the doctorate as a starting point rather than as an ending. In particular, we suggest that a common goal for mathematics education doctoral programs can be to help graduate students to learn how to learn, with special attention paid to helping graduate students develop awareness and skills for a variety of possible future selves based on the completion of the doctorate.

A question that arises immediately from this assertion is: How do we do that? One answer: mentoring. Because the format of many doctoral programs is based on the take-courses-and-then-do-research model, few doctoral students are offered structured mentoring in the exploration and development of career goals. The felt need for mentoring in doctoral work is more universal than just mathematics education graduate programs (Golde & Walker, 2006). Moreover, the value of mentoring goes beyond the doctoral program years.

Induction of Mathematics Education Doctorates in their Future Work

U.S. universities graduate about 100 new doctorates in mathematics education each year (in comparison, U.S. institutions produce over 1,000 doctorates in mathematics each year). One finding from the research leading up to the Kansas City conference was that about 50% of mathematics education doctoral graduates do not seek jobs in higher education (Glasgow, 2000; Reys, 2006). Instead, half of graduates take jobs in K-12 teaching and administration, in governmental agencies, educational assessment and publishing, or other places. Of interest to the RUME community are the questions: What are the most common jobs taken by RUME doctoral graduates, and what is the distribution across these jobs? What are their job responsibilities? Have they been well prepared by their doctoral programs for tackling these duties? What strategies are useful in supporting the induction of new doctoral graduates into the profession (especially in higher education)? How can the community of mathematics educators facilitate ongoing learning opportunities in key areas (e.g., evolving research techniques, technological advances) as well as the higher education areas of teaching, research, and service?

For those graduates who do enter higher education, induction opportunities range from informal to formal and quite structured. Institution-provided mentoring mentioned in Kansas City included:

- personnel-based strategies like mentoring teams,
- emeritus faculty mentors for new hires and peer-mentoring,
- co-advising of doctoral students for induction into the role of research advisor,
- activity-based mentoring (e.g., participation in grant-writing workshops),
- university-sponsored writing seminars, or
- returning to the doctoral-granting institution to see it through new eyes.

Among the ways recent doctoral graduates have had access to mentoring include the National Science Foundation funded Centers for Learning and Teaching (CLTs), where novice and more experienced researchers in associated fields collaborate on work that is focused on the teaching and learning of mathematics and science. This work might be at any grade level, including collegiate learning and teaching. Future induction possibilities included an AMTE Mentoring Task Force that would support the development of policy documents, establish an AMTE Committee on Mentoring, and would create an AMTE-sponsored Mentor Program. Finally, within the research mathematics community, the Mathematical Association of America's Project NExT already provides some mentoring and community-building for doctorates from mathematics departments, including those whose doctorates are in mathematics education. However, the professional enhancement and mentoring in Project NExT are founded on the assumption that the NExT fellow is someone whose research and teaching is in mathematics, *not* in the social science traditions found in mathematics education.

There are opportunities here for the RUME community to develop documents and experiences that help mentor doctoral students and recent graduates. In particular, a final question arises: How do we mentor our doctoral students and graduates for becoming stewards of the discipline, regardless of the employment they take?

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[1] For information about the conference, including agenda and presentations from keynote speakers, please see http://mathcurriculumcenter.org/conferences/progress/.

[2] Association of Mathematics Teacher Educators Doctoral Programs Database is available at http://matheddb.missouri.edu/survey/start.php