

PART 2: NARRATIVES & MATRICES

MATHEMATICS CONTENT PREPARATION

Mathematics Content Preparation Narratives:

Mathematics Content Preparation Outcomes 1.1 through 1.4: Problem Solving, Reasoning, Communication, and Connections:

An undergraduate degree in mathematics (or the equivalent as determined on a case by case basis) is required to be eligible to apply for and enter the graduate program for Adolescent / Young Adult Mathematics Licensure. At Wright State University, students who plan to teach mathematics at the secondary level pursue the Bachelors Degree in Integrated Mathematics. For the most part, the mathematics content courses that the undergraduate students are required to take are fairly traditional courses taught via direct instruction. Some of the mathematics professors in the College of Science and Mathematics are making great efforts to incorporate non-traditional teaching methods that provide the students' with opportunities to develop their skills in problem solving, reasoning, communication, and connections (as described in the Principles and Standards for School Mathematics), but change is slow as one might expect.

Wright State University has a unique understanding of the need to support collaboration between professors in teacher education and professors in the content areas. As a result, the Department of Mathematics and Statistics has one associate professor in mathematics education (Ann Farrell, Ph.D.) and there are two professors – one associate and one assistant (Susann Mathews, Ph.D. and Tracy Rusch, Ph.D. respectively) – who have joint appointments between the Department of Teacher Education in the College of Education and Human Services and the Department of Mathematics and Statistics in the College of Science and Mathematics. Drs. Farrell, Mathews, and Rusch work closely with math department faculty to help facilitate understanding of the need for changes in mathematics instruction and the need for specialized coursework for mathematics majors planning to go into teaching.

As part of the Bachelor's Degree in Integrated Mathematics, prospective secondary mathematics teachers must take at least two of six dedicated mathematics content courses for middle school mathematics teachers. These courses have been carefully designed to model the teaching strategies recommended by NCTM, NRC, and other experts in the field of mathematics education, and to develop the special depth of understanding required for middle and secondary level mathematics teachers. Although only two of these courses are required, prospective secondary mathematics teachers are encouraged to take as many of the six courses as possible.

PART 2: NARRATIVES & MATRICES

Mathematics Content Preparation Matrix:

Although the instructions provided in the NCATE / NCTM documentation indicate that course numbers should be listed in the matrix, we chose to list course titles instead. This is because students take these courses at the undergraduate level and course numbers will vary depending on the institution from which the licensure candidate earned his/her mathematics degree.

The faculty in the Department of Mathematics at WSU provided the information which links the desired outcomes with content courses that address that outcome in some way. The six mathematics content courses designed specifically for prospective teachers – courses that are unique to WSU – are listed in bold print. These six courses are designed to provide students with opportunities to immerse themselves in a mathematical learning environment which emphasizes the five process principles described in the Principles and Standards for School Mathematics (NCTM). As mentioned in earlier parts of this document, prospective secondary mathematics teachers pursuing a Bachelors Degree in Integrated Mathematics at WSU are required to take two of the six courses and are encouraged to take as many as possible. Students who are admitted to the AYA Mathematics Licensure program from other institutions, and who have not had coursework of a similar nature, will be required to take at least two of these courses during their graduate program.

Since all of the listed courses are part of the required undergraduate degree in mathematics, no syllabi have been included. Syllabi for the mathematics content courses designed specifically for prospective teachers have been included since all candidates for the Adolescent / Young Adult Mathematics Licensure will be required to take at least two of the six courses, whether at the undergraduate or the graduate level.

MATRIX:

7-12 Outcomes	Course #'s which address this outcome. Be sure the syllabus for each listed course reflects that this outcome is addressed.
1.5 Programs prepare prospective teachers who can...	
1.5.1 apply concepts of number, number theory, and number systems;	Elementary Number Theory, Differential Equations, Partial Differential Equations and Boundary Value Problems, Applied Statistics I-II
1.5.2 apply numerical computation and estimation techniques and extend them to algebraic expressions;	Differential Equations, Partial Differential Equations and Boundary Value Problems, Calculus I-III, Geometry, Applied Statistics I-II, Probability and Statistics for Middle School Teachers, Algebra and Functions for Middle School Teachers, Mathematical Modeling for Middle School Teachers
1.5.3 apply the process of measurement to two-and three-dimensional objects using customary and metric units;	Calculus I-IV, Differential Equations, Partial Differential Equations and Boundary Value Problems, Calculus I-III, Geometry, Applied Statistics I-II, Geometry for Middle School Teachers
1.5.4 use geometric concepts and relationships to describe and model mathematical ideas and real-world constructs;	Calculus II-IV, Differential Equations, Partial Differential Equations and Boundary Value Problems, Geometry, Applied Statistics I-II, Geometry for Middle School Teachers

PART 2: NARRATIVES & MATRICES

1.5.5	understand the major concepts of Euclidean and other geometries;	Geometry, Calculus I-IV, Differential Equations, Partial Differential Equations and Boundary Value Problems, Geometry, Applied Statistics I-II, Probability and Statistics for Middle School Teachers
1.5.6	use both descriptive and inferential statistics to analyze data, make predictions, and make decisions;	Calculus I-IV, Differential Equations, Partial Differential Equations and Boundary Value Problems, Applied Statistics I-II, Probability and Statistics for Middle School Teachers
1.5.7	understand the concepts of random variable, distribution functions, and theoretical versus simulated probability and apply them to real-world situations;	Calculus I-IV, Differential Equations, Partial Differential Equations and Boundary Value Problems, Mathematical Modeling, Applied Statistics I-II, Statistical Methods, Probability and Statistics for Middle School Teachers
1.5.8	use algebra to describe patterns, relations, and functions, and to model and solve problems;	Calculus I-IV, Mathematical Modeling, Applied Statistics I-II, Introduction to Modern Algebra I, Geometry for Middle School Teachers
1.5.9	understand the role of axiomatic systems and proofs in different branches of mathematics, such as algebra and geometry;	Calculus I-IV, Mathematical Modeling, Introduction to Mathematical Proof, Applied Statistics I-II, Introduction to Modern Algebra I, Concepts in Calculus for Middle School Teachers
1.5.10	have a firm conceptual grasp of limit, continuity, differentiation and integration, and a thorough background in the techniques and application of calculus;	Calculus I-IV, Real Variables I, Applied Statistics I-II, Geometry for Middle School Teachers
1.5.11	have a knowledge of the concepts and applications of graph theory, recurrence relations, linear programming, difference equations, matrices, and combinatorics;	Calculus I-IV, Real Variables I, Applied Graph Theory, Optimization Techniques, Linear Algebra, Advanced Linear Algebra, Combinatorics, Applied Statistics I-II, Mathematical Modeling for Middle School Teachers
1.5.12	use mathematical modeling to solve problems from fields such as natural sciences, social sciences, business, and engineering;	Mathematical Modeling, Differential Equations, Partial Differential Equations and Boundary Value Problems, Real Variables I, Calculus I-IV, Applied Graph Theory, Applied Statistics I-II, Problem Solving for Middle School Teachers
1.5.13	understand and apply the concepts of linear algebra;	Differential Equations, Partial Differential Equations and Boundary Value Problems, Calculus I-IV, Linear Algebra, Advanced Linear Algebra, Applied Statistics I-II, Statistical Methods I-II
1.5.14	understand and apply the major concepts of abstract algebra;	Differential Equations, Partial Differential Equations and Boundary Value Problems, Calculus I-IV, Introduction to Modern Algebra I, Applied Statistics I-II
1.6	Programs prepare prospective teachers who have a knowledge of historical development in mathematics that includes the contributions of underrepresented groups and diverse cultures.	History of Mathematics, Differential Equations, Partial Differential Equations and Boundary Value Problems, Real Variables I, Calculus I-IV, Matrix Computations, Applied Statistics I-II, Concepts in Calculus for Middle School Teachers

PART 2: NARRATIVES & MATRICES

TEACHING PREPARATION

Teaching Preparation Narratives:

2.1 Diverse Learners:

The graduate program for Adolescent / Young Adult Licensure provides a wide variety of experiences which develop understanding and insight into the needs of diverse learners. All of these courses (none of these are specifically related mathematics) develop a foundation on which the mathematics methods course builds knowledge of diversity in mathematical learning styles.

- A. Diversity in Learning Style: Our prospective teachers experience, as learners, a variety of instructional strategies in the two required mathematics content courses designed especially for prospective math teachers. The general methods courses the students take incorporate a wide variety of experiences which focus on diversity in learning styles not necessarily connected directly with mathematics. The mathematics methods course requires students to consider what they have learned about diversity in learning styles and incorporate activities that will allow students to capitalize on their strengths when they develop lesson plans for mathematics.
- B. Diversity in Learning Exceptionalities: The general methods courses our prospective teachers take incorporate a wide variety of experiences which focus on the causes and manifestations of learning exceptionalities. The mathematics methods course dedicates one class period to a focused discussion on learning exceptionalities. The prospective teachers are required to develop modifications for lesson plans they design which will accommodate exceptional learners on both ends of the spectrum – from those who may be struggling with a concept to those who grasp a concept quickly and need additional challenge and extensions.
- C. Cultural Diversity: The general methods courses our prospective teachers take incorporate a wide variety of experiences which focus on cultural diversity. The mathematics methods course addresses two elements of cultural diversity: 1) how the culture of learning environments, both at home and at school, influence motivation and the development of effective learning strategies; and 2) how to evaluate instructional materials for gender and/or cultural bias or imbalance. The field experiences guarantee that all prospective teachers experience teaching in both urban and suburban settings.

2.2 Technology:

The prospective teachers in the graduate phase of the AYA Mathematics Licensure program take one general methods course which focuses on technology in education: ED 622, Technological Instruction & Integrated Methods for the Secondary Level.

The mathematics content courses designed especially for prospective teachers (of which all candidates are required to take at least two) incorporate technology whenever it is possible and

PART 2: NARRATIVES & MATRICES

appropriate. Students use scientific calculators, graphing calculators, and computer programs like Sketchpad and Fathom on a regular basis.

The mathematics methods course addresses technology in three ways. First, there is focused discussion on the use of technology in the mathematics classroom, including discussion about how technology can be used well or used poorly as well as discussion about the public controversy and misconception surrounding use of technology (most specifically calculators) in classrooms.

In addition, the mathematics methods course emphasizes the technological resources available to teachers. Prospective teachers are introduced to, and required to use, discussion lists, the internet, OhioLink, and ERIC as resources for student activities and professional development.

Finally, the College of Education and Human Services has a commitment to building a library of software resources that will be housed in our Educational Resource Center. As our holdings of educational software increase we are committed to making use of that software an important element of the mathematics methods coursework. The prospective teachers will be required to explore and evaluate software that may be used in the Adolescent / Young Adult mathematics classroom and develop lesson plans which incorporate instructional software in effective and meaningful ways.

2.3 Assessment:

Our students will experience, as learners, a variety of non-traditional assessment strategies in the mathematics content courses designed especially for prospective teachers (of which all candidates are required to take at least two). These experiences will make non-traditional assessment strategies familiar and comfortable and thus will facilitate the prospective teachers' implementation of these strategies in their own classrooms.

Within the mathematics methods course, prospective teachers will be required to think about and articulate the "prior knowledge" or "scaffolding" required for a child to be ready to learn a given concept and to identify strategies to determine whether or not a child is ready to begin learning a new concept. Students will also be required to articulate objectives for student learning which will have embedded in them strategies for assessing whether or not the student has mastered the material desired. Finally, students will be required to incorporate into those objectives, and into their lesson plans, a wide variety of assessment strategies which are sensitive to the learning styles and exceptionalities of their students. A major focus of discussion related to assessment will be alignment with objectives and learning experiences.

Our prospective teachers will be required to implement and reflect upon a variety of assessment strategies during their field experiences.

PART 2: NARRATIVES & MATRICES

Teaching Preparation Matrix:

Although the mathematics content courses designed especially for prospective teachers (of which all candidates are required to take at least two) contribute in a significant way to the outcomes below (see the narratives above), they do not focus specifically on the concepts described in outcomes 2.4 through 2.10 below. To avoid an overly complicated matrix, only the methods class – in which the prospective teachers think about children as learners -- has been listed in the matrix below. The syllabus for this course begins on page 29.

7-12 Outcomes	Course #'s which address this outcome. Be sure the syllabus for each listed course reflects that this outcome is addressed.
2.4 Programs prepare prospective teachers who can identify, teach, and model problem solving in grades 7-12.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.5 Programs prepare prospective teachers who use a variety of physical and visual materials for exploration and development of mathematical concepts in grades 7-12.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.6 Programs prepare prospective teachers who use a variety of print and electronic resources.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.7 Programs prepare prospective 7-12 teachers who know when and how to use student groupings such as collaborative groups, cooperative learning, and peer teaching.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.8 Programs prepare prospective teachers who use instructional strategies based on current research as well as national, state, and local standards relating to mathematics instruction.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.9 Programs prepare prospective teachers who can work on an interdisciplinary team and in an interdisciplinary environment.	Education 638: Secondary School Mathematics: Curriculum and Materials
2.10 Programs introduce and involve prospective teachers in the professional community of mathematics educators.	Education 638: Secondary School Mathematics: Curriculum and Materials

PART 2: NARRATIVES & MATRICES

Field Experience Matrix:

7-12 Outcomes	Course #'s which address this outcome. Be sure the syllabus for each listed course reflects that this outcome is addressed.
3.0 FIELD-BASED EXPERIENCES	
3.1 Programs provide prospective teachers with a sequence of planned opportunities prior to student teaching to observe and participate in 5-8 mathematics classrooms with qualified teachers. Experiences include observing, tutoring, mini-teaching, and planning mathematics activities and lessons for different mathematics courses.	Education 612 (Syllabus begins on page 33) Education 614 (Syllabus begins on page 35) Education 616 (Syllabus begins on page 37) Education 651 (Syllabus begins on page 39)
3.2 Programs provide prospective teachers with a full-time student teaching experience in 5-8 mathematics that is supervised by a qualified teacher and a university or college supervisor with a 5-8 mathematics teaching experience.	Education 612 (Syllabus begins on page 33) Education 614 (Syllabus begins on page 35) Education 616 (Syllabus begins on page 37) Education 651 (Syllabus begins on page 39)
3.3 Programs provide prospective teachers with time to confer with the supervising teacher and to do instructional planning.	Education 651 (Syllabus begins on page 39)

COLLEGE OF EDUCATION AND HUMAN SERVICES
COURSE SYLLABUS

Department: Teacher Education

Course Number: 638

Credit Hours: 5

Course Title for Catalog: Methods for Teaching Mathematics to Adolescents and Young Adults

Catalog Description: ED 638: Curriculum, methods, and materials in the mathematics of grades 7-12.

Prerequisites: Successful completion of the first and second quarters of Phase II of the Graduate Licensure Program

Co-requisites: ED 631, ED 659, and ED 616

Enrollment Restrictions for this Course: This course is only open to graduate students who have successfully completed the first and second quarters of Phase II of the Graduate Licensure Program.

Course Objectives:

Knowledge:

The students will demonstrate:

1. Understanding of the history of mathematics education in the U.S. during the 20th century.

Students will be able to: compare and contrast the progress of mathematics education leading to the current reforms.

2. Understanding of learning theories of mathematics

Students will be able to:

- a. Compare the current theories of learning mathematics.
- b. Reflect on which theories they plan to use to inform their teaching.

3. Understanding of the appropriate use of manipulatives in teaching/learning mathematics in grades 6 – 12.

Students will be able to:

PART 2: NARRATIVES & MATRICES

- a. Justify the use of manipulatives in secondary mathematics classrooms.
 - b. Demonstrate the use of several manipulatives that can help students learn abstract concepts.
4. Understanding of the appropriate use of technology in teaching/learning mathematics in grades 6 – 12.

Students will be able to:

- a. Use TI-83 calculators.
 - b. Discuss and write papers explaining what they think is the appropriate use of calculators and computers in mathematics teaching and learning.
5. Knowledge about how to plan instruction.

Students will be able to:

- a. See how the teaching of given mathematics concepts develops from the 6th through the 12th grades.
 - b. Plan and teach individual lessons, determining where the lesson fits into the development of the concepts involved in the lesson.
6. Knowledge about the recommendations presented in *Principles and Standards for School Mathematics*.

Students will be able to:

- a. Use the *Principles and Standards for School Mathematics* to evaluate secondary mathematics curricula.
 - b. Use the *Principles and Standards for School Mathematics* to plan and teach lessons in alignment with these standards.
7. Understand and learn how to use alternative assessments.

Students will be able to:

- a. Identify the difference in formative and summative assessments.
- b. Develop performance tasks and rubrics.

Performances:

1. Contribute to classroom discussions.
2. Participate in cooperative groups in mathematics activities and discussion.
3. Read, summarize, and present articles in mathematics education.

PART 2: NARRATIVES & MATRICES

4. Evaluate one of the new standards-based secondary mathematics curricula. Compose a written report and an oral presentation to the class.
5. Teach a lesson from the curriculum that they evaluate.
6. Choose and prepare a review of the literature in an area of secondary mathematics education.

Suggested Instructional Strategies:

1. Lecture
2. Whole-class discussions
3. In-class mathematics activities
4. Small group conversations
5. Collaborative assignments
6. Reading
7. Written assignments

Evaluation of the Students:

Students will be evaluated in a variety of ways including some or all of the following:

1. Class participation and discussion.
2. Discussions of reading from the text.
3. Written summaries and reflections of articles read outside of class.
4. Written and oral reports of evaluation of a standards-based secondary mathematics curriculum.
5. Teaching a lesson from the curriculum evaluated.
6. Comprehensive final examination.

PART 2: NARRATIVES & MATRICES

Grading System: A through F