Mid-Tenure Review Portfolio

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CURRENT WORK AND PROFESSIONAL GOALS

Higher education in mathematics involves several entities including: (a) mathematics instructors, including faculty, graduate teaching assistants, adjuncts and other part-time instructors; (b) an evolving curriculum consisting of content required of mathematics-based majors as well as content for non-majors; (c) an evolving pedagogy, rooted in tradition and growing with changes in technology, experience from practice, and results from research; (d) students who are majors, potential majors, non-majors, and pre-service teachers; (e) an administration, composed of people who may or may not be mathematicians; and (f) the partnerships and coalitions created by combinations of the above entities. My recent and current work focuses primarily on two of these entities — students and instructors — and the impact that various pieces of the system, and the system as a whole, have on these people. In particular, I am interested in studying issues of access and diversity, and the experiences needed for instructors and students to pursue their chosen career paths effectively.

Below is a listing of the contents of this document, describing my work as a faculty member. Embedded in this statement are references to the kind of work done by researchers in (undergraduate) mathematics education. The category "research and creative activity" includes work in curriculum development, as well research articles in refereed journals. (There are those who would argue that work in instructor development — such as designing a course like "Teaching College Mathematics" — should also count as "creative activity" rather than teaching). My teaching statement includes remarks on philosophy as well as descriptions of practice (primarily from my perspective). I do not offer a separate section to detail my service activities, although I have participated in such enterprises, including a variety of Project NExT (New Experiences in Teaching) ventures. The structure of this document is based on my belief that the components of my work — research, teaching, and service — must be integrated to enable the greatest impact. The chart on the next page gives examples of the activities involved in these threads.

Contents:

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<u>Threads through work components.</u>

	Research & Creative Activity	*Teaching*	*Service*
Access, Diversity, and Retention	• (1998) ``Subsequent course and degree paths of students in a Treisman-style workshop calculus program.'' • (manuscript) ``Workshop calculus viewed from a Vygotskian perspective.'' • (1995; dissertation) ``College mathematics instruction in Transition: A study of reform in a college algebra course for 'at-risk'''students.``	• college algebra for ``at-risk" students (UIUC) • Treisman-style workshop calculus (UIUC) • consultant, Rick Marcilla's work with MEP students (OU)	• faculty advisor, OU chapter of the Association for Women in Science
Instructor Development	• (manuscript) ``College mathematics instructors in Transition: A case study.'' • (manuscript) ``Developing snapshots of undergrad math classrooms: Evolving efforts to describe instructional practices.''	• ``Special Topics and Methods for Secondary Mathematics Teachers'' (OU) • ``Teaching College Mathematics'' (OU)	• liaison, Oklahoma Teacher Education Collaborative-Master Teacher in Residence • member, OU Math Teacher Certification Cmte • member, entry-yr teacher cmtes (OU) • member, AMS-MAA Cmte on Teaching Assistants and Part-Time Instructors
Visualization	• (1999, to appear) ``Using *Mathematica* with Multivariable Calculus.''	• Multivariable Calculus & *Mathematica* Project (OU)	• Multivariable Calculus & *Mathematica* Project (OU)

Research and Creative Activity

In 1987 I began graduate school in mathematics. I had visions of being a faculty member in a department of mathematics. At the time, the path to such a career included a doctorate in mathematics. A few years later, however, that condition began to change. As interest in reforming calculus spread, the need for scholars trained both in mathematics and in educational research grew. Meanwhile, I found myself interested in my students ("at-risk" students primarily from inner-city Chicago) and their experiences in the system. This interest extended beyond the classroom: I was asking questions for which I wanted answers — but most of the answers I found were based on speculation and mythology. Then I learned about the possibility of a doctorate in undergraduate mathematics education.

State of the Field

Previously, most doctorates in mathematics education went to specialists in elementary or secondary education. In fact, my transcript says "secondary" because "undergraduate mathematics education" was still too young a field to have made the list of options. Much of the research on pre-college issues is applicable to higher education, but there remains an abundance of unanswered questions. The next section describes some aspects of the field, drawing on the documents in Appendix A.

What and why. "The field" is not well-defined. 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 (the teaching and learning of college mathematics) has only been active since the mid-1980's. As such, the structure of the field — the issues of interest and the methods for studying them — are evolving quickly. In [1], Selden and Selden list the following topics as examples of the kinds of things that researchers in undergraduate mathematics education study: "teachers' knowledge and beliefs; problem solving; calculus; proofs, logic, reasoning; differential equations; gender and equity; learning styles; representations; visualization; affective issues; technology; misconceptions; functions; cooperative learning; writing." In [2], Schoenfeld offers the analogy of medical research and then guides the reader through the flow of a few examples of research themes.

How and when. Primarily the field draws on the methods of the social sciences: psychology, sociology, anthropology. These fields offer research that is evidence-based rather than proof-based (as mathematics is). Thus answers are not definitive and, in fact, can (and usually do) change over time. As with other fields, any research in education begins with a search of the literature. The literature review, ultimately, is a synthesis of previous work: competing theoretical foundations and competing methods of inquiry, as well as results. The literature review leads to a refinement of the questions of interest and to a design of the intended study. Design also includes the construction of instruments (e.g., a survey) by which data will be collected. The data collection phase is often dependent on the flow of the school timeline: classroom observations can only happen when classes are in session, student interviews can only happen when students are around. Data collection also depends on the willingness of participants to participate: students are often offered money or grades as incentive to participate. Given this dependence on external factors, a researcher in the social sciences (including education) must find events in their local situation to study, or have the support and resources to travel to the populations of interest (this travel is difficult if the researcher is tied to a particular place because of teaching responsibilities). Data collection and analysis are often iterative: analysis of the data collected leads to a deeper understanding of the issues, and thus to subsequent data collections. Since the data collected is often a combination of qualitative data (e.g., interviews) and quantitative data (e.g., test scores), data analysis can involve a variety of procedures each of which requires someone with special training (e.g., content analysis, statistics). Of course, the final step is finding an appropriate journal and writing the article(s).

<u>Who and where.</u> Researchers in undergraduate mathematics education are well-versed in “advanced” mathematics and in the methods of social science research. In some cases they are researchers in mathematics education with a strong background in mathematics (equivalent of a masters degree); in other cases they are mathematicians who turned to research in education later in their careers. Scher and Findell [4] did a content analysis of database records to “collect, chart, and analyze a substantial body of [the field’s] research output.” Over the years 1985-1994 they found 312 articles. More striking, “out of the 332 total authors, 23 researchers have three or more articles on our list, and only ten have five or more articles.” These numbers can be misleading (and misused): for example, when I went through the database I counted that 141 of the 313 papers had multiple authors (instead of what the pigeon hole principle would lead us to believe). Trisha Bergthold and I found additional issues with this database. However, what we can get from this paper is the author’s intended conclusion: “[the] data provide support for viewing the field as still in its infancy, as there are so few articles, and so few researchers who have published more than three papers.” We can also note the small number of journals available in which to publish research articles; according to the Scher and Findell, most of the 313 articles were published in six journals (one of which is PRIMUS — and other people have said that papers published in PRIMUS are questionable as research). All of these journals publish papers from across grade levels; none of them focuses on undergraduate mathematics education (except PRIMUS).

My Research and Creative Activity

I am currently studying issues of (a) access, diversity, and retention; (b) instructional development; and (c) visualization. My dissertation research included work in the first two areas; the abstract is provided below. After completing my dissertation, I became involved in a large, ongoing project (proposed by Travers, Weichsel, Mahoney, and Ewen, funded by NSF) to develop statistical indicators to monitor the condition of undergraduate mathematics education (affectionately referred to as the "indicators project").This project is continuing to collect data on a variety of issues and I intend to be part of the team that analyzes the data relevant to the first two issues listed above. In addition, recent experience with multivariable calculus is leading me to pursue research issues in visualization. The next part of this statement discusses my primary research and creative activity interests and experience in greater detail.

Access, diversity, and retention. The work I value most has been with research and interventions aimed at recruitment and retention of populations underrepresented in science, mathematics, engineering, and technology fields (African-American, Hispanic, Native American, female). While I recognize the critical nature of equity in early childhood and elementary education, I am most interested in secondary, undergraduate, graduate, and junior faculty levels. Past projects include the article, "Subsequent Course and Degree Paths of Students in a Treisman-Style Workshop Calculus Program" (in Appendix B), whose abstract is provided below. Currently, I am working on a co-authored manuscript that places a Treisman-style workshop calculus program in the theoretical context provided by Vygotsky's work. In addition, I hope to begin a meta-analysis of Treisman-style programs, using data available through the Charles A. Dana Center for Mathematics and Science Education in Austin, Texas. Furthermore, I am a member of a team of scholars that recently submitted a grant proposal to NSF to study and improve the representation of women in science, mathematics, engineering, and technology in the state of Oklahoma.

Instructional development. For three years I worked as an academic professional in the field of instructional development. This experience in training graduate teaching assistants and working with faculty who wanted to improve or revive their teaching enabled me to develop an unusual set of skills and knowledge. Much research has studied teacher preparation at pre-college levels; less is known about undergraduate mathematics instructor development. I am currently preparing the two manuscripts whose abstracts are given below. In addition, the Mathematical Association of America is interested in the status of adjuncts in the mathematics community; I intend to take advantage of this interest to pursue this important and timely issue.

Visualization. At the University of Oklahoma, I was one of the leaders of the "Multivariable Calculus and *Mathematica* Project" team. This project was funded by the College of Arts and Sciences at the OU, to integrate the computer algebra system *Mathematica* into the multivariable calculus course. Multivariable calculus was chosen as the starting point to integrate technology in the calculus sequence because

Mathematica has graphics capabilities that can be used to facilitate the visualization of the objects being studied. Maximally effective use of this tool, then, requires an understanding of how students visualize objects and how they learn to expand their visualization skills. Although his work is still primarily at the literature review stage, it resulted in the acceptance for publication of the paper: "Using *Mathematica* with Multivariable Calculus" (in Appendix B).

Abstracts and Works in Progress

The five abstracts mentioned above are provided here. The remaining work is presented according to its stage of development: data collection and analysis or literature review and study design.

Dissertation: *College Mathematics Instruction in Transition: A Study of Reform in a College Algebra Course for "At-Risk" Students*.

ABSTRACT: Historically, students from academically disadvantaged and minority populations have experienced disproportionately high dropout and failure rates in college mathematics. There is some evidence that providing an appropriate environment can facilitate the success of underrepresented students in calculus (Treisman, 1985). However, these students often place into courses considered remedial at the college level. This research examined the effort to extend such strategies to a college algebra course for "at-risk" students, who were admitted to a research university through an academic support program. In particular, the study analyzed the extent of reform in this course and the impact of the course on student outcomes, and identified barriers and enhancers to implementing reform in this context. A combination of retrospective and prospective data was utilized. Admissions and transcript records enabled the calculation of background characteristics (demographic and academic) and persistence rates (university retention and course and career paths). Prospective data included classroom observations, instructor and researcher journals, pre- and posttest, and student interviews. The results indicated that (a) the academic support program provided a support structure for both the students and the instructors; (b) the course employed active (not collaborative) learning (but content remained at lower cognitive levels); (c) the instructor experienced frustrations in trying to balance content coverage with student involvement, in learning to release control to the students, and in discarding traditional notions of remediation; and (d) the treatment did not adversely affect student skills or attitude, and in fact the course enabled some students to pursue their chosen fields. Recommendations include: upgrading the course content, providing instructor development opportunities, and -- most importantly -- strengthening the partnerships between the units (program, department, and instructor) involved in the management of the course.

[1] Published: 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).

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.

[2] Accepted for publication: Murphy, T. J., White, J. J., Kline, B. J., Black, E., Goodman, R., and Hofer, M. (1999, to appear). Using *Mathematica* with Multivariable Calculus. Proceedings of the American Society for Engineering Education Annual Conference, Charlotte.

ABSTRACT: The Department of Mathematics at the University of Oklahoma (OU) is developing technology-based materials for its engineering calculus sequence, both to enhance conceptual understanding and to prepare students for problem-solving with the computational power available. In this paper, we discuss the in-class use of *Mathematica* animations and sequences of overhead transparencies, and the out-of-class use of problem sets and the World Wide Web, with multivariable calculus. A goal of the ongoing project is to offer interested instructors a variety of materials that will enable them to incorporate technology at a level of integration that they deem appropriate.

[3] Manuscript: (Murphy; soon to be submitted to *College Teaching*) *Developing Snapshots of Undergraduate Mathematics Classrooms: Evolving Efforts to Describe Instructional Practices*.

ABSTRACT: In lecture settings, observers tend to focus on the behavior of the instructor, with occasional attention shifts to student behavior. However, traditional lecture settings are giving way to an expanding diversity 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. To this end, the author observed college mathematics classes, whose format varied in the extent to which small group work and technology were intended to be an integral part of the course. These observations led to the proposed categories — physical setting, instructor primary activity(s), student primary activity(s), primary media used by instructor, and primary media used by students — as suggested focal points to guide observers in watching classes in the current reform movement.

[4] Manuscript: (Murphy and Weger; submitted to and rejected by the *Journal for Mathematics Teacher Education* and currently being rewritten for resubmission) *College Mathematics Instructors in Transition: A Case Study*.

ABSTRACT: Current reform efforts in undergraduate mathematics education ask instructors to engage students in the classroom with content that is meaningful. This study followed an instructor through her first semester of attempting to implement reform in a college algebra class for "at-risk" students. Data analyzed included classroom observations and videotapes, and a journal that the course instructor kept. Results from these data confirmed that the instructor struggled with (a) balancing "content coverage" and student involvement and (b) learning to use challenging content to drive student collaboration. Recommendations included increasing the types of and availability of instructional development and other support opportunities.

[5] Manuscript: (McCreary, Murphy, and Kline; in preparation) "Workshop calculus viewed from a Vygotskian Perspective".

ABSTRACT: The Merit Workshop Program at the University of Illinois at Urbana-Champaign was designed to engage university calculus students in collaborative problem solving activities. For more than a decade students from underrepresented groups in science and mathematics-based majors have excelled in their academic performance in the context of the Merit Workshop Program. What has not been made clear to the mathematics and education communities is that this program can be set in the theoretical framework proposed by the Russian social scientist Vygotsky. According to Vygotsky, understanding is forged first in a social context and then internalized within the individual. Skilled autonomy can arise from an individual's social activities. This view directs our attention away from the individual as isolated creator and retainer of knowledge and focuses our attention instead on the interactions that students have with those surrounding them in an educational settings: the teachers and their classmates.

[6] Manuscript: (McKnight, Magid, McKnight, and Murphy; book in preparation, to be published by AMS in January 2000) *Mathematics Education Research: A Guide for the Research Mathematician*.

[7] Data collection and analysis: (Covington, Doer, and Murphy) Covington and Doer want to know what experiences in-service teachers think that pre-service teachers need from the undergraduate curricula. A preliminary survey of open-ended items was administered to a group of in-service teachers. Covington, Doer, and Murphy have been through the first rounds of the content analysis and are about to design a survey of closed items to be given to teachers on a larger scale.

[8] Data collection and analysis: (Murphy, White (Jon not Luther), Stafford?) "Facilitating Visualization in Multivariable Calculus." As instructors (nationally as well as at OU) of multivariable calculus struggle with the issues that come with integrating technology into the curriculum, the question is not *whether* to integrate technology but *how* to integrate it in an effective, appropriate way. Unfortunately, most of the current literature — upon which decisions are based — consists of anecdotes and opinion, rather than mathematics education research. This project is investigating the ways in which students learn to visualize the three-dimensional objects analyzed in multivariable calculus, and the ways in which the integration of technology might facilitate this process. In Spring 1999, Murphy and White began to gather data from the students taking multivariable calculus. Data collection continues and data analysis is at the very beginning stages (creating a database and starting exploratory data analysis). The intention is to submit an article to the Journal for Engineering Education and to submit a grant proposal to NSF for funding to extend the depth and breadth of the study (described below under "literature review and study design").

[9] Project design and piloting: (Molina, Hsu, May, Shoaf, Epperson, Murphy, Gomez, and Stanley) A team of scholars affiliated with the Charles A. Dana Center for Science and Mathematics Education, in conjuntion with Cogito Learning Media, Inc., CBMS, and ETS, is designing a package of web-based AP Calculus materials. A prototype is due June 30, 1999 with a marketable version due October 1, 1999. We have intentions of collecting preliminary data from students during Summer 1999.

[10] Literature review and study design: (Murphy, Epperson, and Hsu) Much folklore has developed around Treisman-style workshop calculus, Emerging Scholars Programs (ESP). However, not much is documented in the research literature. Armed with a list of institutions that house such programs, and some contacts with the ESP community, I will be conducting a "meta-analysis" of existing program features, expectations, and results.

[11] Literature review and study design: grant proposal (G. Kay Powers from UCO is PI) submitted to the National Science Foundation by the University of Central Oklahoma (host institution), the University of Oklahoma, St. Gregory's College, and Tulsa Community College, for a planning grant to address issues of gender equity in the state of Oklahoma in science, mathematics, engineering, and technology. I represent OU as a co-PI. $30,000 requested.

[12] Literature review and study design: grant proposal and research study (Suzanne Lenhart from UTK is PI), "New Keys for a New Millennium", submitted to the Fund for the Improvement of Post-Secondary Education (FIPSE) by the AMS-MAA Committee on Teaching Assistants and Part-Time Instructors, to investigate the issues related to teaching assistants and adjuncts (i.e. To update and expand MAA Notes Volume 11). I am listed as a co-PI. Unfortunately we found out on Jan 19 that the FIPSE competition has been cancelled for this year so the Committee with have to seek alternate funding.

$176,428 requested. Meanwhile, I am continuing the literature review and study design process with the hope of contributing to this area and to connect the committee's work to the research literature.

[13] Literature review and study design: grant proposal and research study, "Facilitating Visualization in Multivariable Calculus." In order to extend the study described above, the literature search will have to be extended to include results in cognitive psychology and perhaps even in neuroscience. $6000 internal money from OU, intentions to request external funding from NSF.

The charts on the next page summarize the progress on each of these projects. The first chart includes only those projects for which I am "team leader"; the second chart includes those projects on which I am a "team member".

<u>Research and Creative Activity Timeline</u>: projects for which I am team leader.

	design	collect/analyze	write/re-write	publication progress
fall 96	3	1		1 sbmttd & rjctd
spring 97	3	1 (re-analyze)	1 (re-write)	
summer 97	3		1	
fall 97	3		4 (old data)	1 re-sbmttd & accptd
spring 98	2	3	4	
summer 98	2	3	4	4 submitted
fall 98	8	2, 3	2, 3	4 rjctd, 2 sbmttd
spring 99	10	8	3, 4 (re-write)	2 accepted
summer 99	10, 13	10	4, 8	[submit 3, 4, 8]
fall 99		10, 13	10	
spring 00		13	10, 13	
summer 00			13	
fall 00				
spring 01		construct	tenure dossier	

<u>Research and Creative Activity Timeline</u>: projects for which I am a team member.

	design	collect/analyze	write/re-write	publication progress
fall 96				
spring 97				
summer 97				
fall 97				
spring 98				
summer 98	12			
fall 98	11, 12		5 (theory ~data)	
spring 99	9, 12	7	4, 5, 6	
summer 99	9, 11, 12	7, 9	4, 6	[submit 5]
fall 99		7	6, 9	[Cogito markets 9]
spring 00		7, 11		[AMS publishes 6]
summer 00		11	7	
fall 00	11.2		11.1	
spring 01		construct	tenure dossier	

Teaching

I have taught a variety of courses: college algebra, calculus, topics for teachers; and a diversity of students: mainstream undergraduates, underrepresented undergraduates, pre-service secondary teachers, new graduate teaching assistants, and doctoral students in undergraduate mathematics education. For three semesters (of my six semesters as a faculty member) I taught large lecture (120-150 students) calculus; in addition I have taught smaller calculus courses (35-40 students), small pedagogy classes (5-12 students), and a variety of independent study and reading courses. These experiences, and my understanding of the research literature, have led me to statements asserted here. The foundation of my philosophies and strategies has been the belief that all students can learn mathematics given the opportunity and an appropriate environment in which to do so.

The table below summarizes my teaching load at OU during pre-tenure years. Appendix C contains sample course materials from (a) a large lecture (Calculus II), (b) a “small” calculus course (Calculus IV), (c) “Topics and Methods for Secondary Mathematics Teachers”, and (d) the course for teaching assistants new to the Department of Mathematics at the University of Oklahoma.

Pre-Tenure Teaching Schedule: number of students enrolled at semester end.

	calc 1	calc 2	calc 3	calc 4	secondary	Col Tchg	Dctrl Seminar
fall 96	38				5	6	
spring 97	95 + 34						
summer 97							
fall 97		120			5	9	5
spring 98		142	41				
summer 98							
fall 98				26	11	9	3 enrolled
							7-8 attending
spring 99				(35 + 35)			
summer 99							
fall 99				x	x	x	x
spring 00							
summer 00							
fall 00							
spring 01							

Instructional philosophies. My primary goal in any class I teach is to support students in pursuing their chosen career paths. Beyond that, however, specific classroom goals 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, my classroom goals included nurturing students’ confidence in their mathematical abilities, fostering a support structure consisting of peers and instructors, and facilitating the choice of appropriate career paths, in addition to preparing the students for success in future mathematics-based courses. On the other hand, the students I taught in a Treisman-style Workshop Calculus program already were confident in their mathematical abilities; thus, my primary goal was to build a community of scholars who would push each other to excel in what has traditionally been a “weed-out” sequence of courses. Under these conditions my goal was to provide challenging mathematical tasks that compelled the students to interact, and to use questions, non-verbal communication (e.g., physical positioning, eye contact, and silence), and awareness of events in the classroom to keep the students interacting with each other about mathematics.

Active learning and student collaboration. As a lecturer, I work to engage the students. For every statement I might make, I try to ask a well-phrased question instead (interactive, sometimes socratic, lecturing). If the students are reluctant to respond or the question is particularly difficult, I ask the students to write their responses before sharing them — sometimes they share their responses in pairs or small groups before a class-wide debriefing. Furthermore, when I lecture, I provide examples for the students to work on in class; these examples are based on the homework (traditional, routine exercises) and are used to allow the students to experience success with the problem type before attempting the homework, as well as to provide feedback to me about misunderstandings that still remain.

Although I have experienced success by interactive lecturing, I value more the benefits of student collaboration. My favorite role is facilitator and coach, role model and cheerleader, rather than expert and authority figure. Under these conditions, my job is to design and execute activities that guide and challenge students. To this end, I get to know my students and their interests and goals. I supplement the textbook with in-class worksheets and activities, non-routine problems and non-traditional assignments that take advantage of the power of collaborative learning. As part of encouraging student ownership, I rarely assign groups — except to create greater interdependence among the students. I enjoy "controlled chaos" and the power of a room full of emotional, heated, mathematical arguments.

Variety in tasks. In general, I intend that students be able to: (a) do mathematics by exploring problems, getting and verifying answers, and representing problems and answers in multiple ways (symbolically, numerically, graphically); (b) communicate mathematically by reading and writing mathematics (including the use of good notation), and listening to and speaking mathematics; and (c) use technology appropriately as a tool to solve problems. From the textbook I select a variety of skills-based exercises that involve a variety of functions, tasks, and levels of difficulty. In addition, I assign “problem sets” that consist of problems that are too difficult for students to work in isolation, and often require the use of a graphing calculator or computer algebra system to complete computations. I also use in-class quizzes and tests, with items tending to be routine (unusual items are reserved for problem sets) — I believe strongly in not startling students with unexpected tasks under already-stressful testing conditions. Since I allow the use of any calculator, I try to write items that emphasize the set up and explanation of a solution, rather than the computation of an answer; in some cases, this has meant giving the students the answer and asking them to show that it is correct. This variety of assignments is intended to capture a variety of student learning styles and abilities.

Professional development for teachers. I regularly teach a course for pre-service secondary teachers and another course for teaching assistants new to the Department of Mathematics at OU. For both of these classes, I believe that my job is to provide a set of experiences and to ask a set of questions that will lead each teacher to a personal philosophy of teaching. I try not to impose my own philosophy. I also believe that practice at teaching is the best way to learn about teaching, so I require that each teacher design and execute lessons (the TAs do this in their own classrooms). Finally, I believe that reflection and networking are the best resources a teacher can have; thus, I require that they submit e-mail journals, watch videotapes of themselves teaching, participate in class discussions, conduct peer observations and debriefing conversations, and read each other's statements of teaching philosophy.

Graduate students. I am currently one of the two faculty members in the Undergraduate Pedagogy and Curriculum Research Option in the Department of Mathematics at OU. As such I have been a committee member (masters and doctorate) for graduate students in education, mathematics, physics, and psychology. I object to a system that takes the brightest, most dedicated students in the pipeline, and uses their self-esteem for target practice. I believe that the graduate experience can be more about scholarship and less about rites of passage. To this end, I have attempted to provide graduate students with timely feedback on their work, suggestions for navigating the political and bureaucratic establishment, and, most importantly, emotional support for their continuing struggle in a system filled with barriers and discouragements. The topics of reading courses I have offered have been directly relevant to the individual student's interests and research progress (e.g., begin a literature search, use the literature to explore conjectures). The seminar for the Undergraduate Pedagogy and Curriculum Research Option has allowed students to present their research — at levels varying from beginning a literature search to writing a dissertation — for feedback and input from faculty and classmates. As lecturer for large courses, I considered my teaching assistants to be members of an instructional team — they helped me to design activities and to keep in touch with the students. In all cases, I have attempted to treat graduate students with respect, as colleagues, rather than as servile underlings.

Opportunity to learn and diversity. As implied by my work with underrepresented populations, I am committed to creating and maintaining the opportunity to learn for all students. To this end, I strive in all courses at all levels to provide a supportive, inclusive, non-threatening environment. It is my job as an instructor to make mathematics accessible and meaningful for all of my students. It is my job as a member of the higher education community to role model attitudes and behaviors that enrich the community for both my students and my colleagues. It is my job as a citizen in a democracy to advocate diversity in the classroom, in the discipline, and in the community. This is the single most important goal in my work.

Student evaluation results. The following table lists mean responses to a selection of scaled questions on the UIUC Instructor-Course Evaluation Survey and on the OU Arts and Sciences Instructional Evaluation Form. These means are complied from a sample of courses I have taught: "Preparation for College Algebra", college algebra, engineering calculus, “Topics and Methods for Secondary Mathematics Teachers,” and “Teaching College Mathematics,” from the most recent time that I taught the course. All responses are on a 5-point Likert scale, with 5 = high. Sample comments from students are available upon request. [or should I include these?]

Student Evaluations: overall teaching effectiveness on a 5-point scale (5 = high)

prep alg	col alg	calc 1	calc 2	calc 3	Calc 4	tchrs	GTAs
Fa94 (n=16)	Sp93 (n=13)	Sp97 (n=31)	Sp98 (n=104)	Sp98 (n=32)	Fa98 (n=28)	Fa98 (n=12)	Fa98 (n=10)
4.9	4.7	4.3	4.2	4.5	4.5	4.6	4.5

Professional development activities. Each year I attend the AMS-MAA Joint Meetings and Mathfest; typically I also attend an NCTM or AERA meeting. At OU, I have regularly attended seminars conducted by the Instructional Development Program. I collaborate regularly with near and distant colleagues (as well as current and former students) — in person and by e-mail. This list is not exhaustive, but is meant to offer a sample of the activities in which I engage to continue to grow as a faculty member.

APPENDIX A

References for State of the Field

[1] Annie Selden and John Selden, “Collegiate Mathematics Education Research: What Would That Be Like?” in The College Mathematics Journal, volume 24, Number 5, November 1993.

[2] Alan H. Schoenfeld, “Some Notes on the Enterprise (Research in Collegiate Mathematics Education, That Is)” in CBMS Issues in Mathematics Education, volume 4: Research in Collegiate Mathematics Education I, 1994.

[3] Annie and John Selden, “Enthusiasm for Research in Collegiate Mathematics Education Grows” in MAA FOCUS, volume 17, number 1, February, 1997.

[4] Daniel Scher and Bradford R. Findell, “Research in Undergraduate Mathematics Education: A Map of the Territory.

APPENDIX B

Preprints

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).

Murphy, T. J., White, J. J., Kline, B. J., Black, E., Goodman, R., and Hofer, M. (1999, to appear). Using *Mathematica* with Multivariable Calculus. Proceedings of the American Society for Engineering Education Annual Conference, Charlotte.

APPENDIX C

Sample Course Materials

Calculus II: Integral Calculus, Spring 1998, 142 students

- Syllabus
- Problem Set 3
- Problem Set 3 Sample Student Solutions
- Final Exam

Calculus IV: Multivariable Calculus, Spring 1999, two sections of 35 students each

- Syllabus
- Sample Selected Topic Available at the Course Web Site
- Problem Set 1
- Problem Set 1 Sample Student Solutions
- Test 1 Sample Student solutions

Topics and Methods for Secondary Mathematics Teachers

- Syllabus
- Sample Student Portfolios

Teaching College Mathematics

- Syllabus
- Reading Packet: “Introduction to the Reform Movement”