As a graduate student at the University of Illinois at Urbana-Champaign (UIUC), a faculty member at the University of Oklahoma (OU), and an adjunct faculty member at Oklahoma City Community College, I have taught a variety of courses: college algebra, calculus, topics for teachers, graduate seminars and topics courses, and most recently applied statistical methods. I have also taught a range of students: mainstream undergraduates, underrepresented undergraduates, preservice 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 apprentice 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 confidence 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. Most of my undergraduate teaching at OU has been in calculus courses. In these courses, 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, including clicker questions for conceptual understanding, 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. I have employed these strategies in the calculus sequence, linear algebra, and most recently statistics.

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. I have considered replacing the usual quizzes and tests with alternate forms of assessment, but since the vast majority of my undergraduate teaching has been as part of a sequence, I have been hesitant to move too far off the norm in that context. In addition to quizzes and tests, my recent courses have required that students complete online pre-class reading quizzes intended to motivate them to look over the content prior to coming to class. 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, in the past, 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. I burned out from so much grading so I have abandoned having students turn these reports in for a grade, but the problems often show up for in-class work. 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. 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. Most recently, I have used online pre-class reading quizzes and in-class clicker questions.

Statistics

I have had the opportunity to teach three statistics courses: two at OU that were senior-level calculus-based for science, engineering, and mathematics majors as well as one at Oklahoma City Community College that was sophomore-level algebra-based for a variety of majors including education, nursing, and psychology. As with my other teaching assignments, I am committed to active learning strategies and I make heavy use of group work and technology. Specifically, I used in-class time to have the students work with small data sets using their calculators, larger sets of data using computers, and clicker questions to emphasize conceptual

understanding. I have come to depend heavily on electronic resources including causeweb.org (Consortium for the Advancement of Undergraduate Statistics Education), https://ore.gen.umn.edu/artist/ (Assessment Resource Tools for Improving Statistical Thinking), and data sets provided by textbook publishers. In addition, I have been part of a multi-disciplinary team of statistics instructors at OU who are writing annotated clicker questions for use in introductory statistics courses (NSF award CCLI-0535894)

Mathematics Teachers

Classes. At OU, I have 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 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, seminars 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 believe that it is difficult for a person to write good research questions if that person has not experienced data collection and analysis. Thus, in recent years, I have been experimenting with having doctoral students begin their education research experiences with existing data that need to be analyzed. From this experience, they gain insight about what can be done at the data collection phase to produce higher quality data. Continuing backwards, they then have a better idea of what constitutes an answerable focused research question. Or so I hope. I also believe that graduate students have the right to a balanced life. I have tried to be efficient with students' time while pressing them to maintain high aspirations.

Documentation of Effectiveness

- Good Teaching Award, OU, 2003.
- Educators' Leadership Academy/Outstanding Professors' Academy, 2002-2003.

- Spring 2004: chosen by the Instructional Development Program)IDP) Faculty Discussion Group *Observing Outstanding Teachers* as a teacher to be observed.
- Fall 2004: selected by L. Dee Fink (then-Director of OU IDP) to have classes observed by visitors from Thailand and Lebanon. Email sent (October 25, 2004) by Dee to Mike McInerney (Botany/Microbiology), Bruce Mason (Physics), Teri Reed-Rhoads (Engineering), and me: "As a result of some traveling and contacts I did this summer, we have several international visitors (N=11) from universities there, coming to OU, Nov. 8 - 10. Some are from Lebanon and some from Thailand. Several of them are interested in seeing some actual classes where the professor is doing some innovative teaching, i.e., something other than straight lecturing and occasional whole class discussions. As I thought of whose classes they might visit, you all came to mind.

- Summer 2003: invited panelist on Teaching a Class Better the Second Time Around, Project NExT panel at MAA MathFest, Boulder.
- Summer 2007: invited presentation on "Using Group Work" for the Project NExT panel on *Deciding How to Teach*, at MAA MathFest.

On end-of-semester student evaluations, I tend to have mean and median scores in the upper ranges (4-5 out of 5). However, I don't actually believe that these evaluations are a good indication of teaching effectiveness. Instead, I prefer to consider information about students' progress through subsequent classes, degree completion, and career paths. These data are difficult to obtain because education records, such as academic transcripts, are protected private information. So, for example, I have not found a good way to investigate how students who took Calculus 1 from me did in their Calculus 2 classes. However, I do hear from students regularly and I include here some sample comments. Comments like these convince me that I am having the kind of impact I would like to have.

email received August 22, 2007: Hey! It's been a long time! I'm not sure if you remember me as you've had tons of students in the past. But I just recently had to look back at my linear algebra notes from the class you taught in 2002. So for a little update I graduated in 2004 and went to work for IBM for about 3 years. I recently stopped working for them in order to pursue my masters degree full time at the University of Arizona (mechanical engineering thermal sciences). I intend to work with solar thermal power generation. All ME grad students are required to take two semesters of advanced engineering math. Well it just so turns out that the bulk of the material covered in the first semester is Linear Algebra. And it just so turns out that I took Linear Algebra at OU as a tech elective taught by none other than you. I really enjoyed your class and I often tell people about how my Linear Algebra (also calc 3) prof was one of my favorite profs :) I got an A in your class but it has been 5 years and I didn't have my notes any more. So I did some searching around and found your website and saw that you still had all the handouts and group problems and solutions and a few tests from the Linear Algebra class you taught in 2002! I was so relieved. I just wanted to thank

you for keeping that stuff posted. I'm pretty rusty on my math in general so any help I can find is wonderful. I think these notes will be a great refresher. I hope all is well back in Oklahoma. And thank you again for just being awesome in general.

email received October 27, 2005: I know it's been a long time but I wanted to know if there was a time that I could come by and talk to you about some stuff... I'm strongly considering changing majors and have thought that math might be something I want to do. Before I do I thought I'd ask some of my professors what they thought so if there is some time that you have, could I stop by and say hello for a bit?

follow-up email received October 16, 2006: I know your going to think I only come around when I have problems and questions but I hope that you can entertain my queries one more time. I wanted to get some advice about your thoughts on grad school. Let me know if there's some time you could spare.

email received May 8, 2006 (after the student sent flowers to thank me for connecting him to career opportunities): Your welcome and by the way you are invited Saturday May 13th between 1-3pm at Reeves park at the large pavillion. Some of my family will be there eating, playing and chillin. If you get the time to stop by, I would like to introduce you to my mom. And by the way, you can't be sick this week, it sort of isn't allowed! :-)

email received April 25, 2005: I have some exciting news to share with you. If you were to peer into the far reaching computer systems that make the information grid of OU students, you might come across a young man named [name deleted to protect confidentiality]. If you delved a bit deeper into his file, you might notice that on [date deleted] he declared himself a math major. So as it is, I stand before you officially a math (professional option) major. Since you helped quite in the decision, I thought you should be the first to know. That and I still have your book on graph theory, I assure you that you will have it back before the end of the semester!

follow-up email received November 8, 2006: I would just like to let you know that the NSA has received the letter of recommendation you wrote on my behalf. Thank you so much for doing that! As an update, they have asked me to take their mathematical aptitude test (a standard procedure) and further, they wish me to come out to Maryland for a round of interviews! I couldn't be more pleased and I am sure no small part of my progress is due to you. Thank you again! I will keep you updated.

email received August 31, 2005: I haven't seen you in quite some time. I finished up Calculus IV last semester with an A, and have transferred to the University of North Texas. I'm currently taking Real Analysis and Linear Algebra and have changed my major to Mathematics. I'm getting very excited about the opportunities that will be opened to me with this degree. I hope all is well with you and your life. I trust that you've gotten a student that has been as much of if not more than a smartass than I was. I always did appreciate your class and your teachings, though, and I want to thank you for teaching me as well as you did. I am convinced I only passed my last semester of Calculus because of your help. I am applying for a math grader/tutor job here in Denton for the university, and I was wondering if I could list you as a reference. It would really help out a lot, and I would greatly appreciate it. Thank you for everything.