The certification program in secondary mathematics extends and enhances the conceptual framework of the College of Education by providing the opportunities and experiences necessary for beginning teachers to reflect on the perspective of the schools and the profession. Indeed, the National Council of Teachers of Mathematics (NCTM), the principal professional organization for our program, has for the past decade promoted teaching that fosters the development of students’ abilities to explore, conjecture, and reason logically, as well as the ability to use a variety of mathematical methods to solve nonroutine problems (NCTM, 1989; NCTM 1991, NCTM, 2000). In addition, the certification program in secondary mathematics prepares students to meet Kentucky’s New Teacher Standards, benchmarks relating to a variety of aspects of pedagogy, collaboration, professional development, and subject matter knowledge (Education Professional Standards Board, 1994). Teaching to meet these goals requires a great deal of reflective decision making, because what students learn depends to a large extent on how it has been learned. Consequently, this certification program strives to blend the learning of mathematics with the learning of pedagogy.

As the gateway to the professional community, the Secondary Mathematics Teacher Education Program is charged with helping its students understand the principles that guide not only the professional teacher but the professional mathematician as well. As developed and outlined in the NCTM (2000) Principles and Standards for School Mathematics, these principles address (i) Equity, (ii) Curriculum, (iii) Teaching, (iv) Learning, (v) Assessment, and (vi) Technology and mesh well with the New Teacher Standards. For instance, NCTM’s comment about equity, “that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students” (NCTM 2000, p. 12) fits well with Kentucky’s New Teacher Standard II “Creating and Maintaining a Learning Climate” and the position undergirding the Kentucky Education Reform Act (1990) that all students can learn. Indeed, research reports (e.g., Silver and Stein, 1996) that when provided access to high-quality instruction, even students who traditionally have not succeeded in school mathematics programs show greater achievement than they otherwise would show. Clearly there is no panacea – this takes a great deal of work on the part of the classroom teacher, and it is fed not by the wafers seen in Gulliver's Travels (Swift, 1726), but rather by a purposeful dose of reflection on his or her own teaching and that of colleagues. As NCTM (2000, p. 13) puts it, “To accommodate differences among students effectively and sensitively, teachers also need to understand and confront their own beliefs and biases.”

Curricular issues, likewise, need to be carefully considered. If the curriculum represents the mathematics to which students have access, it also, by nature of its coherence and the importance of the mathematics it addresses, determines what students do learn. As Stigler and Hiebert (1999) point out in their analysis of classroom instruction from the Third International Mathematics and Science Study (TIMSS), “big ideas,” supported by insightful pedagogy, foster higher-level mathematical thinking, thus bridging the gap between the perspective of the mathematics student and the perspective of the mathematician. It is to this central tenet – that the teacher is the primary mediator between a beginner’s understanding and the mathematician’s sophisticated development, communication, and evaluation of mathematical ideas – that the Secondary Mathematics certification program adheres. Developing a coherent and important curriculum must involve a great deal of planning, deep and flexible understanding of the subject matter, and sensitivity to developing a learning climate in which purposeful representation of important mathematics is played out in classroom instruction. The use of a few important ideas with which to engage students from a variety of perspectives can draw upon the strength of addressing different learning styles (see e.g., Davidson, 1990) and different kinds of intelligences (Gardner, 1993). In the Secondary Mathematics certification program, students are prepared to examine and critically evaluate the coherence of a curriculum in terms of how it reflects central and important mathematics and to reflect on its articulation across grade levels. Consistency is vital.

“Teaching mathematics well is a complex endeavor, and there are no easy recipes for helping all students learn or for helping all teachers become effective” (NCTM 2000, p. 16). However, most beginning teachers are in danger of being overwhelmed by the tension between being a student themselves and becoming a teacher (Jones, 1995) and are not provided experiences in which they are encouraged and helped to develop the kinds of understanding of mathematics, of students, and of pedagogy that will ensure their effectiveness. In this certification program, substantial attention is given to cultivating the above understandings and helping beginning teachers learn how to help their students see mathematics as both connected and meaningful. Effective mathematics teachers cultivate a
challenging and supportive classroom environment; effective mathematics teachers engage their students in real problem-solving activity; effective mathematics teachers are reflective when it comes to their teaching and have sufficient – and sufficiently supported – access to professional development (Grouws, Cooney, and Jones, 1988; National Commission on Teaching and America’s Future, 1996).

And what is required for meaningful understanding of mathematics? Brownell (1947), Skemp (1976), Hiebert and Carpenter (1992), and Bransford, Brown, and Cocking (1999) assert that conceptual understanding, factual knowledge, and procedural facility all are important. Attaining a useful balance among these three areas is difficult for beginning teachers (Eisenhart et al., 1993) let alone for high school students. By pairing instruction in pedagogy with instruction focused on bringing a university perspective to bear on secondary math topics, this program prepares beginning teachers to make the kinds of decisions that lead to students’ willingness to engage in mathematical activity as well as to their achievement.

A crucial part of the teaching and learning of mathematics – from the teacher’s perspective and the student’s perspective is the assessment. “Assessment should support the learning of important mathematics and furnish useful information to both teachers and students” (NCTM, 2000, p. 22). Preparing for high-quality assessment relies on the teacher’s ability to look deeply at his or her experience with particular subject matter and with particular students at a particular time, and the ability to use the information to which he or she has access in order to make good instructional decisions. Relying on different formats, focusing on different purposes, and drawing on purposefully selected problems and tasks, assessment can be key in students’ ability to solve problems of a variety of difficulty levels and their willingness to engage in mathematical study.

Finally, we see technology as a tool to enhance students’ abilities to reason and solve problems, communicate both with and about mathematics, and establish meaningful connections due to the possibilities of representation afforded by technological devices. Yet, as with all issues surrounding the preparation of high quality teachers of mathematics, there is a need – perhaps a greater need – for reflection on one’s teaching, for making decisions regarding what constitutes important mathematics, and for carefully planning purposeful instruction. The appropriate use of technology is seen not as a substitute for knowing a body of mathematical knowledge, but rather as an avenue to help students get to the heart of what it means to do mathematics.

This framework, informed by both experience and scholarship, is shared as a document with students in the program and teachers and administrators in the schools in which our students are placed. It also is shared through one-on-one interactions with colleagues in the schools and in our own College of Education. Further, as program, we go to substantial lengths to model with our students our belief that teachers are reflective decision makers. From advisement to application, from admission to midpoint retention, from instruction in the classroom to supervised instruction in the field, and from early assignments to certification we strive to embody this framework.

References


