APPENDIX A

Selected References and Information Sources

This annotated list describes recent reports that inform MET II's recommendations, and gives sources of information about accreditation and licensure.

Early Childhood: Teacher Preparation and Professional Development

Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity, National Research Council, 2009, `http://www.nap.edu/catalog.php?record_id=12519`

This report summarizes research concerned with early childhood teaching and learning of mathematics. It notes that:

> Traditionally, early childhood educators have been taught that mathematics is a subject that requires the use of instructional practices that are developmentally inappropriate for young children. (p. 299)

> The content of young children's mathematics can be both deep and broad, and, when provided with engaging and developmentally appropriate mathematics activities, their mathematics knowledge flourishes. Yet these research findings are largely not represented in practice. (p. 300)

Much research on teaching–learning paths focuses on early childhood, and its findings are described in this report. These have implications for several aspects of early childhood education and the report gives recommendations for curriculum, instruction, and standards. The recommendations about preparation and professional development for the early childhood workforce are especially relevant to MET II. These are:

> Coursework and practicum requirements for early childhood educators should be changed to reflect *an increased emphasis on children's mathematics* as described in the report. These changes should also be made and enforced by early childhood organizations that oversee credentialing, accreditation, and recognition of teacher professional development programs. (pp. 3–4, emphasis added)

> An essential component of a coordinated national early childhood mathematics initiative is the provision of professional development to early childhood in-service teachers that helps them

> (a) *to understand the necessary mathematics*, the crucial teaching–learning paths, and the principles of intentional teaching and curriculum and (b) to learn how to implement a curriculum. (p. 3, emphasis added)

Elementary Mathematics Specialists: Preparation and Certification

Standards for Elementary Mathematics Specialists: A Reference for Teacher Credentialing and Degree Programs, Association for Mathematics Teacher Educators, 2010, `http://www.amte.net/resources/amte-documents`

This report notes: "Many have made the case that practicing elementary school teachers are not adequately prepared to meet the demands for increasing student achievement in mathematics." Elementary mathematics specialists are an "alternative to increasing all elementary teachers' content knowledge (a problem of huge scale) by focusing the need for expertise on fewer teachers."

Depending on location, an elementary mathematics specialist may have the title elementary mathematics coach, elementary mathematics instructional leader, mathematics support teacher, mathematics resource teacher, mentor teacher, or lead teacher. In several states, specialists and mathematicians collaborate in teaching courses offered for teachers in the specialists' districts.

This report summarizes research on specialists' effectiveness and outlines the knowledge, skills, and leadership qualities necessary for their roles and responsibilities. It is intended as a starting point for state agencies in establishment of certification guidelines and as a guide for institutions of higher education in creation of programs to prepare specialists.

Teacher Preparation

Preparing Teachers: Building Sound Evidence for Sound Policy, National Research Council, 2010, `http://www.nap.edu/catalog/12882.html`

This report summarizes what is known about teacher preparation, in general and with respect to teaching mathematics, concluding that:

> Current research and professional consensus correspond in suggesting that all mathematics teachers ... rely on: mathematical knowledge for teaching, that is, knowledge not just of the content they are responsible for teaching, but also of the broader mathematical context for that knowledge and the connections between the material they teach and other important mathematics content. (pp. 114–115)

Postsecondary institutions predominate in preparing teachers, educating 70% to 80% of those who complete a preparation program. There are numerous alternative pathways for teacher preparation. These include "fellows' programs" established by school districts, which usually combine expedited entrance into teaching with tuition-supported enrollment in graduate study in education.

Information about what these programs do is sparse, however, the report concludes that "there is relatively good evidence that mathematics preparation for

prospective teachers provides insufficient coursework in mathematics as a discipline and mathematical pedagogy" (p. 123).

Moreover, the mathematics that teachers need to know is in sharp contrast with state requirements for licensure.

> 33 of the 50 states and the District of Columbia require that high school teachers have majored in the subject they plan to teach in order to be certified, but only 3 states have that requirement for middle school teachers (data from 2006 and 2008; see `http://www.edcounts.org` [February 2010]). Forty-two states require prospective teachers to pass a written test in the subject in which they want to be certified, and six require passage of a written test in subject-specific pedagogy.
>
> Limited information is available on the content of teacher certification tests. A study of certification and licensure examinations in mathematics by the Education Trust (1999) reviewed the level of mathematics knowledge necessary to succeed on the tests required of secondary mathematics teachers. The authors found that the tests rarely assessed content that exceeded knowledge that an 11th or 12th grader would be expected to have and did not reflect the deep knowledge of the subject one would expect of a college-educated mathematics major or someone who had done advanced study of school mathematics. Moreover, the Education Trust found that the cut scores (for passing or failing) for most state licensure examinations are so low that prospective teachers do not even need to have a working knowledge of high school mathematics in order to pass. Although this study is modest, its results align with the general perception that state tests for teacher certification do not reflect ambitious conceptions of content knowledge. (p. 118)

Professional Development

Key State Education Policies on PK–12 Education: 2008, Council of Chief State School Officers, `http://www.ccsso.org/Resources/Publications.html`

An overview of individual state policies on professional development is given on pp. 22–24. Professional development requirements are specified by 50 states. The majority require 6 semester-hours of professional development over approximately 5 years. Twenty-four of these states specify that professional development should be aligned with state content standards.

Effects of Teacher Professional Development on Gains in Student Achievement, Council of Chief State School Officers, 2009, `http://www.ccsso.org/Resources/Publications.html`

Few studies of professional development use an experimental or quasi-experimental research design. This report gives a systematic analysis of 16 studies that did. Two of these covered the Northeast Front Range Math Science Partnership (whose focus was science). Twelve studies focused on mathematics. Common patterns of successful professional development programs are summarized on p. 27:

- strong emphasis on teachers learning specific subject content as well as pedagogical content for how to teach the content to students.

- multiple activities to provide follow-up reinforcement of learning, assistance with implementation, and support for teachers from mentors and colleagues in their schools.

- duration: 14 of the 16 programs continued for six months or more. The mean contact time with teachers in program activities was 91 hours.

Designing for Sustainability: Lessons Learned About Deepening Teacher Content Knowledge from Four Cases in NSF's Math and Science Partnership Program, Horizon Research, 2010, `http://www.mspkmd.net/cases/tck/sustainability/crosscase.pdf`

This report elaborates and illustrates lessons learned from experiences of the Math Science Partnerships. Page 8 lists these as:

- Recognize that it takes time to develop and nurture a *productive partnership*.

- Consider how to *engage a range of important stakeholders whose support is important* for efforts to deepen teacher content knowledge.

- Help ensure that *key policies in the system are aligned with the vision* underlying the reform efforts.

- Design and implement professional development that is not only aligned with the project goals, but is also both feasible and *likely to be effective with the teachers in their particular context*.

- *Use data* to inform decisions, improve the quality of the interventions, and provide evidence to encourage support for system change.

- Work to *develop capacity and infrastructure* to strengthen teachers' content knowledge and pedagogical skills, both during the funded period and beyond.

National Impact Report: Math and Science Partnership Program, National Science Foundation, 2010, `http://hub.mspnet.org/index.cfm/20607`

This report gives an overview of the National Science Foundation's Math Science Partnership program and its impact. Some features that may be of particular interest to MET II readers are:

- Yearly score increases between 2004 and 2009 on the 11th grade mathematics exam of the Texas Assessment of Knowledge and Skills for students of teachers who participated in an MSP mathematics leadership institute (p. 6).

- Yearly score increases between 2003 and 2007 on state assessments for students in schools that participated in MSP projects (pp. 10–11).
- Five-year score increases for elementary students in schools that were significantly involved in MSP projects (p. 12).
- Discussion of changes in university policies to reduce barriers to faculty involvement in activities for increasing K–12 student achievement (p. 15).

Supporting Implementation of the Common Core State Standards for Mathematics: Recommendations for Professional Development, Friday Institute for Educational Innovation at the North Carolina State University College of Education, 2012, `http://www.amte.net/resources/ccssm`

These recommendations are intended to support large-scale, system-level implementation of professional development (PD) initiatives aligned with the CCSS. These rest on four principles of effective PD derived from research listed on p. 7 of the report:

- PD should be intensive, ongoing, and connected to [teaching] practice.
- PD should focus on student learning and address the teaching of specific content.
- PD should align with school improvement priorities and goals.
- PD should build strong working relationships among teachers.

Credentials and Accreditation

Significantly different new accreditation standards for preparation programs are forthcoming from the *Council for the Accreditation of Educator Preparation*. This organization was formed by the merger of the National Council for the Accreditation of Teacher Education (NCATE) and the Teacher Education Accreditation Council (TEAC), `http://www.caepsite.org`

The Council for Exceptional Children gives information about program accreditation and licensure for special education teachers, `http://www.cec.sped.org`

The Association for Middle Level Education lists middle level teacher certification/licensure patterns by state, `http://www.amle.org`

The Elementary Mathematics Specialists and Teacher Leaders Project lists mathematics specialist certifications and endorsements by state, `http://mathspecialists.org`

The National Board for Professional Teaching Standards offers an advanced teaching credential in 25 different areas, `http://www.nbpts.org`

These credentials complement, but do not replace, a state's teacher license. The certificate areas that include mathematics are:

- Early childhood (ages 3–8)
- Middle childhood (ages 7–12)
- Mathematics (ages 11–18+)
- Exceptional needs (ages birth to 21+)