TENURE AND PROMOTION DOSSIER [ABBREVIATED VERSION]

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Department of Mathematics, University of Oklahoma

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For decades the Department of Mathematics at the University of Oklahoma (OU) has maintained two permanent lines for mathematics education faculty. In the late 1980s, faculty member Curtis McKnight initiated the Undergraduate Curriculum & Pedagogy Research Option (a.k.a. the Pedagogy Program), a doctoral program in which graduate students complete a Ph.D. in mathematics with a research specialty in undergraduate mathematics education (UME). In keeping with the Pedagogy Program's apprenticeship design, I have involved students in research projects at every opportunity, regularly taught the Pedagogy Seminar as well as topics and readings courses for the Pedagogy and other students, and served on masters and doctoral committees not only in mathematics but also in education, physics, and psychology. Underlying all of my work are premises that include:

- All students can learn mathematics.
- All instructors can learn to be competent and effective.
- Learning takes place in a social context in which all participants – from the least experienced apprentice to the most experienced master – can make gains.

In order to achieve maximum effectiveness, I view the components of my work – research, teaching, and service – as an integrated whole. That is, my research informs my teaching and service, my teaching informs my research and service, and my service informs my research and teaching.

T(a) Statement of Teaching Philosophy and Activities

As a graduate student at the University of Illinois at Urbana-Champaign (UIUC) and a faculty member at the University of Oklahoma (OU), I have taught a variety of courses: college algebra, calculus, topics for teachers, and graduate seminars and topics courses. I have also taught a diversity of students: mainstream undergraduates, underrepresented undergraduates, pre-service teachers, new graduate teaching assistants, and doctoral students in undergraduate mathematics education. These experiences, and my understanding of the research literature, have led me to the philosophies and strategies discussed in this statement. The foundation of my philosophies and strategies has been beliefs that include: all students can learn mathematics, given the opportunity and an appropriate environment; teachers can learn effective instructional strategies; teaching includes responsibilities beyond formal coursework, such as mentoring; and listening to students' ideas, concerns, and suggestions is one of the most important activities for an instructor. The statements in this section are meant to reflect my general teaching philosophies and strategies with regard to courses and other instructional activities for lower-division mathematics, mathematics teachers, and mathematics education researchers. Samples of course materials, including sample student work, are available at my website http://www.math.ou.edu/~tjmurphy.

Lower-Division Mathematics

My primary goal in any mathematics class I teach is to support students in pursuing their chosen career paths. Beyond that, however, specific classroom goals and instructional strategies depend heavily on the objectives of the course and the needs of the student population. For example, during the years that I taught "at-risk" students at UIUC, my classroom goals included nurturing students' confidence in their mathematical abilities, in addition to preparing the students for success in subsequent mathematics-based courses. On the other hand, the students I taught in the Treisman-style Merit Workshop Calculus Program at UIUC already had a certain level of confident in their mathematical abilities; thus, my primary goal was to foster a community of scholars who would support each other and push each other to excel.

In calculus courses at OU, I have intended for students to be able to: (a) do mathematics by exploring problems, calculating and verifying answers, and representing problems and answers in multiple ways (symbolically, graphically, verbally, numerically); (b) communicate mathematics by listening to, speaking, reading, and writing mathematics (including the use of good notation, graphical displays, verbal explanations); and (c) use technology appropriately as a tool to solve problems. To these ends, I have most recently used a combination of interactive lecture, group work in class and out of class, calculator and computer demonstrations and activities, quizzes, tests, and extended problem sets, with almost all written work also requiring brief verbal explanations. Although these recent habits have so far been restricted to the calculus sequence, I will likely continue such practices when I teach linear algebra at OU in Spring 2002.

In-class time. In keeping with my strong inclination toward active learning and student collaboration, I have tended to try to minimize the amount of class time I spend lecturing. During lecture classes (including large lecture classes) I typically have introduced new material, worked some examples, and asked the students to work some examples in their seats, either individually or in small groups. Most recently, I have typed my lecture notes into a course packet, with space provided for students to work out examples during class (copied on blue paper, the students refer

to them as "the blue sheets"). In this way, I have transferred time spent copying notes by hand to time spent doing in-class activities. (Instructors are always complaining that there isn't enough time, so I have bought some time this way.) I also believe that students learn basic content as they work on harder problems. Thus, I have tried to reserve at least one or two class periods per content "chunk" for the students to work on harder examples in groups in class.

Assessment and feedback instruments. My recent courses have required that students take quizzes and tests as well as complete "problem sets". Each instrument has a specific role in my assessment of student learning. Quizzes typically have focused on skills by using template textbook homework questions, but I have experimented with the format. For tests, the items have been intended to be more conceptual and most items have required verbal explanation as well as computation or interpretation. I have also assigned harder, non-routine problems (a.k.a. "problem sets") – ones which I consider important but too long or too hard for tests – for students to complete in groups outside of class, turning in a "report" with solutions written using complete sentences and justifications for their strategies. Several years ago I discovered that students enjoy having their work displayed as outstanding solutions, so I have made available via the WWW sample student solutions to tests and problem sets. Some students have told me that as a result their goals shifted from merely wanting to get an "A" on an assignment or test to wanting to do such a good job that they would be used as the sample solution!

Technology. As I explain in the research narrative, for me the question has not been *whether* to use technology but *how* to use technology. For example, I dislike the use of laptops as expensive overhead projectors (i.e., using PowerPoint to show slides that work just as well as overhead transparencies would); thus, I have tried to take advantage of high-powered technology to enhance student learning in ways that I could not otherwise (e.g., showing animations). On tests, I have allowed the use of any calculators, including those that perform symbolic computations, and have tried to write test items that assumed the use of a graphing calculator (so I could ask questions that I might not otherwise ask) but did not assume any particular calculator and that did not give advantage to certain calculators. When I taught multivariable calculus, I incorporated basic use of *Mathematica* (e.g., the Plot3D function) on problem sets (but not on tests due to access constraints), intending for the students to become familiar with computer algebra systems as a tool.

Mathematics Teachers

Classes. At OU, I have regularly taught two courses for mathematics teachers: one for pre-service secondary teachers and one for teaching assistants new to the Department of Mathematics. For both of these classes, I have wanted the participants to examine, develop, and monitor their beliefs and behaviors (and how their beliefs and behaviors interact), rather than to rely primarily on the default models they had experienced themselves as students. To foster reflection and networking, I have expected the participants to engage in activities such as: submitting electronic journals, watching videotapes of themselves teaching, participating in class discussions, conducting peer observations and debriefing conversations, and reading each other's statements of teaching philosophy.

Mentoring. In addition to teaching these specific courses, I have also had opportunities to mentor graduate students when they were teaching assistants (GTAs) for my large lectures of calculus. As tomorrow's faculty will come from today's graduate students, I feel strongly that teaching assistantships can be apprenticeships: graduate students who show interest in teaching

should be encouraged to develop their philosophies, experience level, and instructional strategies. To this end, with my own large lecture classes, rather than using recitation time to give quizzes and GTA time to grade homework, I asked the GTAs to design activities for their sections to emphasize important content, deepen the students' understanding, and strengthen connections in the students' learning. The GTAs and I met for at least one hour per week as a team, with frequent additional conversations, during which we discussed in-class and out-of-class activities, issues of teaching and learning in general, and the needs of specific students as well as of the entire class.

Mathematics Education Researchers

I believe that graduate school should be founded on an apprenticeship model. To this end, the Pedagogy Seminar and special courses I have taught have been directly relevant to the individual students' interests and evolution as researchers (e.g., work on literature review, use the literature to explore conjectures, consider a variety of research design options, present research-progress-to-date). I have also worked extensively with graduate students in broad ways from their efforts to focus their ideas to their efforts to find balance in their lives. See section T(b) (Math 5803, Math 5900, and Math 5950) for details on courses I have taught and section T(e) for an additional discussion of work with graduate students.

T(b) Courses Taught, Enrollments, Individual Work with Students

In this section, I provide an annotated list of the courses I have taught at OU. The table at the end of the section details the courses by semester and includes enrollment data. The teaching load in the Department of Mathematics at OU is 6 hours per semester. Typically, each fall I have taught three courses: one 3-hour calculus course, one 2-hour course for pre-service secondary mathematics teachers, and one 1-hour course for new mathematics graduate teaching assistants. Since Fall 1997 I have also run the fall Pedagogy Seminar (McKnight is in charge each spring). Typically, each spring I have taught two 3-hour calculus courses. For three semesters (Spring 1997, Fall 1997, and Spring 1998) I taught large lectures of calculus, with the aid of three graduate teaching assistants. I intentionally began with Calculus I and moved through the sequence so that I could have a better understanding of what the students experience. I have made a habit of teaching the same calculus course several semesters in a row, so that I could improve my effectiveness with that content before I moved on. As of Summer 2000, I have added the habit of offering a graduate level topics course designed for the Pedagogy students and attractive to College of Education students; the topic selected depends on the needs of the current group of students.

Calculus. The calculus sequence at OU has four 3-hour courses, each of which I have taught at least twice:

- Math 1823: Calculus and Analytic Geometry I (differential calculus)
  -- Fall 1996, Spring 1997
- Math 2423: Calculus and Analytic Geometry II (integral calculus)
  -- Fall 1997, Spring 1998

- Math 2433: Calculus and Analytic Geometry III (sequences and series, parametric equations, polar curves, introduction to three-space, vectors, vector functions)
  -- Spring 1998, Spring 2000, Fall 2000, Spring 2001
- Math 2443: Calculus and Analytic Geometry IV (multivariable calculus)
  -- Fall 1998, Spring 1999, Fall 1999

Each course carries 3 credit hours, for a total of 12 hours in the sequence. Calculus I and II are offered as large lecture courses (120 students) with and additional 1-hour recitation sections (some smaller sections are also offered) run by graduate teaching assistants (GTAs). Calculus III and IV tend to be smaller sections (35 students). Throughout my time at OU, the textbook has been Stewart's Calculus, either the 3rd or the 4th edition.

Math 4232: Topics & Methods for Secondary Mathematics Teachers (Fall 1996, Fall 1997, Fall 1998, Fall 1999, Fall 2000). This course is one of two 2-hour "methods" courses for pre-service secondary mathematics teachers. (The other course is taught in the College of Education.) The specific topics and format of the course are instructor-dependent. My approach to the course has varied depending on my perception of the needs of the students. I see that they particularly need two things: (a) experience designing lessons and teaching and (b) in-depth study of content they can expect to teach. I have yet to figure out how to provide both of these time-consuming experiences in one 2-hour course.

Math 5803: Topics in Mathematics (Summer 2000: Readings in Educational Theories; Summer 2001: Research Design in Mathematics Education). My teaching of a summer topics course came about for several reasons: (a) the graduate students needed a course to take, (b) there are things that I believe graduate students should read that are not built into formal coursework, and (c) I get no credit for teaching a reading course. Enrollment has consisted of students in the Pedagogy Program and students from the College of Education (both in Summer 2000 and in Summer 2001). It has been a powerful combination of experiences, perspectives, and goals. In Summer 2000, we read writings by Piaget and Vygotsky. In Summer 2001, we are reading much of the book: *Handbook of Research Design in Mathematics and Science Education* (2000, edited by Anthony Kelly and Richard Lesh).

Math 5900: Graduate Readings. Faculty get no teaching credit or money for these courses, but often students need credit hours and have a special interest in a particular topic. Several of the Pedagogy students have use reading courses as a way of exploring their interest in the program and in potential research topics. Topics have included: technology and mathematics education, reform curricula in undergraduate mathematics, reviewing research literature, collecting and analyzing data, and research in UME as a field (who, what, when, why, how).

Math 5950: Seminar for the Undergraduate Curriculum & Pedagogy Research Option (Fall 1997, Fall 1998, Fall 1999, Fall 2000). This seminar is offered each semester during the academic year. It is taken for credit (1-2 hours) by students who have officially declared the Pedagogy option but who have not yet graduated. We have had a variety of other interested participants as well, including graduate students and instructors in the Department of Mathematics, graduate students in the College of Education, instructors in Philosophy and Chemistry, and a faculty member in Physics.

In Fall 1997, Fall 1998, and Fall 1999 the Pedagogy program had several students in the final stages of their doctoral work. Thus, I deemed it appropriate to use most of the seminar time to have these students present progress reports on their research. In this way, I expected that they would gain experience in presenting their work and have an opportunities to receive ongoing feedback from a number of people. I also expected that students who were less far along in the program would benefit from what more experienced students had to share. In Fall 2000, we read the book *Talking About Leaving: Why Undergraduates Leave the Sciences* (1996, by Elaine Seymour and Nancy Hewitt).

Math 5990: Teaching College Mathematics (Fall 1996, Fall 1997, Fall 1998, Fall 1999, Fall 2000). See section T(f) for a discussion about this course.

Semester	Course #	Course Title	Instructor Credit Hours	Number of Students Enrolled at End
Fall 1996	Math 1823	Calculus & Analytic Geometry I	3	37
	Math 4232	Topics & Methds for Scondry Math Tchrs	2	5
	Math 5990	Teaching College Mathematics	1	6
Spring 1997	Math 1823	Calc & Analytic Geo I (two sections)	3 (each)	116 and 36
	Math 5900	Graduate Reading (Pedagogy)	0	3
Fall 1997	Math 2423	Calculus & Analytic Geometry II	3	129
	Math 4232	Topics & Methds for Scondry Math Tchrs	2	5
	Math 5950	Pedagogy Seminar Research Option	0	5
	Math 5990	Teaching College Mathematics	1	9
Spring 1998	Math 2423	Calculus & Analytic Geometry II	3	142
	Math 2433	Calculus & Analytic Geometry III	3	41
Fall 1998	Math 2443	Calculus & Analytic Geometry IV	3	28
	Math 4232	Topics & Methds for Scondry Math Tchrs	2	12
	Math 5950	Pedagogy Seminar	0	3 enrlld, 7-8 attndng
	Math 5990	Teaching College Mathematics	1	9
Spring 1999	Math 2443	Calc & Analytic Geo IV (two sections)	3 (each)	35 and 37
Fall 1999	Math 2443	Calculus & Analytic Geometry IV	3	35
	Math 4232	Topics & Methds for Scondry Math Tchrs	2	8
	Math 5900	Graduate Reading (Pedagogy)	0	1
	Math 5950	Pedagogy Seminar	0	2 enrlld, 8 attndng
	Math 5990	Teaching College Mathematics	1	5
Spring 2000	Math 2433	Calc & Analytic Geo III (two sections)	3 (each)	33 and 37
	Math 5900	Graduate Reading (Pedagogy)	0	3
	Math 5990	Special Problems in Math (Pedagogy)	0	1
Summer 2000	Math 5803	Topics in Mathematics: Readings in Educational Theories	3	4
Fall 2000	Math 2433	Calculus & Analytic Geometry III	3	32
	Math 4232	Topics & Methds for Scondry Math Tchrs	2	7
	Math 5900	Graduate Reading (Pedagogy)	0	1
	Math 5950	Pedagogy Seminar	0	3 enrlld, 8 attndng
	Math 5990	Teaching College Mathematics	1	7
Spring 2001	Math 2433	Calc & Analytic Geo III (two sections)	3 (each)	36 and 33
	Math 5900	Graduate Reading (Pedagogy)	0	2
Summer 2001	Math 5803	Topics in Mathematics: Research Design in Mathematics Education	3	10

T(c) Student Evaluations (from the OU Arts & Sciences Instructional Evaluation Form)

The first table below lists numerical data from the item: "Overall, the instructor's teaching effectiveness was ... " All courses for which evaluations were solicited are included. Responses were on a 5-point Likert scale, with 5 = high. The left-most column in the table lists the course title; the next column indicates the semester from which the data were drawn. The third column gives data specific to my classes: mean, standard deviation, and number of students who responded to the question. The next column gives department data as a benchmark against which to compare my scores: mean for courses similar in size and level, and the number of such courses used to compute the department mean. Finally, the right-most column shows the differences between my means and the corresponding department means. It is worth noting that my means were at or above department means for all semesters.

The second table below summarizes my means in a frequency distribution. After my first year at OU (when I was teaching first-semester calculus – most of the students were also new to OU – and one of those sections was my first large lecture), I have scored above 4.0 without exception and above 4.5 in nearly half of the 23 courses for which students filled out evaluations.

Sample comments from students are provided below the tables.

Student Evaluation results	semester	**mean**, standard deviation, and n, on a 5-pt scale (5 = high) for the item: Overall, the instructor's teaching effectiveness was ...			Department of Mathematics mean for courses similar in size and level (and number of comparison courses)		TJM mean – Math Dept mean
Calculus & Analytic Geometry I	Fall 1996	**3.8**	1.1	(n = 31)	3.7	(102 courses)	0.1
	Spring 1997 (2)	**3.9**	1.1	(n = 61)	3.5	(10 courses)	0.4
		4.3	0.9	(n = 31)	3.4	(94 courses)	0.9
Calculus & Analytic Geo II	Fall 1997	**4.2**	0.9	(n = 94)	3.5	(10 courses)	0.7
	Spring 1998	**4.2**	1.0	(n = 104)	3.7	(11 courses)	0.5
Calculus & Analytic Geometry III	Spring 1998	**4.5**	0.7	(n = 32)	3.8	(84 courses)	0.7
	Spring 2000 (2)	**4.7**	0.5	(n = 30)	3.7	(75 courses)	1.0
		4.8	0.5	(n = 24)	3.7	(75 courses)	1.1
	Fall 2000	**4.7**	0.6	(n = 23)	3.7	(130 courses)	1.0
	Spring 2001	[results not in yet]					
Calculus & Analytic Geometry IV	Fall 1998	**4.5**	0.6	(n = 24)	3.6	(122 courses)	0.9
	Spring 1999 (2)	**4.5**	0.7	(n = 28)	3.7	(84 courses)	0.8
		4.3	0.7	(n = 29)	3.7	(84 courses)	0.6
	Fall 1999	**4.4**	0.7	(n = 29)	3.7	(127 courses)	0.7
Topics & Methods for Secondary Mathematics Teachers	Fall 1996	**4.2**	0.8	(n = 5)	4.1	(12 courses)	0.1
	Fall 1997	**4.2**	0.4	(n = 5)	4.0	(7 courses)	0.2
	Fall 1998	**4.6**	0.7	(n = 12)	3.3	(9 courses)	1.3
	Fall 1999	**4.1**	0.8	(n = 8)	4.1	(5 courses)	0.0
	Fall 2000	**4.7**	0.5	(n = 6)	4.0	(7 courses)	0.7
Teaching College Mathematics	Fall 1996	[co-taught, TJM not evaluated]					
	Fall 1997	**4.8**	0.5	(n = 9)	4.2	(8 courses)	0.6
	Fall 1998	**4.5**	0.7	(n = 10)	4.0	(13 courses)	0.5
	Fall 1999	**4.5**	1.0	(n = 4)	3.9	(11 courses)	0.6
	Fall 2000	**4.0**	0.7	(n = 5)	3.9	(12 courses)	0.1
Pedagogy Seminar	Fall 2000	**4.3**	0.6	(n = 3)	3.9	(12 courses)	0.4

Frequency Distribution of TJM's mean scores from the above table		
	3.8 - 3.9	2 classes
	4.0 - 4.4	10 classes
	4.5 - 4.8	11 classes

Student Comments (from the OU Arts & Sciences Instructional Evaluation Form)

On one side of the Instructional Evaluation Form students are asked to respond to open-ended items such as:

- What were the specific strong points of the course?
- What were the specific weak points of the course?
- What is your overall opinion of this course?

The sample comments provided below are representative of the tone found in the student comments and were selected because they refer to specific issues. I have tried to preserve the character of each response by not correcting spelling or grammar and by retaining structures such as underlining and punctuation. In order to conserve space, I have limited the number of comments included here; however, the complete set of student comments is available on request (607 sheets).

The Calculus Sequence

- Certainly not enough room on this page to even begin to list all of her strong points. Down to earth attitude about the subject. Much, much more than most, in her behavior towards the students. Clearly going far out of her way to help us. She is truely responsible for my understanding of calculus. I love how in Calc I she presented a movie about Fermat's last theorem, just another fine example of how she utilize's every different aspect of teaching to help the students. the usual amazing in class attitude that she brings into the room has always left me w/ the strong determination to turn any problem into a mere challenge. ☺
- Dr. Murphy is one of the best professors I have had during my time at OU. She is organized, personable, challenging & fair.
- Dr. Murphy does an excellent job of using verbal explanations to teach math concepts. I like the way she writes everything out in sentences on the board. She explains math with words rather than just working examples. I have never been able to understand math so well as I do when Dr. Murphy teaches.
- The instructor seemed to really care about her students.
- I loved the problem sets, the quizzes, and the homework. I loved the way lecture was structured.
- I learned so much in this class because Murphy made me want to work.
- I learned everything I know that has to do with Calc I and Calc II from her.
- Dr. Murphy's effectiveness lies in her preparation, clarity, examples, and feedback. For a large lecture, I was surprised at how easily I learned the material which was new to me. I credit Dr. Murphy entirely for this.
- Prof. Murphy is an excellent teacher. She cared enough to explain & re-explain everything until we understood.
- She is extremely clear and knowledgable of her subject matter.
- Given the difficulty of the subject matter, she was very aware of what students were thinking. She is also the first instructor I've had in the math department who actually cared about teaching and about her students.

- You make us feel comfortable and you are approachable. The typed notes helped TONS!! I felt that I have learned a lot because it wasn't all memorization, but application of what we already know. Sometimes it was stressful getting the problem sets in, but I liked doing them and the helped apply what we know. You are always fair, and understand where the students are coming from. I really enjoyed this class when I thought that I would hate it.
- You are the first math teacher that has actually taught me math and not just forced me to memorize. W/ the notecard, I spent my time grasping how to use a formula instead of trying to memorize. Although memorization plays a part in math, utilization is what's important to me.
- I enjoyed the "handout" method – It was refreshing not to take notes all the time but focus more on what was important. The handouts allowed us to be pay attention instead of splitting attention between lecture and notetaking.
- Okay, normally I don't take the time to fill out these questions, but Dr. Murphy is such a great teacher I am going to. So much, Dr. Murphy always had creative and helpful analogies, references to material we already know to explain new material, blue sheets were extremely helpful. ... Dr. Murphy put so much effort into teaching, and I could tell, I would have guilty had I not made an "A" on every test. She really restored my faith in math teachers.
- I liked using note cards & calculators on the test. I enjoyed working in groups – it helped me a lot. ... She listens and reacts well to students.
- The blue sheets handed out which explained in detail material including examples to be done in class. Test were excellent in testing material covered. She made class interested and inspired me to actually get out of bed to attend the 9 am class even when I was <u>really</u> tired.
- Teacher interactions w/ students were incredible. & helped many not only survive, but thrive in what is often considered one of the most difficult math classes to get through.
- She's the greatest math prof. I've ever had. She really encouraged learning.
- <u>Bottom Line</u>: Students learn the material – and they do it in an environment that is supportive, encouraging, interactive, and in the end, <u>FUN</u>.
- Lectures were designed to ensure class understanding, not merely give out information.
- The instructor used many different ways to explain concepts, so if you couldn't understand one way, you could possibly grasp it a different way. Loved the blue sheets!!
- The absolute value of the textbook was less than epsilon (although it makes a satisfying "thud" when dropped on the floor). I learned a lot more from the handouts.
- Group environment and easy non-threating environment made you feel at ease to ask questions or answer them.
- Workload was heavy, but very relevant. I never felt like I was wasting my time while doing problem sets, etc.

Of course, not all students liked all (or any) aspects of the courses. For example,

- The problems sets were extremely difficult.
- I don't really enjoy working in groups.
- I don't care for Mathematica or problem sets.

Topics & Methods for Secondary Mathematics Teachers

- It has been the most effective education course I have ever taken. I think that it actually prepared me for after graduation and a lot of my questions were answered. Dr. Murphy really cared about what happened to us after college and in our profession.
- Small class size, very comfortable atmosphere to express viewpoints ... I looked forward to coming.
- [Strong points were] the use of e-mail to get feedback & give feedback to our instructor. the ability to get practice teaching. get lesson ideas. start a portfolio that can be used when applying for a job. This is a great class to get practice of teaching. I had only stood up in front of a class and taught a few times before this class. In this class I taught 5 times and got great feedback from my teacher & peers. It helps to build your confidence.
- We learned so much from watching each other teach. ... It was the best class I have had since it allowed us to actively get involved.
- She helped us see what some of the things our students would be struggling with.
- We learned a lot of math, but just as importantly, learned what to expect in the real world of math ed.
- The course was good because it was only math ed majors and it was a safe environment for us to review math we may have forgotten without a stereotype. Also we were allowed to discuss information important to us not just math. ... Dr. Murphy did a great job managing this course. The books and articles we read were relevant and contained excellent ideas to use in the classroom. The instructor was also sensitive to our needs as math ed students.

Teaching College Mathematics

For the most part, the GTAs did not comment much (if at all). One of them crossed out all of the open-ended questions and wrote "This whole evaluation doesn't apply well to this class!" One semester, in an effort to get useful feedback, I asked them to use the space to comment on each aspect of the course (the readings, e-journals, writing a statement of teaching philosophy); they wrote very positive and thoughtful comments that are perhaps too extensive to include in this synopsis (but I'm happy to send them on request).

- She was very prepared & flexible, found topics to discuss that were relevant to us.
- She did a great job of generating discussion and talking about relevant issues.
- It's a good course for TA's. Maybe it would be nice for other department students who are TA's in the department to get credit for this course.

T(d) Peer Evaluations

At OU the department chair is expected to observe junior faculty members teaching once per year. In this abbreviated version of my dossier, I include only the most recent observation letters from the two faculty who have been department chair during my probation period. These letters are in the Teaching Addenda.

T(e) Graduate Student Advising

The OU Department of Mathematics tenure and promotion document, *A Departmental Approach to Professional Growth*, states: "During the probationary period, the candidate will normally not be involved in dissertation research until such time as the candidate, after consultation with the Chair and Committee A, feels that he/she is ready to take on such responsibilities without compromising the progress of his/her research program" (p. 5). Thus, I have not yet chaired a committee for a graduate student advisee. I have, however, been a member of the masters committees for two Education students and of the doctoral committees of three Pedagogy students, three Education students, one Physics student, and one Psychology student. Two of these students have completed a Ph.D. There are two additional students in the Pedagogy pipeline who may be my first advisees!

Furthermore, I have been actively involved with graduate students at all points along the pipeline in the Pedagogy Program (and other graduate students in mathematics). In keeping with the apprenticeship design of the program, I have assumed responsibilities beyond that of formal course instruction. In addition to guiding research paths, I have spent countless hours discussing strategies for navigating through the system as well as providing emotional support for graduate students' continuing efforts in a challenging system.

T(f) Special Efforts

In academic year 1995-1996 (the year before I came to OU), the OU Provost initiated campus-wide efforts to improve the preparation and development of graduate teaching assistants (GTAs). To this end, several departments – including the Department of Mathematics – agreed to participate in the piloting of a one-semester 1-hour course for GTAs to take during their first semester of student contact. The initial pilot course, in Fall 1996 (my first semester at OU) was co-taught by Arletta Knight of the OU Instructional Development Program and myself. That first time the class included GTAs from several disciplines including accounting and engineering as well as mathematics.

After that first year, it was clear that the Department of Mathematics had a sufficiently high number of new GTAs each year to justify having a discipline-specific course. Thus, I designed Math 5990: "Teaching College Mathematics" and taught it in Fall 1997, Fall 1998, Fall 1999, and Fall 2000. Activities including reading about and discussing teaching and the reform movement, discussing case studies (from the Boston College Case Studies Project, Sol Friedberg, P. I.), keeping an electronic journal, observing more experienced instructors as well as classmates, and writing an initial statement of teaching philosophy.

T(g) Efforts to Improve Teaching

In addition to engaging in frequent informal discussion about teaching and being actively involved in Project NExT (discussed in section T(h)), I participated in the following Faculty Discussion Groups run by the OU Instructional Development Program. The Fall 1996 Professional Development Seminar for New Faculty met every week and was a fabulous opportunity to meet faculty from all over campus (other universities should adopt this model!). Each of the other discussion groups met every other week. In all cases, we spent the first half

hour eating lunch (participating in the campus community! and networking!) and the remaining hour discussing the agenda topic. The list of topics for the Varied Agenda group is determined at the first meeting according to the interests of the participants.

Fall 1996: Professional Development Seminar for New Faculty
Spring 1997: Designing a Course
Fall 1998: Varied Agenda (form and subject of research activities, how to do educational research, assessing the impact of one's teaching, grade inflation, higher level learning)
Spring 1999

- Varied Agenda (managing our several roles as faculty members, time management, interdisciplinary learning, measuring student learning)
- Special Discussion Group [by invitation only] (developing effective assignments for use with small groups, higher level learning, problem-based learning)

Fall 1999: Varied Agenda (challenges of teaching a class for non-majors: dealing with negative student attitude, motivating students to learn, examining our own credibility as teachers)
Spring 2000

- Varied Agenda (sharing ideas for course design and management)
- Teaching Portfolios

Fall 2000

- Varied Agenda (teacher/student interaction issues, management issues, TA issues, university issues)
- Using Small Groups

Spring 2001

- Varied Agenda (questions/concerns regarding assigning final grades, teaching to the test, what is the purpose/value of post tenure review?, what constitutes academic misconduct?, general information regarding BlackBoard and WebCT)
- What becomes of "Teaching" in the Age of Online Courses?
- Making Large Classes Interesting and Exciting

T(h) Honors

- 1996-1997, Project NExT Fellow (Blue Dot)
  – Project NExT (New Experiences in Teaching) is a program of the Mathematical Association of America, with funding from the Exxon Education Foundation, for new and recent Ph.D.s in the mathematical sciences who are interested in teaching. Fellows, selected from a pool of applicants, attend workshops in conjunction with three annual national conferences, interact with senior faculty mentors, and participate in an electronic listserv. Although officially the program is one year long, Fellows remain fellows and many continue to participate in the conferences and the listserv, also acting as "junior mentors" for new Fellows.

- 1999, OU Mathematics Graduate Student Organization Outstanding Teaching Award
  – Each year the mathematics graduate students at OU select, by vote, one faculty member to receive this award.

R(a) Statement of Research & Creative Activities

I have used the "mid-term review of progress toward tenure" letter as a guide to determine specific priorities and goals. The letter itself is included in appendix (along with my most recent progress-toward-tenure letter). In particular the letter itemizes six activities "rank ordered from highest weight to lowest weight". I include this list here, along with an inventory of my accomplishments (since arriving at OU) corresponding to each priority.

"(1) Publication of refereed articles in professional journals. ... We expect that you will have a minimum of four refereed journal articles published or accepted for publication by the time that your tenure dossier is formed."

- 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), 381-396.
- Murphy, T.J., Goodman, R. E., & White, J. J. (1999). Using the web in multivariable calculus to enhance visualization. *International Journal of Engineering Education, 15*(6), 425-431.
- Brown, C. & Murphy, T.J. (2000). Research in undergraduate mathematics education. *Reference Services Review, 28*(1), 65-80.
- Murphy, T.J. (2001). Developing snapshots of mathematics classrooms: Efforts to describe teaching practices. *College Teaching, 49*(1), 9-13.

"(2) Publication of refereed articles in published conference proceedings or refereed chapters in edited books."

- Murphy, T.J., White, J. J., Kline, B. J., Black, E., Goodman, R., Hofer, M. (1999). Using *Mathematica* with multivariable calculus. *Proceedings of the 1999 American Society for Engineering Education Annual Conference and Exposition*, Charlotte, June 1999, 9 printed pages.
- Murphy, T.J., (1999). Using computers to facilitate visualization in multivariable calculus: A variety of options. *Proceedings of the Twenty First Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, Cuernavaca, Morelos, Mexico, October 1999, 410.
- Murphy, T.J. (1999). Recognizing a surface from different viewpoints: Results from a questionnaire item and task-based interviews. *Electronic Proceedings of the Twelfth Annual Conference on Technology in Collegiate Mathematics*, San Francisco, November 1999, 4 printed pages. The World Wide Web at http://archives.math.utk.edu/ICTCM/EP-12/C26/html/paper.html

"(3) Invited or contributed presentations at professional meetings."

Invited

- "Adapting to Collaborative Learning", guest presentation for the focus group *Use of Groups*, sponsored by the Center for Educational Excellence at the United States Air Force Academy, Colorado Springs, October 1996.

- Panelist, MAA panel discussion *Case Studies in Curriculum Reform*, AMS-MAA Joint Mathematics Meetings, Baltimore, January 1998.
- Panelist, NExT panel *Proof-Based Thinking Vs. Evidence-Based Thinking*, MAA MathFest NExT Pre-Session, Providence, July 1999.
- "Preparation and ongoing development: Activities to help GTAs (and others) succeed as instructors of mathematics", guest presentation for the Department of Mathematics at Michigan Technological University, Houghton, MI, March 2000.
- "The Preparation Needs of Graduate Teaching Assistants", presentation for the Working Group for Action: Mathematics Education in Universities at the Ninth International Congress on Mathematics Education, Makuhari, Japan, August 2000.

Contributed

- "Which Way Did They Go? Which Way Did They Go? Examining Transcript Records of Students Who Took Workshop-Style Calculus," MAA session on Reformed Calculus in Performance: What Works, What to Fix, Mathfest 1996, Seattle, August 1996.
- "The Silent Treatment: An Attempt to Bridge the Distance Between 'At-Risk' Students and Mathematics," MAA session on Developmental Programs that Work, AMS-MAA Joint Meetings, San Diego, January 1997.
- "Sensing Mathematics: A Blind Student Meet Calculus", 59th Annual Meeting of the Oklahoma-Arkansas Section of the MAA, University of Central Oklahoma, Edmond, OK, April 1997.
- "College Mathematics Instructors in Transition," MAA Session on Developmental Programs That Work, AMS-MAA Joint Mathematics Meetings, Baltimore, January 1998.
- "Developing Snapshots of Undergraduate Mathematics Classrooms: Evolving Efforts to Describe Instructional Practices Via Classroom Observations," ARUME contributed paper session, MAA MathFest, Providence, July 1999.
- "Using Computers to Facilitate Visualization in Multivariable Calculus: A Variety of Options," Fourth Annual Conference on Research in Undergraduate Mathematics Education, Chicago, September 1999.

"(4) Expository articles, books, and book chapters."

- McKnight, C., Magid, A., Murphy, T.J., & McKnight, M. (2000). *Mathematics Education Research: A Guide for Research Mathematicians*. Providence, RI: American Mathematical Society.
- Murphy, T.J., Branson, W., Friedberg, S., Kappe, L. C., Madden, J., Manderscheid, D., Mantini, L., Marchisotto, E., McCreary, P., Nestler, A., Novak, J., Plisch, S., Speer, N., Wilson, J., & Zia, L. (2000, May/June). Innovative Programs Address Professional Development of Teaching Assistants & Adjuncts. *FOCUS: The Newsletter of the Mathematical Association of America, 20*(5), 9.

"(5) Submission of grant proposals to federal funding agencies." [NONE FUNDED]

1996

- submitted to FIPSE (pre-proposal only): "Destination mathematics: Synergistic apprenticeships for enhanced experiences for underrepresented mathematics students while aiding at-risk undergraduates."

1997

- submitted to NSF (CAREER): "Seeking the missing: Research and interventions to recruit and retain traditionally underrepresented students and junior faculty in mathematics-intensive fields."
- submitted to FIPSE (pre-proposal only): with Alice Lanning (Director of Freshman Programs) and Gordon Uno (Professor of Botany), "Summer Academy for Mathematics and Science (SAMS): A program to retain students in mathematics and science majors.

1998

- submitted to NSF (Gender Equity): G. Kay Powers, PI, Dean of the College of Mathematics & Science at the University of Central Oklahoma, included representatives from St. Gregory's College and Tulsa Community College, with input from the state Regents, "Oklahoma supporting equity through excellence: A planning grant proposal."
- submitted to FIPSE (pre-proposal only): Suzanne Lenhart, PI, Professor of Mathematics at the University of Tennessee at Knoxville and chair of the AMS-MAA Committee on Teaching Assistants and Part-Time Instructors, "New Keys for a New Millenium", with other members of the committee.

1999

- submitted to NSF (CAREER): "Using technology to facilitate visualization in calculus."

2000

- submitted to FIPSE (pre-proposal only): Ronald Sack, PI (Professor of Civil Engineering and Environmental Sciences), "SEEC: Sooner Engineering Education Center."

2001

- submitted to FIPSE (pre-proposal only): "TA PAD: A WWW clearinghouse for mathematics TA preparation and development resources."
- submitted to FIPSE (pre-proposal only): Suzanne Lenhart, PI, Professor of Mathematics at the University of Tennessee and chair of the AMS-MAA Committee on Teaching Assistants and Part-Time Instructors, "Innovative practices in the orientation and support of adjunct faculty and teaching assistants", with other members of the committee.

"(6) Development of technologically based course materials and general access web pages to enhance teaching and learning."

- Murphy, T.J. & White, J. J. (in press). Study Guide for Calculus & Analytic Geometry III. Online Course for the Independent Study Department of the College of Continuing Education at the University of Oklahoma, Norman. preliminary version at http://www.math.ou.edu/~tjmurphy/IndepStudy/Calc3/Calc3.html
- White, J. J. & Murphy, T.J. (in press). Study Guide for Calculus & Analytic Geometry IV. Online Course for the Independent Study Department of the College of Continuing Education at the University of Oklahoma, Norman. preliminary version at http://www.math.ou.edu/~tjmurphy/IndepStudy/Calc4/Calc4.html

The following statement focuses on the written, archival products (listed in priorities (1), (2), (4), and (6) above). As stated earlier, I have worked in the areas of (a) retention programs, (b) instructional development, (c) teaching with technology, and (d) disseminating ideas about UME as a field. I have tended to publish my articles in journals that target practitioners as well as researchers in UME.

Retention Programs. By "retention programs" I mean 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 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. During my last year in Champaign (after I had completed my Ph.D. and was waiting for my husband to graduate) I taught as a visiting lecturer for the Treisman-style Merit Workshop Calculus Program.

Intending to investigate the success of this program, I collected student transcript data for Murphy, Stafford, and McCreary (1998) just before I moved to OU. In addition to corroborating generalizations from the aggregate of related work, this longitudinal study extended previous research both in duration and in scope. Specifically, we lengthened the tracking to allow sufficient time for students to graduate and we investigated gender and ethnicity effects, which had not been so extensively and broadly analyzed in previous literature. Murphy, Stafford, and McCreary (1998) is one of my favorite articles for a number of reasons. First, I feel very strongly about the content – success in mathematics courses by historically underprepared populations. Second, 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. Finally, as is always my preference, I was able to engage a student in the research: Stafford was a graduate student in quantitative psychology at OU who helped with the statistical analysis and editing – this was her first publication.

Although constraints have slowed my progress in this area, I have continuing interest. Unfortunately, once I left UIUC, I left my convenient access to ongoing data from the Summer Bridge & Transition Program as well as the Merit Workshop Program. (The Department of Mathematics at OU does not have such programs.) However, in the near future I still hope to complete a meta-analysis of Treisman-style workshop calculus programs.

Instructional Development. Toward the end of my graduate program at UIUC, I worked as an "education specialist" for the Division of Instructional Development. This experience in 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 studied teacher beliefs, attitudes, knowledge, and communities; less is known about undergraduate mathematics instruction and instructor development.

In 1997 my dissertation advisor, Ken Travers, invited me to be a consultant for a multi-year project (funded by the National Science Foundation) to develop a set of statistical indicators to monitor the condition of undergraduate mathematics education. My background in mathematics, mathematics education, and instructional development, as well as my familiarity with the setting, directed my attention to the classroom observations part of the project design. When I looked for a suitable observation guide (form) that I could use as a tool to "train"

mathematicians to observe traditional and non-traditional classes (a goal of the project), I found only guides that focused attention primarily on the instructor. Under current efforts to increase the use of active learning in the classroom, the observation results from these guides gave unsatisfactory descriptions of events in "reform" classes in which students are meant to be active participants. I wanted a guide that would not require significant training to use, but that would capture the essence of the classes being observed. To this end, in Murphy (2001), I used actual classroom observation data from a variety of course formats (lecture-recitation calculus, Treisman-style workshop calculus, and computer-based calculus) to draw attention to consequential phenomena that standard observation guides miss (e.g., "What are the students doing?") and to offer an example of an alternate observation guide.

An additional paper included in the dossier, Murphy, T.J. & Wahl, K. (in review) combines two topics that I feel strongly about: instructional development and retention programs. By way of a case study, this article describes some of the instructional challenges faced by an instructor (the second author) during her first semester experimenting with instructional strategies, in the context of an academic support program for "at-risk" students. I was also delighted to be able to include the instructor as a co-author (it was her first publication). This research used data from class observations and videotapes, as well as the instructor's journal, to document some of the challenges the instructor faced. The data was actually collected as part of my dissertation, but I was able to conduct new analyses in light of more recent results from other sources. Similar challenges have been discussed at length in the pre-college literature, and to some extent at the undergraduate calculus level, but they have received less attention at the college algebra level.

As a member of the joint AMS-MAA Committee on Teaching Assistants & Part Time Instructors, I have been involved in the organizing of sessions at national conferences and in the writing of grant proposals. One of the conference sessions led to the expository paper Murphy, et al (2000, May/June) listed in section R(a). In addition, in June 2000, I attended a meeting run by the Boston College Case Studies Project (Sol Friedberg, P.I.) about the use of case studies in the development of teaching assistants. I hope that my continued involvement with this project will lead ultimately to research on the development of GTAs and other instructors (e.g., adjunct instructors and new faculty). My work on this committee has made clear to me the need for research about graduate teaching assistants and graduate school experiences in general. For example, working with one of the current Pedagogy graduate students, I intend to study the graduate school process from an apprenticeship perspective.

Teaching with Technology. Instructors at all levels have been presented with exciting but complex and controversial possibilities arising from the integration of technology into the curriculum. For some instructors, including those on the project team listed below, the question has not been *whether* to integrate technology but *how* to integrate technology in effective, appropriate ways. As students are less practiced at mentally working with 3D objects, multivariable calculus was a natural initial point for the OU Department of Mathematics to start to take advantage of the powerful capabilities of computer algebra systems (CAS) and the WWW. To this end, in 1998 the OU College of Arts & Sciences (CAS) funded the "Multivariable Calculus with *Mathematica*" project to facilitate the integration of computers. (It should be noted here that other faculty members in the department were also working to integrate computers in their classes – faculty member Black initiated this project to unify the individual efforts of isolated faculty members.) Goals of the project have included: (a) to increase the use of

computers in at least some sections of multivariable calculus (a CAS priority), (b) to make available computer-based resources that instructors can use as they deem appropriate, and (c) to explore appropriate and effective uses of such technology.

The development and research team has consisted of:

- Jon White, mathematics graduate student at OU beginning to work toward a doctorate in the Undergraduate Curriculum & Pedagogy Research Option;
- Russell Goodman, graduate student in pure mathematics at OU interested in issues related to quality teaching;
- Michael Hofer, undergraduate exchange student from Austria also interested in mathematics education;
- Brad Kline, Assistant Professor of Mathematics at the United States Air Force Academy (now working for the government);
- Elena Black, Assistant Professor of Mathematics at OU (has since resigned from OU);
- Nicole Judice, Assistant Professor of Psychology at OU;
- myself.

One of our hypotheses has been that technology could be used to enhance students' abilities to work visually with the objects they study in multivariable calculus. We have also wanted to explore such issues as, What level of exposure/interaction to/with technology-based resources is necessary/sufficient to enhance learning (daily, weekly, monthly; active, passive)? Such questions change the perspective from Does it work? to How does it work? and What does it do best?

Using our experience as instructors, we developed annotated animations and sequences of computer-generated graphics, making them available as overhead transparencies, for low-tech in-class discussions, as well as over the WWW (on the "Calculus IV at OU Resource Page" at the department website: http://www.math.ou.edu/reference/calc4resources.html) for higher-tech in-class discussions and for ready access by instructors and students outside of class. Then we administered questionnaires to students and to faculty and we interviewed a small handful of students. So far the project has resulted in one journal article (Murphy, Goodman, & White, 1999), three conference proceedings papers (Murphy, White, Kline, Black, Goodman, & Hofer, 1999; Murphy, 1999a; Murphy, 1999b) with another on the way (Murphy, Judice, & White, in progress), and the development of two online courses for the OU Independent Study Department (Murphy & White, in press; White & Murphy, in press).

This work-in-progress has served a number of purposes, some less obvious than others. Clearly, the articles have enabled us to share our progress, with the conference proceedings in particular allowing us to receive feedback on the project from a broad range of professionals. Among the most important functions, however, the articles have tied together the work of a team of mathematicians and mathematics educators with a range of research experience levels (there's that apprenticeship model again!). The students have experienced the conference presentation and paper publication processes first hand, with these papers being their first publications. Furthermore, work-to-date from this project will feed directly into White's doctoral research.

In June 2000 I attended the NSF-funded Java Workshop in Emporia, Kansas. Joe Yanik and Chuck Pheatt of Emporia State University have written Java Programming tools with the intention of teaching mathematicians to use the tools to produce applets to be used in teaching. I will also attend the follow-up workshop and conference in June 2001. I look forward both to

continued learning to produce applications to enhance student learning and to pursuing research issues related to the use of such technologies for teaching.

Disseminating ideas about UME as a field. When I began graduate school, I had visions of becoming a faculty member in a department of mathematics. At the time (1987), the most clear path to such a career included a doctorate in mathematics. Within a few years, however, that condition was evolving quickly: national interest was growing in mathematics education research at the undergraduate level. Although research on the teaching and learning of mathematics at pre-college levels, as well as research on college teaching in general, have been happening since early in the 20th century, research in undergraduate mathematics education (UME) was in its infancy even in the 1980's and developed considerably throughout the 1990's. The year 2000 saw the birth of a new professional organization, originally called the Association for Research in Undergraduate Mathematics Education (ARUME), which subsequently evolved into the first Special Interest Group of the Mathematical Association of America (SIGMAA) and is currently known as the SIGMAA on RUME.

Like any young field, UME continues to experience inevitable growing pains, with each year bringing a more clear picture of the scope of the field and its role in the mathematics community. In order for the field to find itself, it is essential that members of the community – both the UME community and the mathematics community at large – engage in conversations and exchange of ideas. To this end, researchers in the field give presentations, run workshops, and write articles and books that offer multiple perspectives on the nature and role of research in undergraduate mathematics education.

One such book is McKnight, Magid, Murphy, and McKnight (2000, published by the American Mathematical Society), to which I had the honor of contributing. As the preface says:

> This book is intended to meet three goals … First, a non-jargon introduction is presented for educational research. Second, more commonly used research methods are surveyed along with their rationales and assumptions. Third, careful discussions are provided to help research mathematicians read or listen to education research more critically as well as more informedly. (p. viii)

The list of chapters is:

This work was a team effort but, as this is my tenure dossier, I feel compelled to mark my contribution: I wrote the three chapters that make up the section on qualitative research.

My other written contribution to the dissemination of ideas about UME as a field was the article Brown and Murphy (2000). This article was especially fun because it was interdisciplinary. Two years prior to the writing of this article, the librarian (Brown) for the OU Chemistry & Mathematics Library approached me with an opportunity to request funds to augment the library collections. There was special money (Kerr Fund) set aside for new fields. For each of two years, we wrote proposals and received $1500 per year to purchase materials related to UME. As we constructed lists and prioritized purchasing, I was also regularly attending national conferences at which it was increasingly clear that many institutions faced a similar challenge to make available appropriate resources for researchers in UME. With hopes of saving some duplication of our efforts at other institutions, Brown and I turned our results into an article that discusses the development of a collection of reports, monographs, and journals, as well as a list of websites that offer additional information of interest to researchers in UME.

R(b) Publications

This abbreviated dossier includes five papers (four published and one in review). For each paper, I have attached a brief abstract and comments about the journal.

R(c) Grants and Contracts

OU College of Arts & Sciences. 1998, $13,842: As explained in the "teaching with technology" section above, faculty member Elena Black initiated the "Multivariable Calculus with *Mathematica*" project. After she had discussed her ideas with the Dean of the College of Arts & Sciences, she approached me about writing a proposal for internal funding. The funding included part of my summer salary, money to pay a GTA so that Black could have a course release, and a stipend for a GTA to help us with the project.

OU Junior Faculty Research Program. Each year the OU Research Council holds a competition for junior faculty to secure summer research funding. Recipients of this grant agree not to take on non-research responsibilities (such as teaching) and may use the money as a stipend or for travel or other work-related purchases.

- 1997, $6000: “Groundwork: Preparing to study attraction, retention, and attrition of underrepresented students”. I examined the feasibility of continuing my work with retention programs in my new position as a faculty member at OU.
- 1999, $6000: "Using Technology to Facilitate Visualization in Calculus". I worked on the research aspect of the "Multivariable Calculus with *Mathematica*" project.

OU Faculty Enrichment Grants. This OU College of Arts & Sciences program is intended to support research and teaching activities.

- 1999, $685, enabled graduate student Goodman (from the "teaching with technology" section) to attend the American Society for Engineering Education (ASEE) Annual Conference and Exposition in Charlotte, June 1999. Goodman and I attended the conference together and gave a joint presentation, which resulted in the publication Murphy, White, and Goodman as mentioned in sections R(a) and R(b), and afforded Goodman the opportunity to increase his network of contacts.
- 2000, $425, enabled me to travel to Exeter, New Hampshire to attend a meeting, run by the FIPSE-funded Boston College Case Studies Project (Sol Friedberg, PI), on the use of case studies in the development of graduate teaching assistants (GTAs) in mathematics.

OU Faculty Travel Assistance Grants Program. Affectionately known as the 1/3-1/3-1/3 program, the relevant department puts up 1/3 of the travel costs, the College of Arts & Sciences another 1/3, and the University the remaining 1/3.

- 1999, $622 (plus department contribution), to attend the ASEE conference with Goodman.
- 2000, $2038 (plus department contribution), to attend the International Congress on Mathematical Education held in Japan. (This conference is held once every four years).

Retention Programs

- 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), 381-396.

Abstract. In 1989 members of the Department of Mathematics at the University of Illinois at Urbana-Champaign (UIUC) implemented the Merit Workshop Calculus Program. Based on Treisman-style workshop calculus, the UIUC program was intended to address the problems of low success rates of students from underrepresented populations and of failure to retain these students in mathematics- and science-based majors. The authors conducted investigation by examining transcript records for patterns of (a) performance in first-semester calculus; (b) performance in courses that require first-semester calculus as a prerequisite; and (c) persistence at the university, especially in majors requiring calculus. Analyses included gender and ethnicity effects. The results indicate that the Merit Workshop Calculus Program had a positive impact for both genders and for several ethnic groups (African-American, Caucasian, and Hispanic). Particularly dramatic results were noted for women and for Hispanic students. The results reported here are important because they are based on longitudinal data and distinguish differential effects for both well- and under-represented populations.

Journal. With its first volume published in 1994, the *Journal of Women and Minorities in Science and Engineering* is a relatively new journal. As stated in the "information for authors" section of the journal, it "is a quarterly journal aimed at publishing original, peer-reviewed papers that report innovative ideas and programs, scientific studies and formulation of concepts related to the education, recruitment, and retention of underrepresented groups in science and engineering". The Editorial Assistant for the journal, Kathy Wager, e-mailed me the following data: in 1998 (the relevant year), the acceptance rate was 58% and the journal had 70 institutional and 45 individual subscriptions. She also stated that "the target audience for the journal includes educators, K-graduate level; policy makers, business and industry related to science and engineering. ... Papers have been published from the United States, United Kingdom, India, Denmark, Canada, New Zealand, and Australia." I selected this journal most obviously because the topic of the article matched the mission of the journal, but also because it targets policy makers as well as educators.

Note. At the time, Stafford was a graduate student in quantitative psychology. This was her first publication.

Teaching with Technology

- Murphy, T.J., Goodman, R. E., & White, J. J. (1999). Using the web in multivariable calculus to enhance visualization. *International Journal of Engineering Education, 15*(6), 425-431.

  Abstract. As part of the reform movement in undergraduate mathematics education, instructors have been encouraged to take advantage of technology for teaching. At the University of Oklahoma, we chose multivariable calculus as the course in which to begin to increase the use of computers -- particularly to facilitate visualization of the three-dimensional objects studied in that course. In particular, this paper advocates use of the World Wide Web to disseminate multivariable calculus materials to students and to instructors. We begin by presenting an abbreviated example from the materials we have developed; we then offer a variety of options for using such materials. Results from faculty and student surveys provide context and an indication of the need for more extensive use of the web as a resource. We expect that, as appropriate materials are made available and promoted, use will increase and lead to enhanced student learning.

  Journal. The *International Journal of Engineering Education* publishes out of Ireland, with six issues per year and a regular acceptance rate around 9% (personal communication from the editor, Michael Wald). The "Aims and Scope" section of the journal's website states:

  - This journal serves as an international interdisciplinary forum of reference for engineering education.
  - A balance between papers on developments in educational methods technology, case studies, laboratory applications, new theoretical approaches, educational policy and survey papers is aimed for.
  - Comprehensive coverage of new education schemes and techniques makes the journal a unique source of ideas for engineering educators who are keen to keep abreast of latest developments in educational applications in all fields of engineering.

  We selected this journal as the publication outlet because we wanted to participate in ongoing conversations between mathematics and engineering not only at OU but in the larger professional communities. As a majority of the students enrolled in calculus at OU are College of Engineering students, it seemed particularly important to report our progress to the client discipline. I personally feel very strongly about maintaining such interactions to maximize curricular cohesion and thus the gain for students.

  Note. At the time, Goodman was a graduate student in mathematics and White was a graduate student considering the Pedagogy Program. This was their first publication.

Dissemination of Ideas about UME as a Field

- Brown, C. & Murphy, T.J. (2000). Research in undergraduate mathematics education. *Reference Services Review, 28*(1), 65-80.

Abstract. Research in Undergraduate Mathematics Education (RUME), the study of teaching and learning of college mathematics, is a new area of research in mathematics. Information to support this discipline is found in publications from all over the world, in the form of monographs, reports, research guidelines, resource manuals, as well as journal articles. Researchers in RUME require access to materials that are not only specific to their field but also to the broader literature of mathematics, education, learning theories, instructional strategies, alternate assessment techniques, cognitive development, and human behavior. This annotated bibliography is designed to be a template for a comprehensive and up-to-date collection of RUME resources. World Wide Web (Web) locations for many of the items are provided, as are descriptions of several Web sites that present information of interest to RUME researchers.

Journal. According to In Print (an electronic database produced by the Association of College and Research Libraries, http://camellia.shc.edu/inprint/) the quarterly journal *Reference Services Review* has an acceptance rate of 40% and "a recent thrust is reaching an international/global readership". The "Notes for contributors" section of the journal states:

> *Reference Services Review* (*RSR*) is a quarterly, refereed journal dedicated to the enrichment of reference knowledge and the advancement of reference services.
>
> *RSR* covers all aspects of reference functions, including automation of reference services, evaluation and assessment of reference functions and sources, models for delivering quality reference services in all types and sizes of libraries, development and management of teaching/learning activities, promotion of information literacy programs, and partnerships with other entities to achieve reference goals and objectives.
>
> *RSR* prepares its readers to understand and embrace current and emerging technologies affecting reference functions and information needs of library users. ...

We selected this journal as the publication outlet in order to reach librarians at a variety of institution types who need to assemble an initial collection of materials for patrons interested in undergraduate mathematics education. Academic life is smoother when libraries have the resources needed by the clientele!

Instructional Development

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

Abstract. Traditional lecture settings are giving way to an expanding variety of instructional strategies, prompted by recommendations to increase active learning and the use of technology (among others). This paper explores the effect of this evolution in classroom practice on the task of classroom observation -- particularly considering the question, "What phenomena should an observer watch for?" In many cases, use of a protocol can guide an observer through the maze of classroom events. While such guides exist, they have tended thus far to focus the observer's attention on the instructor, with at most occasional attention shifts to student behavior. Yet under current efforts to involve students in active learning, focusing observation attention primarily on the instructor does not give a sufficient representation of classroom events. To establish this assertion, this paper offers examples of actual observations and comments on some classroom events that this kind of focusing misses. These comments lead to suggestions for additional focal points: student primary activity(s), student misbehaviors, primary media used by instructor and students, and physical setting. Although this paper uses mathematics as an example, many of the issues raised here transcend disciplinary boundaries.

Journal. According to In Print (an electronic database produced by the Association of College and Research Libraries, http://camellia.shc.edu/inprint/) the quarterly journal *College Teaching* has an acceptance rate of 20%. As stated in the "new directions for writers" section of the journal,

> *College Teaching* provides an interdisciplinary forum on issues related to teaching at the undergraduate and graduate levels. This journal is interested in articles that explore: (1) Aims and outcomes of teaching philosophy and practices that have significance beyond a specific discipline. These may include teaching techniques, new classroom procedures, evaluations of innovative programs, and examination of contemporary developments. (2) Teachers' roles, education, professional development, preparation to teach, and evaluation. (3) Incentives that encourage good teaching and ways good teaching is evaluated and rewarded. ...
>
> The journal welcomes articles on research in one field as long as it has applications to others as well. However, the journal cannot use: (1) Articles that are purely descriptive without any critical evaluation or analysis. (2) Those that are limited to one specific discipline. (3) Those that show no awareness of current work and literature in the field.

I selected this journal as the publication outlet because the issues raised in the article are significant in disciplines other than mathematics. I also knew from experience that instructional development specialists (and other academics) – the readership of College Teaching – work with faculty (including department chairs) to enhance classroom observation skills (especially as teaching portfolios gain status as an evaluation instrument), and that this path was more likely to reach a widespread audience than other options.

Instructional Development

- Murphy, T.J. & Wahl, K. (in review). Adapting a workshop calculus model to college algebra: Instructional challenges. (32 pages)

Abstract. By way of a case study, this article discusses instructional issues related to adapting Treisman's workshop calculus model to college algebra, with particular attention to the use of challenging activities to drive student collaboration. The study took place in a section of college algebra designated for students considered "at-risk" based on ACT score. The instructor was an adjunct in the Department of Mathematics who had spent several years teaching large lecture courses – the semester of data collection was her first effort with the workshop model. Data included classroom observations and videotapes, instructor journal entries, and class artifacts (in-class and out-of-class assignments and tests). Analysis revealed adjustment issues in instructor behaviors, instructor expectations, designing activities, and allocating class time. Previous literature indicated that these issues are not unique to reform in college algebra. However, an additional issue revealed in the study is the isolation of the instructor. This issue is likely more specific to college algebra and other developmental courses because instructors for these courses tend to be adjuncts – who are among the most isolated members of the mathematics community. If professional development programs are designed to address this critical issue, then it is evident that models such as the workshop calculus model can be adapted to college algebra and other such courses.

Note. In December 2000 this paper was submitted to *The AMATYC Review*. In May 2001 the editor of the journal sent me a letter with comments including, "Overall, the reviewers had a favorable impression of the article; however, all were concerned that the article is too long. … The authors should be encouraged to resubmit the article for publication once it has been revised." The paper included in this dossier is the revised version that has been resubmitted to *The AMATYC Review*.

My most recent progress-toward-tenure letter (included in the appendix to this dossier) states: "Although extensive service contributions are not normally required of pre-tenure faculty members, you have made more than the expected level of service contributions … " (p. 2). As the detailed list of my service contributions is available on my curriculum vita (included at the beginning of the dossier), here I discuss just some highlights.

S(a) Unit Service

- Twice I participated on the department search committee. This contribution was an efficient way for me to learn about the department environment and practices.

- Faculty member Andy Magid is a P.I. on the NSF-funded Oklahoma Teacher Education Collaborative. As such he designated me as the person most appropriate to work closely with the Master Teacher In-Residence (MTIR). This position meant, for example, that I attended workshops with Magid and the MTIR, that I helped (very minimally) with the annual summer workshop for entry year teachers, and that one semester the MTIR helped me to teach the course: Topics & Methods for Secondary Mathematics Teachers. It was a great way to learn about the state of pre-college education in Oklahoma.

- As one of the two mathematics education specialists in the Department of Mathematics, I have obvious responsibilities to committees in the College of Education, such as the Mathematics Certification Committee and the Educational Policy Development committee. Again, these were great ways to learn about the state of pre-college education in Oklahoma.

- The most fun service activities have been those that directly affected students: participating on the department scholarship committee (giving away money!) and being a faculty marshal at the college convocation (the students are so happy!)

S(b) College Service

- As the College of Arts & Sciences representative on the College of Education steering committee to prepare for the NACTE/OCTP site visit, I learned about the accreditation process.

- In 2001-2002 I will get to serve on the College of Arts & Sciences Instructional Technology committee!

S(c) University Service

- As the faculty sponsor for the OU Chapter of the Association for Women in Science, I helped to plan meetings and activities. I resisted this appointment because I did not believe that I could pay proper attention to it during my probation years. But the members insisted when the previous sponsor stepped down. Unfortunately, I was correct. The officers and I

were both to busy to keep the group as active as it had been in previous years. I hope to revitalize this group in 2001-2002.

S(d) Professional Service

- As a Project NExT Fellow, I have organized sessions at national and regional meetings, presented talks during sessions at national meetings, and initiated and managed a regional electronic listserv. I was also a cohort (Blue Dot) coordinator for initial fundraising efforts for the memorial for NExT director, Jim Leitzel (MAA Leitzel Lecture).

- As a member of the AMS-MAA Committee on Teaching Assistants & Part-Time Instructors, I have co-organized and moderated sessions and national meetings, as well as participated in grant-proposal-writing efforts.

- I have also recently been made a member of the Association for Women in Mathematics Committee on Education!