Preparing Middle School Mathematics Teachers
COMET Subcommittee on Middle School Teacher Preparation Curriculum
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Introduction. There has been increasing scrutiny placed on the performance of K-12 mathematics teachers, and on the efforts of those in higher education who
prepare and support them in their work. Of particular concern is the preparation
and professional development of those who teach mathematics to the students in
the middle grades (considered here as grades 6, 7 and 8). Unlike preparation of high
school and elementary school teachers, there is much less consensus on what
constitutes adequate preparation for teaching mathematics to students in the
middle grades. While 46 states have a license or certificate specific to teaching
middle school mathematics (all but two of which include grade 5) [1, p.39]
1, our
committee’s survey of teacher preparation programs revealed a surprisingly low
number of institutions who have programs dedicated to the preparation of middle
school mathematics teachers. Some institutions absorb the middle-school
mathematics preparation into their high school preparation program. Other
institutions adapt their multiple-subject teacher preparation program by having
pre-service teachers take additional mathematics courses to qualify for teaching
mathematics in the middle grades. Programs designed specifically to prepare pre-service teachers to teach middle school mathematics are comparatively rare.
The Mathematical Education of Teachers II report (MET II) from the Conference
Board of the Mathematical Sciences [1] (http://cbmsweb.org/MET2/index.htm)
calls for institutions of higher learning to offer and support programs designed
specifically to prepare undergraduates to teach mathematics in grades 5 through 8.
This report presents recommendations for a program for preparing middle school
mathematics teachers that builds on the MET II report, while providing guidance for
smaller programs to create innovative means by which to enact as many of the
recommendations as possible. The caution that a traditional mathematics major
does not provide suitable preparation for teaching mathematics goes hand in hand
with the concern that a multiple credential does not adequately prepare teachers to
teach middle school mathematics, so all departments who take their teacher
preparation seriously are encouraged to offer a pre-service middle school program.

1 See also:
http://www.amle.org/AboutAMLE/ProfessionalPreparation/Certification-LicensurebyState.aspx

Middle school students taking mathematics truly find themselves in the middle: the
representation-based understandings of arithmetic and the concepts and
procedures of elementary school give way to the beginnings of algebra and more
formal arguments, while the more rigorous use of geometry and functions to
explore the concepts of trigonometry, statistics, and calculus lurks on the horizon.
To that end, teachers of middle school mathematics need to be prepared to take
their students from elementary school mathematics to high school mathematics, and
so need a dedicated education that gives them the tools they need to guide their
students through that transition.
Changing Expectations. As reported in the MET II document, the expectations for
middle school students in their mathematics classes have increased over the years.

mathematics.

The alternate approach of customizing or supplementing a program designed as a
part of a multiple-subject credential also does not adequately prepare pre-service
teachers to teach mathematics at the middle school level. Middle school students are
more sophisticated, and will be expected to demonstrate more integrative and
thorough work in their mathematics classes than their elementary school
counterparts, not to just simply know more concepts. Middle school teachers should
be prepared with more deliberate intent than simply adding content courses on top
of a multiple-subject credential. The increasingly deep expectations placed on
middle school students regarding their mathematical education suggests that their
teachers receive more extensive training in the subject than an adapted multiple-subject program would allow.
This report agrees with the recommendation in MET II, which states that middle
school teachers should be familiar with the mathematics that students will have
seen through Grade 5, and be familiar with the mathematics students will see as
they move into high school. Neither an augmented multiple-subject program, nor a
high-school credential program, on its own, provides sufficient preparation for a
middle-school mathematics teacher. Middle grade teachers need to specialize in
mathematics, and they need focused opportunities to work deeply with the
mathematics they will be expected to teach.
Three different models. The two models of preparation described above---
modifying the preparation of a high school mathematics teacher by adding or
substituting pedagogy courses in lower level mathematics, and increasing the
mathematical content in the preparation of an elementary school teacher by adding
upper level mathematics courses--- can provide manageable, if less desirable,
approaches to middle school teacher preparation, depending on the modifications.
For instance, this report will strongly recommended that either model include at
least one course dedicated to mathematics in the middle school curriculum.

But this report favors a third model. In this model, a middle school teacher would
enroll in a program that offers numerous courses specifically designed for middle
school teachers, along with additional coursework in mathematics. This approach is
also recommended in the MET II report’s middle school chapter
(http://cbmsweb.org/MET2/index.htm), and we repeat and support many of their
recommendations here. After describing this dedicated model, we offer suggestions
for the modifications in the other models of middle school teacher preparation.
Model I. Proposed curriculum for the Dedicated Model
MET II calls for a dedicated program of 15 semester-hours of coursework
specifically designed for pre-service middle school teachers in addition to 9
semester-hours of additional work in mathematics. We offer a similar, slightly
longer, recommendation, in terms of semesters rather than course units.
Institutions on quarters or trimesters can adjust the recommended times

accordingly. For more specifics on the recommended courses beyond the comments
included here, see the MET II report.
A. Courses designed specifically to meet the needs of future Middle School Teachers (5
semester-long courses)
1. Numbers and operations 1
2. Number and operations 2 (ratios, proportional relationships, co-varying
quantities, invariant relationships, early algebraic reasoning)
3. Algebra and number theory
4. Geometry and measurement
5. Statistics and probability

Comments. The MET II report recommends 6 semester-hours in “number and
operations” and 3 semester-hours in “algebra and number theory.” Those courses
are reorganized here into two semester long courses, Numbers and number theory
and Algebra and operations, to reflect a semester system, and to give a little more
description to the current practice in a few programs where these courses have
titles along the lines of Foundations of Middle School Mathematics and are taught
over two semesters. In any case, this model calls for at least a full year devoted to
the foundations of middle school mathematics, involving the real number system,
arithmetic operations, equations, proportional relationships, and divisibility.
An algebra and number theory course would not be the typical College Algebra
course taught at most universities. Instead, it would focus on the algebra taught at
the middle school level. One possibility would have students focusing on
connections between the use of manipulatives and the underlying mathematics of
those uses. The specific topics covered in the class may involve operations involving
positive and negative integers, solving linear equations, and solving quadratic
equations using these manipulatives. This would not only strengthen the content
knowledge of the pre-service teachers, but would also allow exposure to some
pedagogical techniques.
Geometry and measurement was the most common course included in a survey of
existing programs conducting by the members of this working group. Given the
prominence of geometry in the middle school curriculum, middle school
mathematics teachers need an opportunity to work deeply with the geometry topics
they will be expected to teach, with particular attention given to teaching geometric
reasoning.
The CCSS call for a major increase in Statistics instruction in the middle schools, and
this model adopts the recommendations of the MET II report by including two
statistics courses. The second of the two would be intended specifically for middle
school teachers, to provide them with an experience of learning statistics and
probability through active learning and technology, and would carry the standard
introductory statistics course as a prerequisite. The two-course sequence allows for
an immersive, focused experience in the second course designed specifically for
prospective middle school teachers.

courses on top of an existing major, and this report acknowledges the difficulties
involved in working these courses into a student’s course of study, but the need for
outstanding middle school mathematics teachers and the advantages these courses
offer outweigh the difficulties.
This report also acknowledges that it is currently a time of limited resources for
many institutions of higher education. Even if desired, it may not be possible for an
institution to start up a new teacher preparation from scratch if one isn’t already in
place. Indeed, it is hoped that this report might serve as support for protecting
middle school teacher preparation programs that have already been established, but
may be under pressure. However, for institutions with established programs in the
preparation of high school teachers, or for institutions with established multiple-subject credential programs, we offer alternate models that build on these
established programs. Although this report favors Model I, it acknowledges that
there advantages to these other models, not the least of which is increased
practicality and reduced investment in order to get them started.
In both of the alternative models, it should be emphasized that the programs should
have a component specifically designed for middle school mathematics teachers,
and that pursuing the middle school alternative should not be viewed as somehow
inferior to the established path through the programs. The preparation of middle
school teachers should not be viewed as an easier path through the education track
of a mathematics major, or as a way to avoid some of the work in a multiple-subject
credential. In either alternative, the middle school preparation program should be
viewed as equally valid as the established one off of which it is based. Finally, it may
be the case at an institution with established programs in both high school and
elementary school teacher preparation, that the alterations suggested in Models II
and III might lead to a program similar to Model I.
Model II. Proposed Alterations to a High School Preparation Program
Refer to the MET II high school chapter and to the Curriculum Guide for a
Professional Program to Prepare High School Teachers for recommendations on
curriculum for a high school preparation program. We discuss ways in which
expected discrepancies between an established high school program and Model I

and, as long as such a course is designed specifically for pre-service teachers, it
could serve middle school teachers well. Indeed, if an institution’s geometry course
is not meant primarily for pre-service teachers, establishing a middle school
teaching track in the mathematics major might provide an opportunity to redesign
the course. If the current high school preparation program does not include a course
in geometry, one should be added for middle school teachers, given the
preeminence of the subject in the middle school curriculum.
4. Statistics and probability. The MET II report recommends a two-course sequence
in statistics for pre-service high school teachers, and this report does for middle
school teachers. To that end, a high school preparation program should have a
substantial statistics component. If it does not, one should be added for both middle
and high school teacher preparation programs. Otherwise, as long as the pre-service
teachers experience active learning, experimental design and data collection, and
appropriate use of technology, this one or, ideally, two-course statistics component
could serve both populations of pre-service teachers.
The additional courses in mathematics recommended in Model I should still be
available through a mathematics department, and should be included as part of a
prescribed path through the major, if similar courses aren’t already required for the
high school preparation program.
Model III. Proposed Alterations to a Multiple Subject Credential Program
Refer to the MET II elementary school chapter for recommendations on curriculum
for a multiple-subject credential program. We will discuss ways in which possible
discrepancies between an established multiple-subject credential program and
Model I might be expeditiously addresses with a minimal compromise of the needs
of a prospective middle school teacher.
Most multiple-subject credential programs are not housed in departments of
mathematics, but rather in departments (or schools) of education. Our
recommendations are intended to insure that pre-service teachers of elementary or
middle school mathematics get the opportunity to work at a deep level with the
mathematical content they will be covering in the classroom. This need is
particularly acute for prospective middle school teachers, as the mathematical
content in grades 6, 7, and 8 has become both broader and deeper in the CCSS.
Required Courses (3 semesters)
1. Algebra and operations
2. Geometry and measurement
3. Statistics and probability
Multiple-subject credential programs usually cover numbers and number systems in
their mathematical content courses, and this may be sufficient for pre-service
middle school teachers (see Adapted Courses in this model below), but they
generally will not provide enough work with equations and algebraic manipulations,
so this report recommends an additional mathematical content course to address
this discrepancy. Further, since geometry plays a large and pivotal role in the middle
school curriculum, and at a relatively deep level, particularly in terms of proof and

mathematical argument, we recommend a geometry course designed for middle
school teachers, beyond or in place of any geometrical content in the multiple-subject program.
Finally, it remains desirable that pre-service middle school teachers receive a two-course sequence in statistics and probability. Given that most multiple-subject
credential pre-service teachers acquire experience working with hands-on
activities, active learning strategies, and basic statistical concepts, this report
recommends that middle school teachers take an introductory statistics course,
preferably one designed to emphasize conceptual understanding of the tools and
test of elementary statistics, before they take the statistical component of the
multiple-subject preparation, so that they can apply the techniques learned in the
second course to more advanced statistical concepts. If possible, a statistics course
for prospective teachers at all levels could be designed and incorporated into both
the multiple-subject and middle school preparation programs.
Adapted Courses
4. Number and number theory. Any multiple-subject credential program should give
its pre-service teachers experience working with the real numbers; understanding
of basic differences among number systems (natural numbers, integers, rational
numbers, and real numbers); and ways of calculating the result of arithmetical
operations, including different algorithms for addition, subtraction, multiplication,
and division; and patterns in divisibility. It is expected that prospective middle
school teachers would take that component of the program. The mathematical
content should be increased, to go deeper and broader for pre-service middle school
teachers, but this increase in emphasis on mathematical content would also serve
multiple-subject credential pre-service teachers well. Adapting an existing multiple-subject credential program for middle school teachers could provide an opportunity
to increase the mathematical content knowledge for all prospective teachers,
including at the K-5 level.
The additional courses 2 through 5 in mathematics recommended in Model I should
still be available through a mathematics department, and may be collected into a
minor or field of emphasis in the mathematics department. This report recommends
the inclusion of the extra mathematical content in whatever official designation the
middle school preparation program receives.
Further Comments.
Other Suggested Courses. As useful choices for electives, or in order to include
enough credits to warrant listing as a full major or credential program, this report
recommends any of these courses for a prospective middle school mathematics
teacher.

1. Introduction to computer science
2. A science course that exposes undergraduates to the quantitative aspects in
scientil t77selds
3. Economics

These courses p rovide context for the mat hematics taught in middle school

mathematics classrooms, and can serve a s sources for projects and ap plications of

the mathemati cal content. In addit ion, an experience in computer science can

provide t ools for a p ros pective teacher to bring te chnology into t he classroom in

different contexts, such as runn ing simulations, organizing dat a, or pro ducin g

graphical representat ions. Finally, a tea cher who is accomp lished in the use of

technology can demonstrate a variety of ways to use computers as problem-solving

tools.

Comment on technology. This rep ort e choes the Professional Progra m for H igh

School Teachers Curriculum Guide in recommending that technology should be an

integrated compone nt through out the preparation of middle schoo l teachers, an d

not a st andalone comp onent , for example , by being ta ught throu gh a course on

Instructional Technolog y. The classroom experi ence of pre -service middle school

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