Report of a 2007 Survey of U. S. Doctoral Students in Mathematics Education

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Report of a Survey of Current Doctoral Students in Mathematics Education

In preparation for the 2007 National Conference on Doctoral Programs in Mathematics Education, a survey was conducted to gather information about program components and graduate production. A faculty member from each of 70 institutions with doctoral programs in mathematics education that had responded to an earlier survey (Reys, Glasgow, Teuscher, & Nevels, 2007b) were contacted. Representatives were asked to provide three names of current doctoral students in mathematics education that could be contacted to participate in a survey. Faculty members from 52 of these institutions provided names and email addresses for 157 current doctoral students. Four of the email addresses were undeliverable and three names submitted were no longer graduate students as they had recently graduated. We contacted the remaining 150 doctoral students across 50 different institutions, inviting them to respond to a survey. Responses were received from 111 students (74%) representing 90% of the contacted institutions. The results reported here are based on information self-reported by the 111 doctoral students who responded to the survey.

These survey results are meant to supplement the information received from the earlier survey of doctoral programs (Reys et al., 2007b). We sought to confirm general information about graduate programs provided by faculty members, but also to gather new information useful to institutions and students in doctoral programs in mathematics education. Doctoral students were given the opportunity to disclose various aspects of their educational experience ranging from their reasons for choosing their institution to where they intend to work. We hope this information helps inform the decision-making process of doctoral programs in several ways. Understanding what motivates students to choose a particular institution may aid doctoral programs in the recruitment process. Ascertaining the educational background and teaching experience of entering doctoral students may assist in determining how to design and develop programs that will best serve the students. Finding where new doctoral graduates seek employment may allow institutions to identify strong program areas as well as reveal areas in need of strengthening.

Citizenship and Gender of Doctoral Students

Citizenship and gender data reported on this survey is consistent with data reported on the Doctoral Programs survey (Reys et al., 2007b). One doctoral student did not provide citizenship. About 90% of the respondents are citizens of the United States. Seven different countries were represented by the other respondents, and the percent of international students is consistent with an earlier study by Glasgow (2000). Sixty-six percent of respondents are female, which is consistent with the two-decade trend of more female doctoral students in mathematics education than their male counterparts (Reys, Glasgow, Teuscher, & Nevels, 2007a).

Doctoral students' ages ranged from 24–64 with an average age of 36 and a mode of 31. Nearly three-fifths (59%) of the doctoral students in the survey are married.

Educational Background and Teaching Experience

A significant concern across doctoral programs in mathematics education is students' educational background and teaching experience. Doctoral programs have varied requirements

for acceptance into their respective programs. Some programs require teaching experience while others do not. On the other hand, some require a Master's degree in mathematics or mathematics education, while others do not stipulate a minimum standard for collegiate level mathematics study.

Students reported receiving undergraduate degrees in many different fields. Majors included: Education (e.g., elementary, middle, policy, special, curriculum & instruction), Engineering (e.g., chemical, mechanical, computer), Mathematics (e.g., computational, applied, pure), and Science (e.g., microbiology, physics). Table 1 displays the percentage of students' first and second Bachelors' degrees across different content areas. About half of the doctoral students (50%) held a Bachelor's degree in mathematics while 15% of respondents held a Bachelor's degree in mathematics education. Education - related fields (e.g., mathematics education, psychology, and education) accounted for less than one-fourth of undergraduate degree programs.

Table 1
Bachelors' degrees of doctoral students in mathematics education (N=111)

Major	1st Bachelor's degree	2nd Bachelor's degree
Mathematics	50%	4%
Mathematics Education	15%	2%
Education	6%	2%
Engineering	5%	
Psychology	2%	1%
Science	2%	1%
History	2%	
Liberal Arts	2%	
Computer Science	1%	1%
Administration	1%	
Business	1%	
Interdisciplinary	1%	
Human Ecology	1%	
Film and Media		1%
Music		1%

Mathematics majors (50%) were dominant at the undergraduate level for current doctoral students, but their major course of study shifted to be more closely aligned to Education (e.g., teaching & leadership, curriculum & instruction, science education, mathematics education, middle, elementary) at the master's level. Table 2 displays students' content areas for first and second Masters' degrees. Mathematics education majors (32%) lead all categories for Master's degrees, while Education-related degrees (mathematics education, education, counseling, science education, technology in education) accounted for 58% of all majors at the master's level. About 30% of the doctoral students held master's degree in mathematics.

Teaching experience varied among respondents with the majority (77%) indicating they were certified to teach mathematics in some K-12 grades. Thirty-four percent of respondents indicated two certifications and 14% earned a third. The respondents received their teaching certification

from 6 countries (Colombia, Kenya, Puerto Rico, Slovakia, Turkey, USA). Respondents reported 31 different states as the grantor of their certifications in the USA.

Table 2
Masters' degrees of doctoral students in mathematics education (N=111)

Major	1st Master's degree	2nd Master's degree
Mathematics Education	32%	4%
Mathematics	29%	1%
Education	23%	3%
Business	2%	
Counseling	1%	
History	1%	
Multimedia Systems	1%	
Science Education	1%	
Technology in Education	1%	
Viral Oncology	1%	
Statistics		2%

Six grade bands were created to encompass the variety of grade level certifications. Figure 1 displays the percentage of students with each level of teaching certification. The majority (54%) of doctoral students were certified to teach at the secondary level prior to entering doctoral programs.

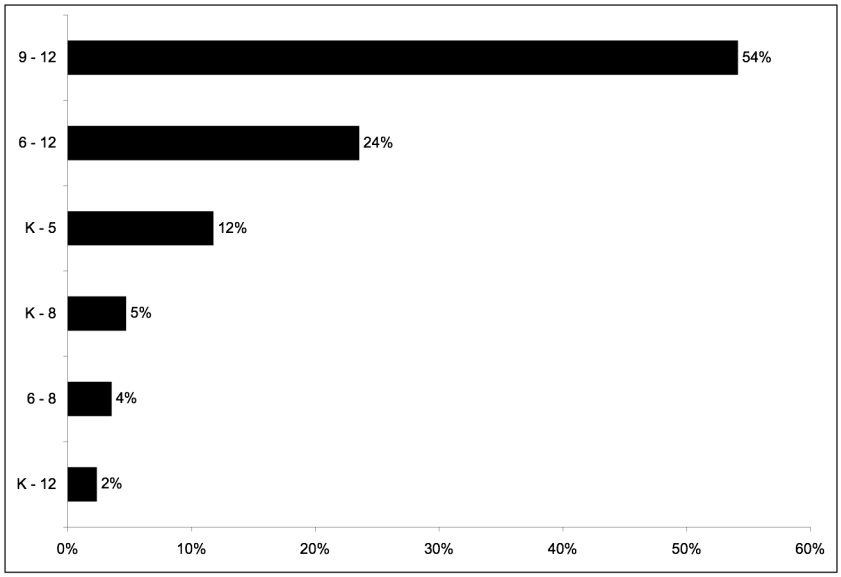

Figure 1. Teaching certifications of doctoral students in Mathematics Education (N=111)

When asked to specify the grade band for the majority of teaching experience, students indicated the following: K-5 (8%), 6-8 (15%), 9-12 (43%), and 13+ (34%). That is, nearly 77% of doctoral students have teaching experience at the secondary or college levels before entering their programs. The number of years doctoral students taught mathematics at the K-12 level varied from 0–31 years with a mean of 5.6 years. One respondent reported having no experience teaching in the K-12 level and also did not have teaching certification; however, this respondent

reported having a Master's degree and several years' teaching experience at a community college. Nineteen respondents indicated they had no K-12 teaching experience. Of these, seven were certified somewhere in the K-12 range. Six more left the question blank; however, the same six all indicated 1 to 10 years (3.8 years average) of teaching experience at the college level.

Choosing Doctoral Programs

Research has documented the shortage of doctoral graduates in mathematics education (Reys, 2002, 2006). Institutions are continually searching for effective methods for recruiting quality students. In response to this issue, doctoral students were asked three questions:

1) Why did you choose to pursue a doctoral degree in mathematics education?
2) How did you learn about different doctoral programs in mathematics education?
3) Why did you choose your current doctoral program?

Figure 2 displays six common responses for why students chose to pursue a doctorate in mathematics education. The most common reason cited was to advance their careers. For example, respondents wanted to become a better teacher, obtain an increase in pay, make a career change, or escape a glass ceiling in an earlier position. Other reasons included the desire to work with preservice teachers (17%) and conduct research that moves the field forward (17%).

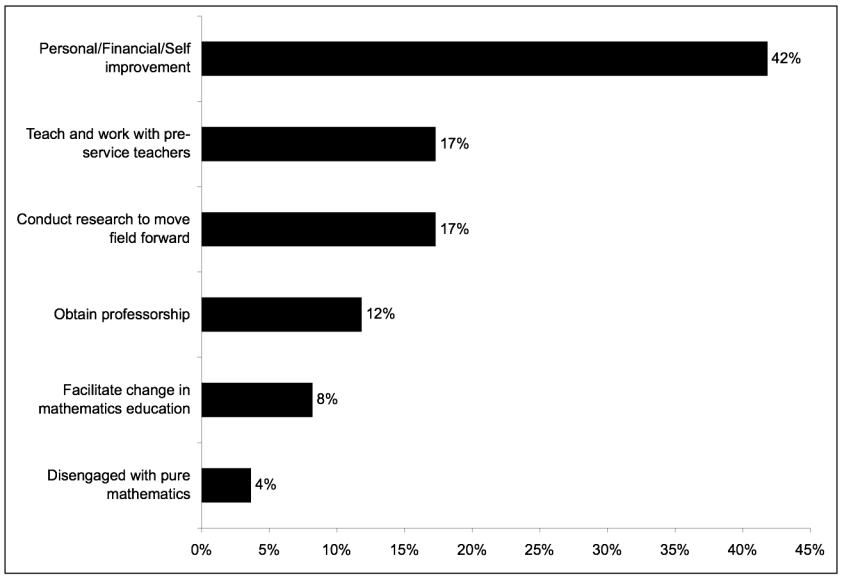

Figure 2. Six reasons given by doctoral students for choosing to pursue a doctorate in mathematics education (N=111).

To assist in the recruitment efforts of institutions, this survey sought information about how prospective doctoral students gained information about potential mathematics education programs. Figure 3 displays commonly cited methods. Respondents indicated they learned about various programs primarily from internet searches or other means of self inquiry (40%). A popular strategy used by many institutions is to advertise in professional journals; however, few respondents (2%) used this method as they searched for programs in mathematics education.

Only two respondents cited the reputation of the institution as a significant factor in their search for doctoral programs in mathematics education.

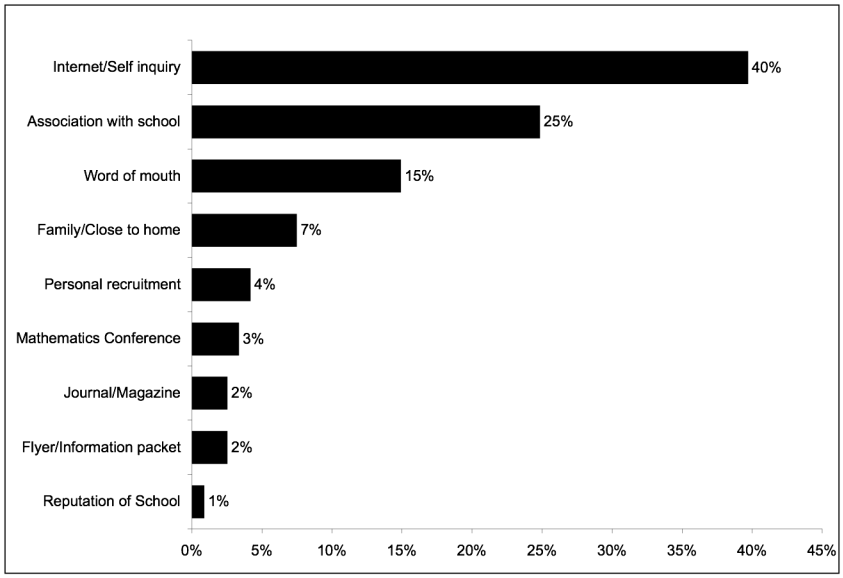

Figure 3. Doctoral students methods for learning of different programs (N=111).

Respondents were asked to identify why they chose their respective program. Figure 4 displays common responses. Family reasons and/or being close to home (30%) were most important in making this decision and were cited more often by married students than single students. The reputation of the school (8%) seemed the least important among the top selections. Other reasons included that the school was in an attractive location, the applicant had a previous relationship with the institution, the tuition was inexpensive, the program was young and growing, and the applicant liked the amount of mathematics content that was required for the program. It is interesting that the reputation of the mathematics education faculty outweighed the reputation of the institution by more than 2 to 1 in their selection process.

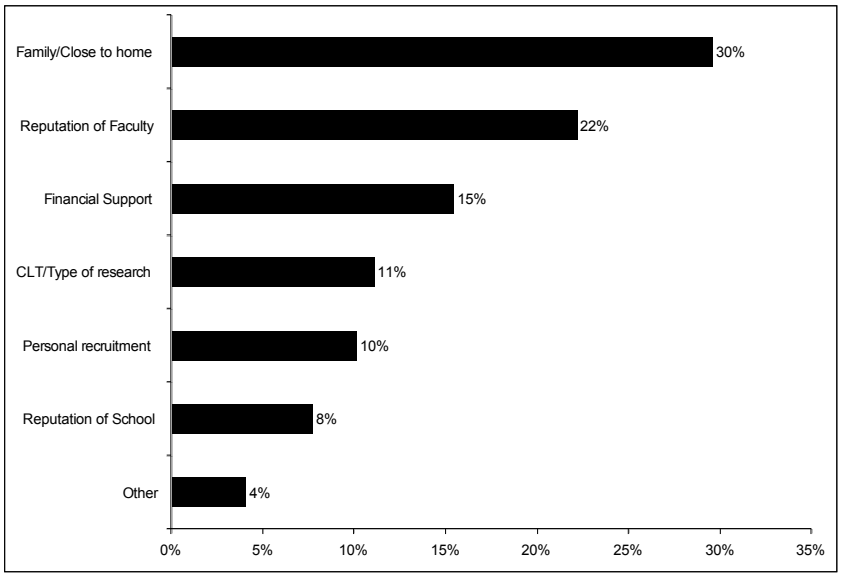

Figure 4. Top reasons doctoral students selected their respective institutions. (N=111)

Mathematical Preparation for Current Students in the US

To gain a better understanding of the mathematical preparation of students entering doctoral programs, respondents were asked to identify all collegiate mathematics courses completed prior to entry. Figure 5 displays the different courses and the percentage of students in our survey that took each course.

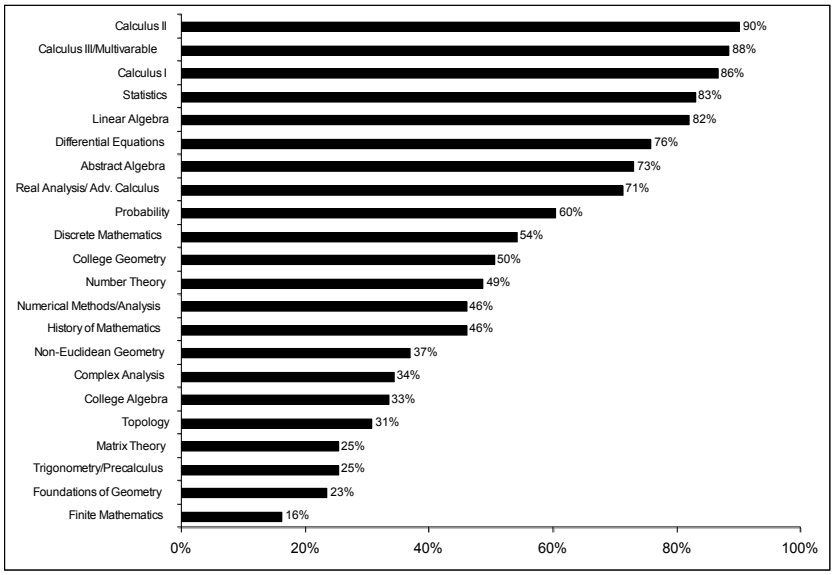

Figure 5. Mathematics courses completed prior to entering a doctoral program (N=111)

Most respondents (86-90%) enter their doctoral program having completed the calculus sequence (Calculus I, II, III). A large percentage of students had also completed Linear Algebra (82%), Differential Equations (76%), Abstract Algebra (73%) and Statistics (83%). However, fewer students enter with a background in geometry (only 50% of students completed a college-level geometry course, 37% completed a Non-Euclidean Geometry course, and 23% completed a Foundations of Geometry course). Thirty-six students responded that they had completed other mathematics courses not listed on the survey, which included Combinatorics, Differential Geometry, Graph Theory, and Mathematical Modeling.

Respondents were asked to list mathematics courses they have or will be completing during their doctoral program. Figure 6 displays the most popular mathematics courses to be completed during their doctoral programs. As might be expected, Statistics was the most popular course completed. This may be because students are required to complete at least one research methods (qualitative or quantitative) course. About a fifth (18%) of students had not taken a mathematics course during their doctoral program. It may be the case that these students entered with a Master's degree in mathematics; however, some students noted their institution did not have a requirement for mathematics courses. It is also interesting to note that the majority of students are entering their doctoral programs with limited, if any, knowledge of geometry at the collegiate level, and only a few of them (14%) are completing a collegiate-level geometry course.

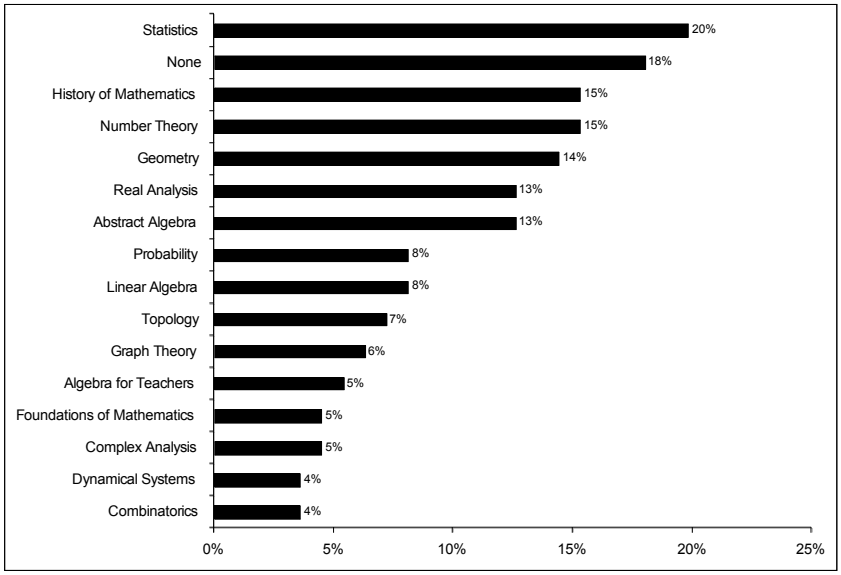

Figure 6. Mathematics courses students completed during their doctoral program (N=111)

Students were asked what level of mathematics course work they would obtain upon finishing their program. Figure 7 displays four different levels of mathematics course work. Almost half (48%) of the students will have obtained a MA/MS degree in mathematics or higher and only 14% of students will graduate with less than a BA/BS degree in mathematics. Eight students did not respond to this question, possibly because they are just beginning their program and are not aware of what mathematics courses they will take.

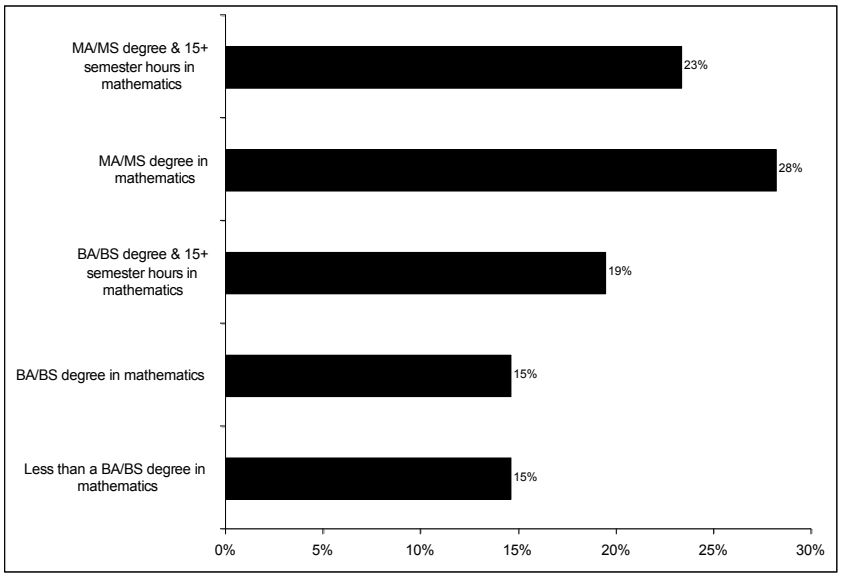

Figure 7. Level of mathematics course work that will be obtained when doctoral students graduate (N= 103)

Looking Forward

As institutions continue to prepare doctoral students to enter into the field of mathematics education, questions arise, such as: what will these new students bring to the field; what research

will these graduates build upon; what new ideas will they develop; and how will these new professionals move the field forward? To address these questions respondents were asked about their current research interests at the time of the survey as well as what type of job they would be interested in pursuing after graduation.

Current doctoral students in mathematics education are interested in a variety of research interests: student learning (32%), teacher knowledge and learning (23%), curricula topics (21%) and equity (17%). Other research interests noted were elementary mathematics, manipulatives, professional development, and technology. Although these categories are quite broad, they provide some indicators of current research areas of interest.

Respondents were asked to select the top two jobs they planned to pursue after graduating. Figure 8 displays the responses. The majority of students plan to take a job in higher education at doctoral (63%), master's level (42%), or bachelor's level (24%) institutions, while few students plan to go back into the K-12 system.

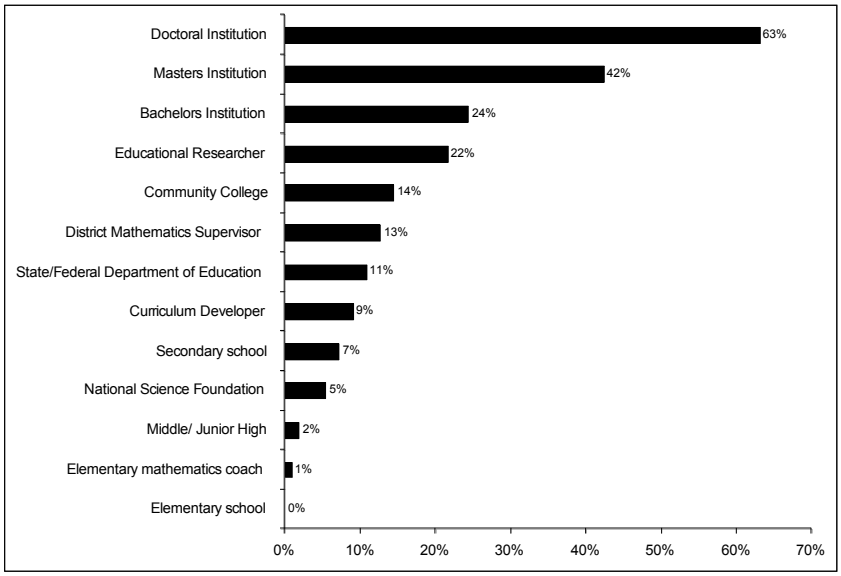

Figure 8. Job opportunities likely to be pursued after graduation (N=111)

Other possibilities noted by doctoral students were: a job in educational policy, a return to a current teaching position at either a university or public school, a postdoc position, and K-12 classroom teaching to gain experience prior to accepting a position in higher education.

Finally, students were asked to identify if they were interested in obtaining a job in a specific geographical region. Figure 9 displays the results with the majority of those that have a preference being in the northeast region of the US. Ten percent of the respondents are planning to work internationally.

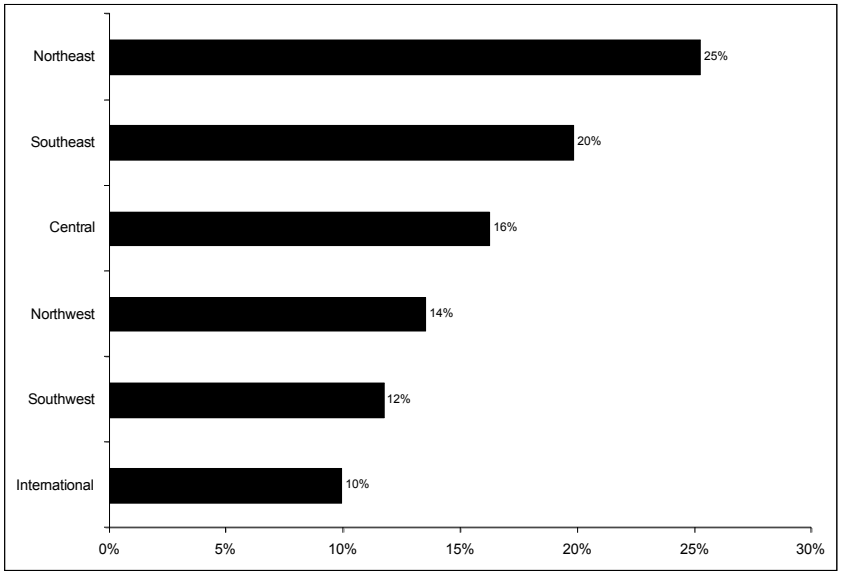

Figure 9. Geographical location doctoral students are interested in obtaining a job

Strengths and Weaknesses of Doctoral Programs

As each institution evaluates its doctoral program in mathematics education it may be of help to understand what current doctoral students across the US believe are strengths and weaknesses so changes can be made to improve doctoral programs. Respondents were asked to identify aspects of their program that were the strongest and weakest. Table 3 lists the most frequently mentioned strengths. The number one strength noted by respondents was collaboration with highly qualified and productive faculty members.

Table 3
Strengths of individual doctoral programs

Strengths	Percent of students (N=111)
Faculty members	50%
Being involved in research projects	15%
Course requirements and sequencing	14%
Many opportunities (conferences, manuscript writing, projects)	9%
Individualized programs	8%
Community of doctoral students	7%
Balance between Mathematics and Mathematics Education courses	6%

Doctoral students also identified general weaknesses of their programs. Table 4 provides a list of the most frequently noted program weaknesses. The most frequently cited weakness was lack of course work in mathematics, mathematics education, research (both general and specific to mathematics education), and other areas. Students also desired to be mentored in writing skills such as grant writing, research design, and the dissertation process. Fourteen percent of students mentioned a lack of faculty, resources, or specific expertise in different areas because they were in a small mathematics education program. Some students (9%) desired to have experience

working with faculty members on research projects before they began their dissertation or graduated from their program.

Table 4
Weaknesses of individual doctoral programs

Weaknesses	Percent of students (N=111)
Course work available	30%
Mentoring	15%
Small program/lack of resources and faculty	14%
Opportunities to work on a research project	9%
Lack of funding	5%
Communication	5%

This survey provides data that may be useful in reflecting and comparing with recent reports on doctoral programs in mathematics education across the US. It is only a snapshot, and it only reflects information gathered from 50 institutions. Nevertheless, it provides a current set of benchmarks to use for thoughtful discussion, and possibly action by individual institutions. Additionally it provides information that our mathematics education community may use as we work toward the never-ending task of improving doctoral programs in mathematics education.

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