

CAREER PATH DECISIONS OF MASTERS-LEVEL MATHEMATICS STUDENTS: A COMPARATIVE REVIEW

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There has been a flurry of research activity, in recent years, on the various aspects of STEM programs in the U.S. Yet there is scant research on vocational selection and career path aspirations of mathematics (hereon, math) students during their graduate-level education. The current study, based on a mixed-design, from data obtained on a small sample ($n=28$) at the University of West Florida: a) compares graduate versus undergraduate (from data reported by Piotrowski & Hemasinha, 2012) math students' career decisions and preferences, and b) analyzes qualitative data on pedagogic factors that most influence career choice at the graduate level. Nearly half of our sample (46%) plan on finding immediate employment whereas one-third intend to pursue additional graduate studies while being employed. Findings indicate that masters-level math students' entry-level career preferences were as follows: Teaching in higher education, positions as statisticians, applied finance, secondary-level instruction, and working as a consultant. Moreover, these students felt that coursework in statistics, operations research, and mathematical modeling provided a robust foundation in the preparation for specific career positions. Despite an avid interest in finding professional positions in their chosen field, 68% of our sample plan on earning a doctoral degree within 10 years. Additional studies need to corroborate these preliminary findings at larger, geographically-diverse university settings in the U.S. Such research should expand the knowledge base on career path issues faced by newly-minted graduates of advanced STEM programs. Future investigations on math majors need to examine emerging issues like gender differences, 'hybrid' majors, and the influence of graduate-level online education on vocational selection.

Introduction

While there is an extensive body of research on vocational interest and career choice of undergraduates enrolled in STEM (science, technology, engineering, mathematics) programs (see Bystydzienski, 2009; Fitzpatrick & Silverman, 1989; Lapan et al., 1996; Lent, 2008; Shivy & Sullivan, 2005), there is limited published

research on career path and selection of STEM students in graduate-level programs (Tobias, 2002). Thus, the vexing question is: What do newly-minted students of graduate-level STEM programs plan to do next after graduation? Moreover, What factors contribute most to their career selection? The current study addresses these issues as it pertains to graduate-level math students

of advanced STEM programs.

Literature Review

Page et al. (2011) touted the success of offering teaching fellowships for socializing graduate students in STEM programs to encourage employment in K-12 school settings. Based on a small sample (n=8) of graduate-level math students, Latterell (2009) failed to inspire interest in secondary-level instruction using a pre-service teaching model. Although career path and ultimate job selection are considered central issues to degree-seeking math students (Piotrowski & Hemasinha, 2001, 2012), few studies examine the process by which graduate students choose their career goals (see Borget & Gilroy, 1994). In a cautionary note, Boen and Kjelsberg (1993) suggest that part of the problem is that due to demanding coursework most math students do not focus on vocational issues (and receive little guidance from math faculty) until the latter stages of their graduate studies. By that time, it is too late to choose elective courses appropriate for specific employment settings or professional roles. This increases the probability of experiencing a poor 'match' for the novice graduate.

More robust data on factors that contribute to the career path of graduate students in math STEM programs are sorely needed. Recent studies from overseas indicate that newly-minted math graduates favor pursuing careers in emerging fields like the biological sciences and the financial sector (see Bourner et al., 2009; Fenwick-Sehl et al., 2009). Moreover, data from the U.S. have shown that over 50% of math undergraduates plan on pursuing

graduate degrees in order to increase job prospects (Piotrowski & Hemasinha, 2001). Thus, it would be of interest to examine the intentions and aspirations of math students, enrolled in masters programs, on their choice of career path and specific job selection.

The Current Study

This investigation, using a mixed-method design, has two main objectives: 1) the quantitative portion is a replication of a recent study, by the current authors, that reported on the career path of undergraduate math majors (see Piotrowski & Hemasinha, 2012), and 2) the qualitative section taps on the courses that most influence students' career selection and the rationale for these views. To that end, a 1-page survey form, comprised of 3 objective questions and 2 open queries, was distributed to students enrolled in a masters-level math program from the School of Science & Engineering at the University of West Florida in Pensacola, FL, during the Spring 2012 semester. Based on completed returns, information from 28 participants served as the basis for data analysis.

The survey inquired about post-graduate pursuits and specific plans (i.e., employment, enrollment in doctoral programs, or both), vocational choice, anticipated occupational field, and specialty training. In addition, an open-ended question addressed the key coursework during graduate education that contributed most to career choice.

Findings

The results, based on the survey data, showed that 46% of our sample of math

Table 1

Immediate Career Path upon Receiving M.S. Degree in Math

	N	%
Employment only	13	46
Additional graduate education	6	21
Pursue further graduate education while employed	9	32

students plan on finding immediate employment upon graduating with a graduate degree, about one-fifth want to immediately attend further graduate studies, and 32% want to pursue additional graduate work while holding down a job (see Table 1). Interestingly, regardless of their immediate aspirations, 68% (n=19) of the sample plan on obtaining a doctoral degree within 10 years of earning their master's diploma; of these, 47% want to emphasize statistics while 32% would like to focus on preparation for becoming a math instructor or professor.

In terms of selection of career choice, these graduate-level math students expressed much diversity in job preference. Based on our data analysis (Table 2), a sizeable minority of the current sample (38%) inspire to have a career in teaching math. Indeed, as shown in Table 2, 38% plan on teaching math at the secondary or college level. However, nearly 20% want to work as statisticians in a host of settings at this stage in their education. Perhaps this interest reflects the value that job-ori-

ented math students have toward competency in statistics as a key ingredient in optimizing specific career options. The high saliency of this career-enhancing skill is corroborated by the fact that about one-third of the students in the current sample (n=9) eventually would like to eventually obtain a doctoral degree in statistics, as already noted.

Several other occupational interest areas were noted by only a few of the respondents: Finance, actuary, professional consultant, and biomedical. Somewhat surprising, only 1 student expressed an interest in becoming an engineer. One reason for this may be that nearly all math majors at the graduate level plan on finding work in math-related occupations; graduate students with a specific career goal in the engineering field would be enrolled in a graduate-level engineering program.

As depicted in Table 2, several comparisons on career preferences between this graduate-level sample and our earlier (Piotrowski & Hemasinha, 2012) undergraduate cohort of math students are noted.

Table 2

 Career Selection for Math Graduates based on Academic Level and Degree Program

	Graduate-level*	Undergraduate-level**
	(n=28)	(n=40)
College-level teaching	29%	20%
Statistician	18%	5%
Finance/actuary	16%	10%
High school teaching	9%	28%
Consulting	8%	-
Government	7%	13%
Biomedical	7%	-
Engineering	3%	10%
Health care	2%	-

 Note. *Current sample; ** Data from Piotrowski & Hemasinha (2012).

It appears that undergraduate math students have higher aspirations in teaching positions, particularly at the secondary level. Moreover, it seems that graduate-level math students have more interest than undergraduates in obtaining work as statisticians or statistical consultants. Differences between the two samples across other occupational fields were negligible (see Table 2). Furthermore, another issue in the survey inquired about any future desire for certification. Only 14% of our sample (n=4) expressed certification as part of their career path, mainly in the areas of teaching and CPA credentials.

Qualitative Analysis

A final query sought to determine the graduate-level courses (up to 2) that best prepared students in achieving their career goals and the reasons for their selection. Table 3 presents the specific courses, based on the responses of the graduate math students. Given the career interest that the current sample holds in statistical applications, it was not surprising to see that over half of the respondents chose statistics courses or related coursework (i.e., probability, regression, statistical packages). Students felt that competency in statistics has practical applications in meeting the demands of solving problems with large datasets or in addressing solutions to

Table 3
Graduate-level Math Courses That Most Influenced Career Path

Course	Mentions	%
Statistics*	17	30
Operations research	6	11
Mathematical modeling	5	9
Biostatistics	4	7
Matrix theory	3	5
Quality control	2	4
Partial differential equations	2	4
Graph theory, Real analysis, Numerical analysis	1	3

Note* This group comprises 5 core courses: Design of experiment, Mathematical statistics & probability, Regression & ANOVA, Nonparametric statistics, Multivariate statistics.

applied issues on projects. In addition, basic and advanced courses in operations research and mathematical modeling were also considered quite relevant in the attainment of specific job positions. Here the issue was a) addressing real-life problems faced by industry, and b) having a framework in understanding the process of research. In contrast to these strictly applied issues, some students appreciated select courses in providing a foundation and theoretical basis of math applications.

Final Note

Future research should: a) examine vocational preferences and career path in samples of STEM graduate students with various 'hybrid' levels of training and pro-

fessional preparation (e.g., math-computer science, math-biological sciences, math-business/finance, math-engineering); perhaps the career path of STEM students may be largely a function of not only vocational interest but also adjuvant academic preparation and attainment across disciplines, b) analyze findings based on gender with regard to career selection and attainment (see Jacquot, 2010; Stoet & Geary, 2012; Wilkinson, 1996; Zeldin et al., 2008), and c) explore the impact that online coursework and programs, at the graduate level, have on preparing math students in adapting personal career goals to the challenges of the contemporary occupational marketplace (Amin & Li, 2010).

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