

Capstone, Curriculum, and Collaboration:

Local Efforts to Improve the Mathematical Education of Teachers

David W. Dempsey, Jacksonville State University

Jacksonville State University began in 1883 in northeast Alabama as a state normal school and later became a state teachers college in 1930. Now a regional comprehensive university with more than 9000 students and several graduate programs, teacher education retains its priority status on our campus. In our Mathematical, Computing, and Information Sciences (MCIS) Department, we have seen in the last several decades a drastic decrease in the number of mathematics majors and a comparable increase in the number of computer science majors. The majority of our mathematics majors now are double majors in secondary education and earn a B.S. in Education (B.S.Ed.). (We normally have between 60–80 math/education majors and 15–20 mathematics majors.) It is worth noting that there are many students who commute long distances to campus, and about one third of JSU students are non-traditional.

When I arrived at JSU to teach mathematics full-time in 2000, the B.S.Ed. in secondary mathematics required only 32 hours of mathematics courses, well under the requirements for a math major. Advising was done exclusively by faculty in the College of Education (the term I will use for the longer current name, Education and Professional Studies), and there was very little interaction among faculty members in Education and in Arts & Sciences. Having done extensive work toward secondary certification before earning a master's degree in mathematics at JSU, it quickly became a high priority for me personally to explore ways to improve our preparation of future secondary teachers locally.

In 2001, having been tapped as an MAA Project NExT Dolciani-Halloran Fellow, I joined the NExT-Education listserv, through which I learned of the upcoming National Summit on the Mathematical Education of Teachers (MET). I led a team of three JSU mathematicians to this Summit in November and there learned of the MET report prepared by the CBMS and began brainstorming with my colleagues on how we could improve our local situation. Our team applied for and received an ExxonMobil Innovation Grant to aid in the planning process for a math and science partnership grant (which, unfortunately, was ultimately unfunded). In any case, the seeds for change were planted.

Back at home, transformation began, albeit very slowly. We made great strides in coordinating advisement and in creating new courses. Collaboration among MCIS and Education faculty increased and improved in many ways. Curriculum changes have taken place, but not without dogged determination on the part of mathematicians. I'd like to elaborate on our efforts, in the hope that others might learn from them—or at least not feel alone in facing similar challenges.

We have had the most success with advisement, so I'll start there. During my first two years at JSU, discussions with some of my students led me to the realization that they were getting little help from Education faculty in planning their math course sequence. This was due mainly to a lack of time and expertise—as Education faculty often had (and still have) large numbers of advisees and there were no math educators among their ranks—but the result, nevertheless, was that students often made poor choices in sequencing their math courses, causing problems for the students and for us as math instructors, as well. In Fall 2002, after discussions with my department head and dean, we set up a formal advising collaboration with the College of Education whereby two MCIS faculty handled the mathematics advising for math/education majors before sending them to their designated Education advisor with an advisement form signed by both the student and their math advisor. Currently, I advise all undergraduate math/education majors in this manner, along with the seniors in mathematics. (Just recently I have been granted a one-course teaching load reduction for this work.) This scheme has been a win/win situation for all concerned. Students get advisement from those best equipped for it, faculty work within their areas of expertise, and through this process our department gets information that has helped us coordinate class scheduling and gauge interest for summer courses.

The design of a capstone course sequence was one of two major recommendations in the MET report for the preparation of high school mathematics teachers. Talking with Zalman Usiskin at the 2001 National Summit on MET gave me the confidence to test-run a capstone course at JSU. So, in the summer of 2002, I taught an existing senior topics course and class-tested the preliminary version of the text *Mathematics for High School Teachers: An Advanced Perspective* by Usiskin, Peressini, Marchisotto, and Stanley. Using the MET report, I made the case for offering such a capstone course and eventually requiring it; my chair and colleagues were supportive. I taught the course the next two spring semesters, and every fall and spring since then, during which time the course has earned its own course designation, “Senior Seminar in Mathematics.” Following the advice in the MET report, I have sought to help students “look deeply at fundamental ideas” of high school mathematics; to this end, we spend much of the course exploring the real and complex number systems and then functions in some detail, occasionally followed by topics of the students’ choosing. I work to connect seemingly disparate topics in various branches of mathematics and also topics in high school and collegiate mathematics. I also include a continual historical emphasis, requiring my students to prepare two biographical research papers and class presentations on mathematicians associated with the development of the real and complex number systems. Students routinely rate this course as one of their most valuable.

Almost immediately following the 2001 National Summit, my colleagues and I began to think of ways to strengthen the curriculum for the mathematics teaching field in secondary education. In May 2002, we proposed a revised curriculum, based on MET recommendations, including a new junior-level applied probability/statistics course, a one-semester capstone, and courses in differential equations, combinatorics, and analysis (as there had been no required courses in these areas). At this time, the inertia within the College of Education was too great, and no changes were made.

Following the passage of the NCLB Act of 2001 and the approval of the Alabama Highly Qualified Teacher model in June 2003, new secondary teachers in Alabama suddenly needed the equivalent of an undergraduate major in their teaching field—and the need for curriculum revision became urgent. The immediate fix was to replace a basic statistics course (a general studies course) with our proposed junior-level course; this satisfied the minimum standards of 19 hours at the junior/senior level. In Fall 2003 we reinitiated meetings with colleagues in the College of Education and learned that they anticipated the requirement of an actual academic major in the teaching field for secondary education majors. Following MET and CUPM guidelines, we proposed a new “General Track” mathematics major (39 semester hours) which contained basically our previous recommendations, plus support courses in computer science and physical science. It was anticipated that our agreed-upon changes would be included in the new B.S.Ed. course checklist in 2005. Following the NCATE reaccreditation of our College of Education in Fall 2005, new checklists were submitted to the State Department of Education, but we later learned that no support courses were included. We have met during Summer 2006 to resolve some disagreements over the interpretation of the state articulation agreement, and it now seems very likely that by Fall 2006 we will be able to include most of our proposed support courses in computer science and physics.

In this brief summary, it may not be evident just how much relations have improved between MCIS and Education faculty; it is safe to say that we now have one of the best working relationships with Education. Despite some disagreements and communication issues—one Education colleague (light-heartedly) refers to the “oil and water” nature of relations between Education and Arts & Sciences—we have developed healthy collaboration among our faculty. The great strides we have made in the areas of advisement and curriculum are evident of this. But this collaboration has also extended to grant writing and inservice education for teachers. A large number of faculty in education and natural sciences pulled together to submit a Math and Science Partnership proposal to the NSF in 2002. This proposal was not funded, but in 2003, a subgroup submitted an inservice workshop proposal to the Alabama Commission on Higher Education (ACHE). Although also unfunded, this proposal was rewritten to focus on secondary mathematics teachers and was funded by ACHE in 2004. EMCAT (Exploring Mathematical Concepts through Applications of Technology) was the resulting inservice professional development program

jointly developed and taught by faculty in mathematics and education. In July 2005, we led teachers through an intensive week of activities in statistics, geometry, and algebra and focused on appropriate uses of technology, including TI-84 graphing calculators, Fathom, and Geometer's Sketchpad. Teachers were provided with calculators and software and had assignments and lesson planning to complete during the Fall semester if they chose to receive graduate course credit for the workshop. We hope that this successful program will be funded again in the future.

Of course, even with some successes, our work is never done. Within my department, we continue to look for ways to make our major courses more relevant to future teachers and to encourage more students to pursue mathematics and math education as careers. While effecting any kind of change is difficult, I think our work to address the needs of future teachers has been worth the necessary time and energy. I have found it worthwhile to attend regional and national conferences and workshops (most notably PMET workshops in secondary mathematics) and have often been pleasantly surprised at what I have learned from others and also what I have been able to share with others. I hope this summary of my department's efforts will prove useful and encouraging to others in similar situations.

References

[1] Conference Board of the Mathematical Sciences. *The Mathematical Education of Teachers*. Providence, RI: American Mathematical Society, 2001, Chapters 5 and 9.

[2] Usiskin, Z., A. Peressini, E. Marchisotto, D. Stanley. *Mathematics for High School Teachers: An Advanced Perspective*. Upper Saddle River, NJ: Prentice Hall/Pearson Education, 2003.