

Mathematics Education Positions in Higher Education and Their Applicants: A Many-to-One Correspondence

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The National Research Council reported that during the 1990s, there were between 80 and 115 new doctoral graduates per year in mathematics education [6]. During the same decade, job openings for people with doctorates in mathematics education increased significantly and currently exceed the supply [5]. In a survey of institutions of higher education conducting national searches to fill mathematics education positions during the 2000-01 academic year, I found 134 announced positions in mathematics education. This article presents some information from the survey and documents the shortage of doctorates in mathematics education.

Introduction

One reviewer of this paper asked, "Why should a research mathematician care about a shortage of doctorates in mathematics education?" This question came as a complete surprise to me, as I naively assumed that this shortage would be of keen interest to the entire mathematics community. As I pondered the question, I thought about presidents of the AMS (from E. H. Moore to Hyman Bass) who have expressed both interest in and strong support for teaching and learning mathematics, which is the heart and soul of mathematics education. Such mathematicians have often served as ambassadors for mathematics education within the mathematics community, and have bridged the chasm that seems to separate mathematicians from mathe-

tics educators. This encouraged me to think of reasons why mathematicians (research or otherwise) should care about the shortage of doctorates in mathematics education. Here are a few:

- 1) Because doctoral programs in mathematics education typically require numerous courses in advanced mathematics, doctoral students in mathematics education generate many credit hours (and revenue) for mathematics departments.
- 2) Doctoral students in mathematics education often teach entry-level and service courses in mathematics departments. Thus, a shortage of doctoral students means heavier teaching loads for regular professorial-level faculty.
- 3) Search committees and department chairs need to be aware of the supply of and demand for doctorates in mathematics education. Informed with this information, search committees will likely be more aggressive in their searches, extend the outreach of their job announcements, and make their salary offers competitive.
- 4) Knowing about the shortage of doctorates in mathematics education, research mathematicians can alert their students to career options in mathematics education.
- 5) A significant number of doctorates in mathematics do not continue to do research in mathematics after their doctoral program. However, they do teach mathematics at the collegiate level and frequently have opportunities to work with prospective K-12 teachers. In order to prepare these students

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adequately for the work they will be doing, doctoral programs in mathematics should consider including opportunities for doctorates in mathematics to become aware of the issues, research, and opportunities in mathematics education.

- 6) Doctorates in mathematics education represent a group with many of the same interests and goals as mathematicians. Faculty in both areas have much to gain by working together. They should seek each other out and explore opportunities for collaboration, including joint efforts to seek external funds to support their efforts.

The mismatch between the number of available positions and the number of new doctorates in mathematics education is exacerbated because many new graduates of doctoral programs in mathematics education never apply for positions in mathematics education. About 30 percent of new mathematics education doctoral graduates were on leave from or were already employed by an institution when they completed their degree [1]. These people returned to previous jobs or never left their institution while working on their doctorate and therefore never entered the job market. Another 20 percent of new graduates (including international students) take positions outside the United States or assume a range of other jobs, including working for publishing companies, test developers, government agencies, and K-12 school districts. Thus, of the new doctorates each year in mathematics education, only about half of them vie for announced mathematics education positions in higher education [1].

It is surprising that the discipline of mathematics education maintains no annual survey of openings or placements, yet information regarding doctorates in mathematics is reported annually. In fact, since 1957 the *Notices* has provided annual updates about mathematics doctorates, including number of degrees awarded, specialty areas in mathematics, job opportunities, and salaries for new graduates with Ph.D.'s in mathematics. This information is compiled by an Annual Survey Data Committee, and includes representation from the AMS, the American Statistical Association, the Institute of Mathematical Statistics, and the Mathematical Association of America (MAA). The information collected is so detailed and comprehensive that the annual report [4] in the *Notices* is split over several issues.

During the last two years, I chaired committees at the University of Missouri searching for tenure-track faculty in mathematics education. Although we had three positions and sought applicants aggressively, we received fewer than 20 applications for the three positions. During this same period, the Department of Mathematics received over 400

applications for six positions in mathematics. The application-to-position ratios in mathematics and in mathematics education are significantly different. The few applicants together with the large number of positions in mathematics education suggest that competition for applicants holding doctorates in mathematics education is keen. Although personal testimonies describing the challenges of recruiting faculty with doctorates in mathematics education are abundant, there has been no systematic effort to report the extent of the success or failure of the searches.

The Survey

In an effort to document the job market for doctorates in mathematics education, I surveyed higher education job searches announced and conducted during the 2000-01 academic year in the United States for doctorates in mathematics education. From October 2000 to April 2001, I compiled a list from several sources¹ of higher education institutions that nationally advertised positions for doctorates in mathematics education.

I sent a survey to 133 institutions that announced a faculty position for a doctorate in mathematics education or a position that called for a doctorate in "mathematics or mathematics education" (see <http://showmecenter.missouri.edu/position/survey.html> for a copy of the survey). Nearly 90 percent (119/133) of the institutions responded. The 119 institutions represented small colleges and large universities, including both public and private schools. I used the 2000 Carnegie Classifications (see <http://www.carnegiefoundation.org/Classification/index.htm> for details of the classification) to categorize the responding institutions. In Table 1 the Carnegie classifications are accompanied by the roughly equivalent groupings (defined in [2]) that are familiar to *Notices* readers from the annual survey of mathematics doctorates [4].

The 119 institutions announced searches for a total of 134 positions, all but one being tenure-track. Over half (51 percent) of the positions were in mathematics departments, 44 percent were in schools of education, and the remaining positions were joint appointments. Table 1 summarizes the rate of return by type of institution.

The majority of positions in mathematics departments were in institutions from Group M and Group III, whereas the majority of positions in education were in research universities (Groups I and II).

¹Specific sources used to locate job openings are available upon request from the author.

Institution type	Mathematics Departments			Schools of Education		
	Number Sent	Number Returned	Percent Returned	Number Sent	Number Returned	Percent Returned
Baccalaureate & Associate Colleges (Group B)	4	3	75	3	2	67
Master's Colleges & Universities I (Group M)	40	38	95	17	15	88
Doctoral/Research Universities-Intensive (Group III)	18	16	89	8	6	75
Doctoral/Research Universities-Extensive (Groups I & II)	11	10	91	32	29	91
Total	73	67	92	60	52	87

Table 1: Rate of return job search surveys in mathematics departments and schools of education by institutions according to the Carnegie Classification.

Nature of Positions

The survey included questions designed to provide insight into the nature of the announced positions. In response to the question, “What best describes the research and publication expectation for this position?”, 80 percent of respondents marked “Essential for tenure and promotion”, 16 percent marked “Encouraged but not essential for tenure and promotion”, and 4 percent marked “Excellent teaching is the number one priority, research and publication not important for tenure and promotion”. The responses were uniform across institution type, but research and publication were “essential for tenure and promotion” at all institutions offering doctoral degrees.

The survey asked about the major teaching responsibilities of the positions and the grade-level focus of the courses. At schools of education, the overwhelming majority (89 percent) of the required teaching involved mathematics education courses. At mathematics departments, over three-fourths of the teaching involved both mathematics and mathematics education courses. The grade-level focus of the courses was distributed across the K-12 areas, which demonstrates the need for mathematics educators’ expertise to span a wide range of levels—from elementary grades to senior high school.

Salary Ranges

Figures 1 and 2 show the reported salary ranges for the positions. For both mathematics departments and schools of education, the most frequent salary ranges were \$40,001 to \$45,000 at the assistant professor level and \$50,001 to \$55,000 at

the associate professor level. Over 80 percent of the positions at the associate professor level in either mathematics departments or schools of education had salaries above \$50,000. Many of the respondents requested salary information. One mathematics department chair said: “We have not been successful in hiring mathematics educators, but we don’t know if our salaries are competitive with other institutions. We are anxious to learn from your survey what salary level is required.”

Applicants and Hires

The number of applicants for the advertised positions varied greatly, ranging from 0 to 60. The position that attracted 60 applicants was for a mathematics education position in

a mathematics department, and the majority of the applicants had Ph.D.’s in mathematics. Overall, the number of applicants for the announced positions typically ranged from 2 to 10. The number of applicants interviewed for a position was as high as 7, with a mode of 2 interviews on-site. Of the 134 positions available, 66, or 49 percent, were not filled. Table 2 reports the number of hires by mathematics departments and by schools of education according to institutional type.

About one-third of the hires (24/68) were in Group M mathematics departments, and nearly another one-third (20/68) were in education schools at Doctoral/Research Universities-Extensive. Mathematics departments in groups I, II, and III made about one-sixth (11/68) of the hires.

Tables 3 and 4 provide two different perspectives of the distributions of hires and no hires. Table 3 shows the frequencies of hires with respect to institutions, and Table 4 reports the distribution by academic unit.

Discussion

About 20 percent of the respondents not only completed the survey but also sent personal notes with a range of comments. For example, some respondents (most often ones from mathematics departments) indicated that they were unaware of the job announcement services provided by the National Council of Teachers of Mathematics, the Association of Mathematics Teacher Educators, and the Special Interest Group for Research in Mathematics Education. Respondents from mathematics departments typically reported using the job listings

of the AMS, the MAA, and the Association for Women in Mathematics, as well as Employment Information in the Mathematical Sciences (EIMS) to reach potential candidates. They also sent announcements to mathematics department chairs, so their efforts to recruit doctorates in mathematics education were directed toward the mathematics community. Respondents in departments of mathematics and in schools of education frequently reported being unaware of ways to reach qualified minority candidates in mathematics education.

Chairs of search committees also expressed surprise at the range of academic backgrounds of doctoral students in mathematics education. While diversity of experience is a strength, the lack of a common core of course work stimulated a frequently recurring question: What does it mean to complete a doctorate in mathematics education? Defining mathematics education as a discipline has long challenged mathematics educators, and addressing the issue of a “common core of knowledge” generated a spirited discussion at the National Conference on Doctoral Programs in Mathematics Education [6]. This issue prompted a call for seriously discussing the need for and value of guidelines for doctoral programs in mathematics education that would further define the discipline [3].

Several respondents reported that the majority of their applicants had a doctorate in mathematics, with no record of knowledge or experience in the field of mathematics education. Four institutions reported hiring a Ph.D. in mathematics to fill their mathematics education positions. This is likely an underestimate of the number of institutions that hired mathematicians to fill mathematics

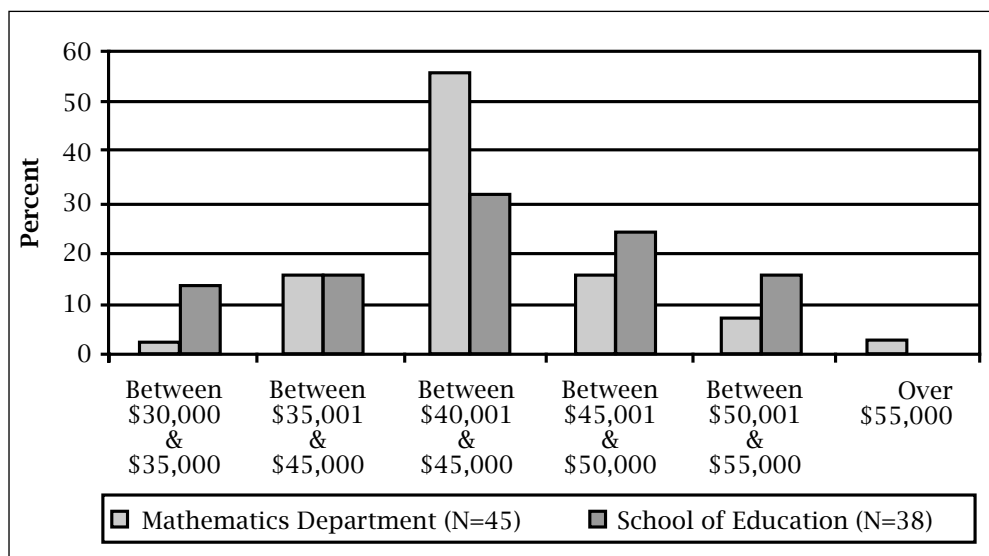


Figure 1. Salary range for assistant professors in mathematics departments and schools of education.

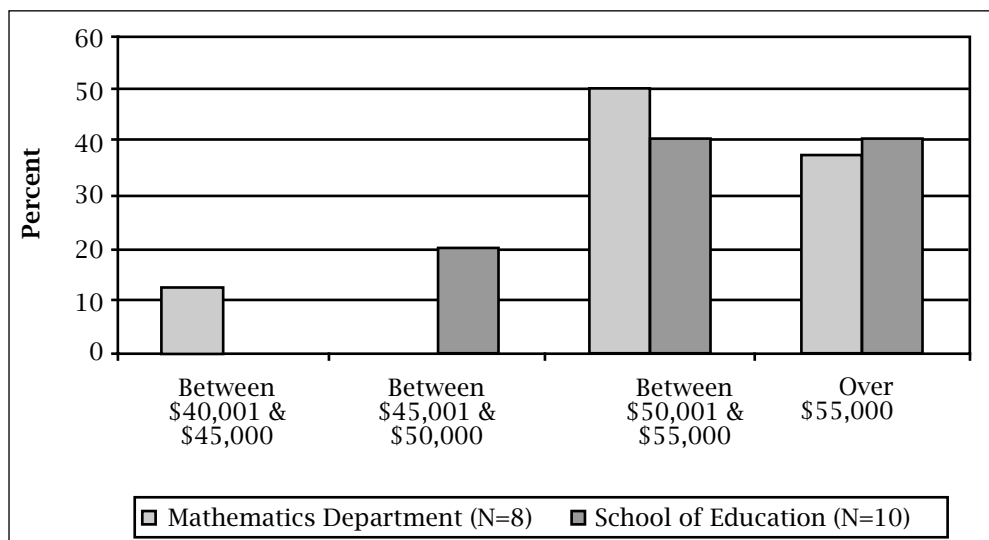


Figure 2. Salary range for associate professors in mathematics departments and schools of education.

Institution	Mathematics Department	School of Education	Joint appointment
Baccalaureate & Associate Colleges (Group B)	0	1	0
Master's Colleges & Universities I (Group M)	24	5	0
Doctoral/Research Universities-Intensive (Group III)	8	3	2
Doctoral/Research Universities-Extensive (Groups I & II)	3	20	2
Total	35	29	4

Table 2: Distribution of the 68 hires by institution type.

Institution type	Number of Hires	Number of No Hires
Baccalaureate & Associate Colleges (Group B)	1	4
Master's Colleges & Universities I (Group M)	29	32
Doctoral/Research Universities-Intensive (Group III)	13	9
Doctoral/Research Universities-Extensive (Groups I & II)	25	21
Total	68	66

Table 3: Frequency of hires (68) versus no hires (66) by institutional type.

Academic unit	Number of Hires	Number of No Hires
Education	29	29
Mathematics	35	33
Joint appointment in mathematics & education	4	4
Total	68	66

Table 4: Frequency of hires (68) versus no hires (66) by academic unit.

education positions, because the survey was not designed to collect this information.

Many respondents reflected frustrations with their searches, and the greatest frustrations centered on the small pool of qualified applicants. The inability to recruit successfully was experienced by all types of institutions and by departments of mathematics as well as by schools of education. The main reason positions went unfilled was an inability to attract a candidate whose qualifications matched the job description. Often the same candidates were interviewing for positions at several institutions, and the competition for these new doctorates was keen. One respondent from a major institution reported:

“Our top candidate had seven offers within a month and accepted a position within one week of interviewing at one place...before we could interview him!”

The frustration of unsuccessful searches is reflected in remarks from a search chair at a four-year college:

“This is the second consecutive year that we have searched unsuccessfully for a mathematics educator, and I must say that I am not particularly optimistic that we will be successful next year...I hope work is being done on creating multiple solutions to the problem that we face in recruiting mathematics educators.”

Positions calling for interest and expertise in working on improving K-8 teacher preparation and doing research related to elementary mathematics education were particularly difficult to fill. Several respondents indicated a desire to find someone with elementary teaching experience AND a *strong* mathematics background. Such candidates are rare, for elementary teachers are required to take very few mathematics courses in their undergraduate programs. Lacking foundational courses necessary to study advanced mathematics, the elementary teacher who completes a doctorate in mathematics education with a *strong* mathematics background is exceptional.

The survey also asked if respondents “anticipated openings” for mathematics educators for 2002-03. More than 80 openings were projected (58 institutions anticipating one opening, 23 anticipating two openings, and 2 institutions anticipating three openings) that were independent of the “no hire.” This finding, coupled with the “no hire” for 2000-01 and the current production level of new doctorates in mathematics education (typically less than 100), suggests that the current shortage of doctorates in mathematics education will become even more acute.

Conclusion

This article provides baseline information regarding job searches in higher education for doctorates in mathematics education. The review of applicants rekindled the questions: What characterizes a doctorate in mathematics education? Is there a core or canon of knowledge? These are important questions in need of answers.

It should be noted that the data presented here underestimate the number of jobs available for doctorates in mathematics education, for the list of positions included only national searches announced by institutions of higher education. Omitted are job announcements from publishers, test development companies, governmental (state/federal) agencies, and school districts, where shortages also exist. Furthermore, many institutions—particularly junior colleges and four-year colleges—advertise position openings only on a local or regional basis. Indeed, a recent study [1] determined

that about two-thirds of the recent graduates in mathematics education were employed at institutions without doctoral programs, yet only about one-third of the 134 job listings in my survey were from these kinds of institutions.

More than half of the announced jobs for doctorates in mathematics education were in mathematics departments. Only about half of the announced mathematics education positions were filled either in mathematics departments or in schools of education. This fact, coupled with anticipated future openings and projected retirements [5], suggests that future demands for doctorates in mathematics education will be great. This many-to-one correspondence between jobs and applicants in mathematics education underscores the need for the mathematics and mathematics education communities to work together to explore ways of increasing the production of doctorates in mathematics education. I hope that this article will help to stimulate increased collaboration.

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