Teri J. Murphy

I am currently an Associate Professor in the Department of Mathematics at the University of Oklahoma (**OU**). This department offers an research in undergraduate mathematics education (RUME) option in the doctoral program, for which I am one of two faculty members. My areas of work have included

- retention programs, especially programs targeting increases in diversity and equity;
- multi-disciplinary science, technology, engineering, and mathematics (STEM) education, with emphasis on issues of diversity;
- instructional development; and
- statistics education.

In the paragraphs below I describe this work in more detail.

Retention Programs. By *retention programs* I mean academic support structures intended to facilitate student success in courses and curricula in which target populations (typically African-American, Hispanic, Native American, and female students, as well as students from large urban or small rural high schools) have historically not been successful. I have been interested in such issues since I was a graduate student at the University of Illinois at Urbana-Champaign (UIUC), teaching college algebra for the Summer Bridge & Transition Program, an academic support program for "at-risk" students, primarily from urban Chicago and East St. Louis. In fact, my dissertation was about the mathematics component of this program.

During my last year in Champaign, I taught as a visiting lecturer for the Treisman-style Merit Workshop Calculus Program. Subsequently, I published a quantitative analysis of student academic transcript data related to this program (Murphy, Stafford, & McCreary, 1998). While most of my research has drawn on qualitative methods, I believe that quantitative research also offers critical contributions to the field and this article is an example of my quantitative work.

Refereed journal articles and book chapter about retention programs:

Hsu, E., **Murphy, T. J.**, and Treisman, U. (in press). Supporting High Achievement in Introductory Collegiate Mathematics Courses: What We Have Learned from 30 Years of the Emerging Scholars Program. To appear in the forthcoming MAA Notes volume *Making the Connection: Research and Teaching in Undergraduate Mathematics.*

Murphy, T. J., & Wahl, K. (2003). Adapting a workshop calculus model to college algebra: Instructional challenges. *American Mathematical Association of Two-Year Colleges Review, 24*(2). pp. 33-44.

Murphy, T. J., Stafford, K. L., McCreary, P. (1998). Subsequent course and degree paths of students in a Treisman-style workshop calculus program. *Journal of Women and Minorities in Science and Engineering, 4*(4), pp. 381-396.

Multi-disciplinary STEM Education. In Fall 2001, I began to forge partnerships with faculty in other departments. To date, I have worked closely with faculty in African and African-American studies, Computer Science, Environmental Science, Industrial Engineering, Library and Information Science, Meteorology, Physics, Psychology, and Women's Studies, as well as Mathematics and Education. I find these multi-disciplinary projects to be the most satisfying and

to have the most potential to make progress in improving STEM education, by tapping into the power of combined strengths and understanding of multiple perspectives. I was trained as an undergraduate mathematics education specialist, but I have grown into an undergraduate STEM education specialist. Below is a summary paragraph of progress on two of these projects.

PGE-RES: Why does it work? A Study of Successful Gender Equity in Industrial Engineering at the University of Oklahoma – NSF award GSE-0225228 – PI Murphy; co-PIs Harris (Women's Studies), Shehab (IE), Reed-Rhoads (Engineering Education), Trytten (CS)

Portraying Success Among URM Engineering Majors – NSF award STEP-0431642 – PI Shehab (IE); co-PIs Davidson (AFAM), Murphy, Reed-Rhoads (Engineering Education), Trytten (CS), Walden (K20 Center)

These two projects (GSE and STEP respectively) focused on diversity engineering education, investigating factors that contribute to the gender parity achieved by Industrial Engineering (IE) at OU and factors that contribute to the success of underrepresented minority students as engineering majors. These projects were unusual in their emphasis on investigating factors that contribute to success, whereas much of the existing literature focuses on barriers and systemic failures. The primary source of data for both projects was interviews with students. The STEP project is in a data-analysis-intensive year. The completed GSE project was officially completed in December 2006, but we are continuing to analyze the enormous amount of data generated. We completed more than 48 STEP interviews in addition to 267 GSE OU interviews (of 228 individuals), including 29 follow-ups for a longitudinal analysis, plus 78 non-OU interviews for a comparative view. We estimate that we have 7000 pages of interview data for the GSE project alone. In addition, both projects made considerable use of triangulation data, such as student academic transcripts and institution historical documents. Analyses of the GSE data indicated that the gender parity success of IE at OU was the result of a combination of attributes of department culture of IE at OU (e.g., a critical mass of student-centered faculty, a diverse group of women faculty who are visible to lowerclassmen undergraduates) along with attributes of IE as a field.

Refereed journal articles in multidisciplinary STEM education:

Martin, J. H., Hands, K. B., Lancaster, S. M., Trytten, D. A., & Murphy, T. J. (in press). Hard but not too hard: Challenging courses and engineering students. To appear in *College Teaching*.

Murphy, T. J., Shehab, R. L., Reed-Rhoads, T., Foor, C. E., Harris, B. J., Trytten, D. A., Walden, S. E., Besterfield-Sacre, M., Hallbeck, M. S., & Moor, W. C. (2007). Achieving parity of the sexes at the undergraduate level: A study of success. *Journal of Engineering Education 96*(3), pp. 241-252.

Brown, C. M. & Murphy, T. J. (2005). Understanding student learning in undergraduate information studies internships. *Journal of Education for Library and Information Science 46*(3), pp. 234-247.

Harris, B. J., Reed-Rhoads, T., Walden, S. E., Murphy, T. J., Meissler, R., & Reynolds, A. (2004). Gender equity in industrial engineering: A pilot study. *NWSA Journal (National Women's Studies Association), 16*(1), pp. 186-193.

Brown, C., Murphy, T. J., and Nanny, M. (2003). Turning techno-Savvy into info-savvy:

Authentically integrating information literacy into the college curriculum. *The Journal of Academic Librarianship, 29*(6), pp. 386-398.

Instructional Development. Toward the end of my time in Champaign, I worked as an Education Specialist for the Division of Instructional Development at UIUC. Working with new and experienced graduate teaching assistants (GTAs) and faculty led to my interest in studying college-level instructors and teaching. Much research at pre-college levels has been published about teacher beliefs, attitudes, knowledge, and communities; less is known about undergraduate mathematics instruction and instructor development. Toward progress in this area, I have mostly been working with researchers in undergraduate mathematics education at other institutions.

Refereed journal articles in this area:

Speer, N., Gutmann, T., & Murphy, T. J. (2005). Mathematics teaching assistant preparation and development. *College Teaching 53*(2), pp. 75-80.

Murphy, T. J. (2001). Developing snapshots of mathematics classrooms: Efforts to describe teaching practices. *College Teaching, 49*(1), 9-13.

Statistics Education. For a number of reasons, I have recently been exploring the possibility of building a research direction in statistics education. This direction is particularly attractive because of its interdisciplinary nature and applicability. My involvement in this area is recent and I have a lot of background to learn, but I have participated in the two NSF-funded grants:

The Statistics Concept Inventory (SCI): A cognitive achievement tool in engineering statistics – NSF award ASA-0206977 – PI Reed-Rhoads (Engineering Education); co-PI Murphy

Classroom Response Systems in Statistics Courses – NSF award CCLI-0535894 – PI Murphy; co-PIs McKnight (Mathematics), Richman (Meteorology), Terry (Psychology)

The first project made use of education and psychometric research methods to develop a multiple choice test, the Statistics Concept Inventory (SCI), that emphasizes conceptual understanding of statistics. The second project recognizes that the most challenging part of using classroom response systems (a.k.a. personal response systems or clickers) is developing worthwhile questions – our task in this pilot project is to use education and psychometric research methods to develop a starter set of such questions for introductory statistics courses. Related projects are also happening in other areas, also funded by the National Science Foundation, including calculus (Epstein's Calculus Concept Inventory and Terrell's Good Questions project). All of these projects were inspired by the ground-breaking work in physics education, namely the Hestenes' Force Concept Inventory and Mazur's *Peer Instruction*.

In May 2007, I joined a Research Cluster organized by the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE). The cluster includes faculty in engineering, mathematics, and statistics, from Ball State University, the Mayo Clinic, Salisbury University, Texas State University the University of Texas at El Paso, Virginia Polytechnic Institute and University. As a first project, this young research group is working toward studying pre-service teachers' understanding of variation.