GEORGE MASON UNIVERSITY
College of Education & Human Development
Graduate School of Education
Mathematics Education Leadership

EDCI 644: Learning and Assessment in Mathematics K-8
SPRING 2011

Instructor:	Dr. Margret Hjalmarson	
Office Hours:	By appointment	
Office Phone:	(703) 993-4818	
Office:	Commerce II, 207A	
Email:	mhjalmar@gmu.edu	
Class Meets:	Mondays, 4:30 – 7:10 p.m.	Robinson, A123

I. Course Description

This course will introduce students to the diverse learning theories and associated assessment practices specific to mathematics education. Topics will also include the historical development of learning theories as well as emerging theories. Assessment topics will include test design, problem-based assessment as well as other forms of assessment of mathematics learning across K-8. The course is intended for mathematics specialists, mathematics teachers, and pre-service mathematics teachers interested in problems of learning and assessment in mathematics education.

II. Course Objectives and Student Outcomes:

1. Understand the learning theories fundamental to mathematics education.
2. Understand the developmental progressions underpinning mathematics learning.
3. Develop an understanding of various forms of mathematics learning assessment related to theories of mathematics learning.
4. Understand the assessment of students' thinking at multiple levels.

Student Outcomes also align with the national standards for mathematics specialist programs (as prescribed by the Association of Mathematics Teacher Educators 2010 publication: *Standards for Elementary Mathematics Specialists: A Reference for Teaching Credentialing and Degree Programs).*

III. Required Texts (Available at the GMU Bookstore)

Donovan, M. S. & Bransford, J. (2004). *How students learn: Mathematics in the classroom*. Washington D.C., National Research Council.

Schoenfeld, A. (2007). *Assessing mathematical proficiency*. Boston, MA: Cambridge.

Additional readings will be posted to the course blackboard site.

IV. Nature of Course Delivery

The delivery of this course combines methods of lecture, discussion, independent study, student group presentations, writing, and online assignments. Access to MyMason and GMU email are required to participate successfully in this course. MyMason can be found at http://mymason.gmu.edu.

VI. Course Requirements, Assignments, & Evaluation Criteria

All assignments are to be completed on time so that class members might benefit from the expertise and contributions of their colleagues. Late assignments will be worth a lower grade. Additional details for the assignments will be provided in separate handouts and/or posted on Blackboard. Successful completion of this course requires the following:

A commitment to participation in class discussions and activities.

The quality of this course depends heavily and primarily on the regular attendance and participation of all involved. Participation will include taking part in discussions informed by critical reading and thinking, leading discussions about selected mathematics problems, and sharing with the class the products of various writing, reflection, lesson planning, and field experience assignments. The expectations, demands and workload of this course are professional and high.

A commitment to reading reflectively and critically the assigned readings.

The readings will be used to provide a framework and coherent theme to the course content. Students are responsible for participating in discussions about the readings in class. Some reading discussions may occur online as determined by the instructor.

ASSIGNMENTS

1. *A reflective "mathematical autobiography" and statement of your own philosophy of mathematics learning and assessment. (5%)*

   How you teach is inseparable from what you believe about mathematics, learning, and teaching. This assignment is intended to bring to light your educational and other personal experiences that influence your expectations and understanding of mathematics, teaching and learning.

   Reflection Questions

   a. How do you best learn mathematics yourself? How has your background in mathematics influenced your work as a teacher? What are your views on how students can better learn mathematics? What factors do you think are most influential in impacting student learning?
   b. What do you see as the primary purpose of assessment? What methods or techniques do you currently use to assess what your students know and are able to do? How do your

students use assessment to enhance their own learning? How do you use the results of classroom assessment? How are the results of external assessments used in your school or district?

2. *Clinical interviews with a student about a carefully chosen problem or activity in mathematics using manipulatives. (30%)*

   (This is your Performance Based Assessment for this course. See the project description and rubric which follow the course schedule.)
   Effective teaching requires a keen awareness of how and what your students are thinking and understanding. The experience of conducting a clinical interview is intended to increase your awareness of students' thinking and learning in a detailed manner about a particular mathematics topic. The other focus of this assignment is on concrete manipulatives and their relationship to learning. So, you should select a manipulative (or manipulatives) to accompany the task and then assess how well the manipulative helped the learner to solve the problem.

3. *Group State Assessment Presentation (25%)*

   Standardized testing as mandated by No Child Left Behind is a controversial topic, but state testing is an important topic. Student groups (3 max per group) will explore and present information about state assessments from 3 different states (note: states will be randomly assigned to groups). The presentation should address the following questions:

   a. For each state, give a short description of their test format (multiple choice? Open-response? Something else?). Describe how the responses are scored.
   b. Describe the overall performance of the state. Is there significant variation between schools or districts? What factors contribute to variation?
   c. Describe the standards that are aligned with the tests. Are they similar to each other? Are there notable differences?
   d. How do the states compare with each other? What are positive and negative aspects of the assessment systems?

4. *Assessment Handout (15%)*

   Students will prepare a handout that explains and summarizes a particular type of mathematics assessment (e.g., formative, summative, portfolios, multiple-choice, warm-ups) that could be used with teachers. Learning how to effectively and efficiently prepare materials for teachers is an ability mathematics specialists need to develop and to refine. The goal is for you to learn about the type of assessment and to learn how to disseminate information to adult learners.

5. *Mathematics Topics and Learning Trajectories (25%)*

   The student will explore research literature on their topic, create a bibliography of the literature, select an article that could be shared with teachers, prepare an appropriate assessment within the topic, and prepare a handout on the topic for their peers. The handout should highlight the essential idea of the topic, describe students' understanding

at different levels, and provide examples of the topic. Students will explore and present information on one of the following topics (or a sub-topic within the category) and how they address learning trajectories for students:

- Whole Numbers
- Rational Numbers
- Functions and Algebra
- Measurement and Geometry
- Data Analysis & Probability

Evaluation Criteria

Graduate Grading Scale

A	93%-100%	B+	87%-89%	C	70%-79%
A-	90%-92%	B	80%-86%	F	Below 70%

VII. UNIVERSITY POLICIES

HONOR CODE

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of George Mason University and with the desire for greater academic and personal achievement, George Mason University has set forth a code of honor that includes policies on cheating and attempted cheating, plagiarism, lying and stealing. Detailed information on these policies is available in the GMU Student Handbook, the University Catalog, of the GMU website (www.gmu.edu).

INDIVIDUALS WITH DISABILITIES POLICY

The university is committed to complying with the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 by providing reasonable accommodations for applicants for admission, students, applicants for employment, employees, and visitors who are disabled. Applicants for admission and students requiring specific accommodations for a disability should contact the Disability Resource Center at 993-2474, or the University Equity Office at 993-8730.

ATTENDANCE POLICY

Students are expected to attend the class periods of the courses for which they register. Although absence alone is not a reason for lowering a grade, students are not relieved of the obligation to fulfill course assignments, including those that can only be fulfilled in class. Students who fail to participate (because of absences) in a course in which participation is a factor in evaluation, or students who miss an exam without an excuse, may be penalized according to the weighted value of the missed work as stated in the course syllabus (GMU University Catalog, pg. 32).

(Performance Based Assessment for the Course)
CLINICAL INTERVIEW ASSESSMENT
PART I: PLAN

Student Description:
Describe the students you plan to assess. Include information you gathered about the child (grade level, age, gender, race, and academic ability level). What do you know about the child's level of understanding about the topic *before* the assessment?

The Mathematics Concept Development & Learning Progression:
Select one specific mathematics concept to assess during the assessment. Examples of concepts might include patterns, sorting, addition of whole numbers, division of fractions, finding averages, percent, geometric shapes, or length measurement. Tell why this concept is appropriate for this child at this particular grade level.

Different Forms of Representation:
During the assessment, assess the child using three different forms of representation. Identify the three different forms of representation you will use during the assessment with at least one example in each form. *Concrete* representations include manipulatives, measuring tools, or other objects the child can manipulate during the assessment. *Pictorial* representations include drawings, diagrams, charts, or graphs that are drawn by the child or are provided for the child to read and interpret. *Symbolic* representations include numbers or letters the child writes or interprets to demonstrate understanding of a task.

Tasks & Questions:
Design tasks and questions that use three different forms of representation (concrete, pictorial, abstract symbols) to diagnose the child's understanding of ONE basic concept. Go beyond the basic level of determining the child's factual knowledge of the concept by asking questions that determine how much the child understands about the concept. For example, suppose you are assessing the concept of ADDITION. (1) Create several tasks where the child uses concrete manipulatives to demonstrate her understanding of addition; ask questions about the child's understanding of the addition tasks with manipulatives. (2) Create several tasks where the child is asked to create or interpret drawings to demonstrate her understanding of addition; ask questions about the child's understanding of these tasks with pictorial models; (3) Create several tasks where the child uses abstract symbols (and letters) to demonstrate her understanding of addition; ask questions about the child's understanding of these addition tasks using the symbols.

* Goal is to assess students' conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive dispositions towards mathematics .

The plan should be typed.

Assessment mathematical proficiency
(Performance Based Assessment for the Course)
PART II: REPORT

Student Work Samples:
Collect and document three different forms of representation (concrete, pictorial, abstract symbols) during the assessment to elicit the child's level of understanding. The report must include samples of the child's computations, writings and drawings, as well as a description of how the child used concrete objects during the assessment or photographs of the child's work.

Question & Response Assessment segments
Audiotape the assessment. For the report, choose segments of your questions and the child's responses. Indicate what you said and what the child said.

Questioning Competence:
The questions and follow-up questions that you use during the assessment will be evaluated. You will be evaluated on the *quality* and the *types* of follow-up questions you use during your interaction with the child. Your textbooks and readings provide direction on the types of questions that are appropriate in an assessment and that go beyond factual information to deeper understanding.

Evaluation of Child's Mathematical Knowledge:
Write an evaluation of the child's mathematical knowledge in the content area. Use evidence from the assessment to support your conclusions. Use your textbook to help you describe the specific types of behaviors and verbalizations you observed using specific mathematical terms. For example, if you conclude that the student has an understanding of addition of fractions with like denominators, you should base this on evidence that you present that shows the child was able to represent $\frac{3}{5}$ and $\frac{4}{5}$ with fraction pieces (concrete), and/or the child used a drawing to find the sum (pictorial), and/or the child computed the answer with symbols (abstract). Give specific examples of the child's responses to support your statements.

Instructional Plan:
Develop a suggested instructional plan for the child. Your assessment of the child's thinking should give you some information for planning instruction. Your suggestions should be based on what you learned about the child during the assessment. Many general suggestions can be valuable for children. However, your recommendations should relate to specifics. For example, if you assessed basic division concepts and you suggest that the instructional plan for the child should include more manipulatives, that would be an important teaching strategy, but it would be too general. You should be more specific about why and how manipulatives might be used. Example: "The student had difficulty making 3 equal groups from a set of 21 chips; therefore, the student should be given more experiences with grouping and partitioning manipulatives in sets of 15 to 30 to develop both the measurement and partitive concepts of division."

Reflection of the Assessment Process:
Comment on the assessment process. How long did the assessment last? What did you learn about assessment techniques? What did you learn about your ability to create mathematics questions and tasks for this concept? If you were to conduct the assessment with another child, would there be any changes in your questions, either the order or the level of difficulty, or the materials you had available for the child to use? Why or why not? What have you learned about how children learn mathematics from this assessment? How might a classroom teacher use the diagnostic mathematics assessment to assess children?

The report should be typed.

RUBRIC FOR ASSESSMENT REPORT

Criteria	Exceeds Requirements (A)	Meets Requirements (A-,B+,B)	Needs Improvement (C)	Inc.	Weight
Is the required information present about the child assessed?	5 In addition to the required information, the Report includes information about the child's performance in other academic, social, or behavioral areas.	4 3 2 The Report includes the child's grade level, age, gender, race, academic ability level, and the child's level of understanding about the mathematics concept.	1 One or more of the required descriptive items about the child is missing.	0	x .05 =
Has the teacher selected one specific mathematics concept and assessed the concept using three different forms of representation (concrete, pictorial, abstract)?	5 Information on age-appropriate variations of the mathematics concept was gathered in preparation for the assessment. One math concept is clearly described and mathematically accurate. Three different forms of representation, with different examples in each form, are designed for use in interesting and creative ways. Connections are made among representational forms. Cite references.	4 3 2 One age-appropriate mathematics concept is selected, mathematically accurate, and clearly described. Three different forms of representation are described and used appropriately to assess the mathematics concept. Different examples may be used within each representational form.	1 One or more mathematics concepts are selected. They may not be age-appropriate. The Report is missing one or more forms of representation.	0	x .10 =
Do the tasks and questions match the specific mathematics concept being assessed? Is there variety in the tasks and questions used for each of the three different forms of representation?	5 In addition to the tasks/questions being aligned with the math concept, there are questions that differentiate and provide extensions for different levels of student performance. In addition to the variety of tasks/questions for each of the three forms of representation, tasks that show creativity and will be motivating for a child are included. Cite references.	4 3 2 The tasks and questions designed for the assessment are aligned with the mathematics concept being assessed. There are a variety of tasks and questions for each of the three forms of representation.	1 The tasks and questions designed for the assessment are not clearly aligned with the mathematics concept being assessed. The Report is missing tasks/questions that address one or more of the forms of representation.	0	x .15 =
Are the child's work samples included with three different forms of representation present in the work samples?	5 In addition to the variety of work samples from the child showing examples in each of the three forms of representation, a creative way of providing an explanatory overview of the child's work is included.	4 3 2 There are a variety of work samples from the child included showing examples in each of the three forms of representation. (concrete, pictorial, abstract)	1 There is only one work sample in each of the three forms of representation or work samples from one form of representation are missing.	0	x .10 =
Is the required question and response assessment transcript of excerpts present?	5 The Report includes a collection of excerpts from the transcript of the mathematics assessment that includes descriptive information on both the behaviors and the actual verbalizations that occurred during the assessment.	4 3 2 The Report includes a transcript of several excerpts from the mathematics assessment using the teacher and the child's actual verbalizations from the assessment (T for teacher; C for child).	1 The Report includes excerpts of the mathematics assessment, but some parts of the assessment conversation are missing.	0	x .15 =
Do the initial and follow-up questions used by the teacher demonstrate variety and higher levels of questioning? Are specific follow-up questions used appropriately?	5 The transcript shows that during the assessment, the teacher used a variety of questions to encourage the child to express his/her thinking, used many higher-level questions to encourage deeper thinking and responses from the child, and used specific follow-up questions to probe for understanding.	4 3 2 The transcript shows that during the assessment, the teacher used a variety of higher-level questions to encourage deeper thinking and appropriate follow-up questions to probe for understanding.	1 The transcript shows that during the assessment, the teacher used very few probing and follow-up questions when a specific follow-up question would have been appropriate.	0	x .10 =
Does the evaluation	5	4 3 2	1	0	x .15 =

accurately represent the child's current level of understanding on this concept using supporting evidence and work samples from the assessment?	The evaluation provides an accurate and detailed description of the child's current level of understanding on the concept. Many different and specific examples from the assessment are given, including the child's quotations, student work, and information from other sources on math development, to provide supporting evidence for the evaluation of the child.	The evaluation provides an accurate description of the child's current level of understanding on the mathematics concept. Different examples from the assessment are given, including the child's quotations and student work, to provide supporting evidence for the evaluation.	The evaluation provides a minimal description of the child's understanding on the mathematics concept. A few examples from the assessment are given, but there is not enough information to provide supporting evidence for the evaluation.		
Does the <u>instructional plan</u> prescribe developmentally appropriate next steps for instruction and take into account the child's current level of understanding on this concept?	5 The plan is a creative, detailed description of developmentally appropriate next steps for instruction taking into account the child's current level of understanding. The plan identifies many specific examples of activities and tasks that would further enhance this child's knowledge of this concept. Information from other sources on math development and child development was used. Cite references.	4 3 2 The instructional plan describes developmentally appropriate next steps for instruction. The plan identifies several specific examples of tasks that would be appropriate to further enhance this child's knowledge on this concept. The plan describes these tasks in relation to the child's current level of understanding.	1 The plan describes some next steps for instruction that may not be developmentally appropriate. The plan gives general (rather than specific) examples of activities and tasks for the child. The tasks may not be appropriate either for the child or the development of the math.	0	x .10 =
Is there an appropriate <u>reflection</u> and evaluation of the assessment process?	5 In addition to the required information, the Report includes a detailed analysis, self-reflection, and self-evaluation of the assessment process.	4 3 2 The Report includes a reflection and evaluation on the assessment process including the required elements.	1 The Report does not include one or more of the required elements for the reflection.	0	x .10 =
TOTAL SCORE					

A	**5.0 – 4.5**
A-	**4.49 – 3.5**
B+	**3.49 – 2.5**
B	**2.49 – 2.0**
C	**1.99 – 1.0**