

**GEORGE MASON UNIVERSITY**

**College of Education & Human Development**

**Graduate School of Education**

**Mathematics Education Leadership**

EDCI 644: Learning and Assessment in Mathematics K-8

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Email	<a href="mailto:bwood9@gmu.edu">bwood9@gmu.edu</a>
Class Online	DL 1- Tuesdays: 4:30 – 7:10
Blackboard	DL 2- Thursdays: 4:30 – 7:10
Collaborate	

**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:

Learning:

- Learning Theory of Mathematics
- Mathematics Topics and Learning Trajectories
- Mathematical Understanding
- Constructivism
- Social Learning Theory
- Situated Learning and Learning Mathematics
- Piaget and Cognitive Developmental Psychology

Assessment:

- Why We Assess
- Types and Examples of Assessment
- English Speaking Nations and Assessment
- Assessment for K-2- Seven Formative Assessment Practices
- Formative Assessment Cycle
- Strategies to Support Oral Assessment
- Strategies to Support Written Assessment
- Strategies to Choosing Mathematically Rich Tasks
- Supporting Self-Assessment
- Assessment Design

Problem-based Assessment  
CRA Assessment  
Math Trajectory for Assessment

**II. Course Objectives and Student Outcomes:**

Understand and apply the learning theories fundamental to mathematics education to lesson planning and instruction.

Understand and apply the developmental progressions underpinning mathematics learning to lesson planning and instruction.

Know learning trajectories related to mathematical topics and apply this knowledge to sequence activities and design instructional tasks.

Use multiple strategies, including listening to and understanding the ways students think about mathematics, to assess students' mathematical knowledge.

Select, use, adapt, and determine the suitability of mathematics assessments and teaching materials (e.g. assessments, textbooks, technology, manipulatives) for particular learning goals.

Choose different formats, purposes, uses, and limitations of various types of assessment of student learning; be able to choose, design, and/or adapt assessment tasks for monitoring student learning.

Use the formative assessment cycle (administer a formative assessment task, analyze student responses to the task, and design and reteach lessons based on this analysis) and be able to find or create appropriate resources for this purpose.

Analyze formative and summative assessment results, make appropriate interpretations and communicate results to appropriate and varied audiences.

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. ISBN 0309089492

01/24/2013

EDCI 644 (Wood)

Isles, Dana (2011). How to Assess While You Teach Math K-2: Formative Assessment Practices and Lessons. Math Solutions, Sausalito, CA ISBN/Item Number: 9781935099178

Joyner, J.M. and Muri, M. (2011). INFORMative Assessment: Formative Assessment to Improve Math Achievement, Grades K-6. Math Solutions, Sausalito, CA (ISBN/Item Number: 9781935099192)

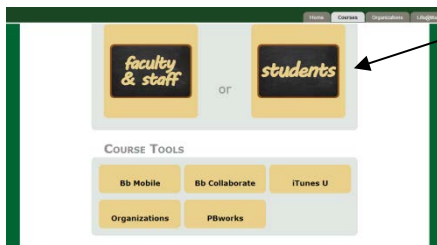
Additional readings will be posted to the course blackboard site.

#### IV. Nature of Course Delivery

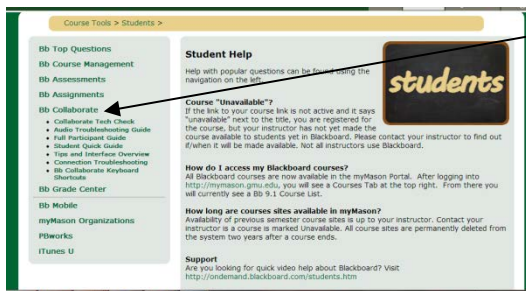
The delivery of this course combines methods of lecture, discussion, independent study, student group presentations, writing, and assignments through the synchronous and asynchronous online medium. Access to MyMason and GMU email are required to participate successfully in this course. MyMason can be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

Students must come to class prepared to participate in the online format. Please make sure to update your computer and prepare yourself to begin using the online format BEFORE the first day of class. The IT Support Center can be found online at: <http://itservices.gmu.edu/>

Navigate to the Student Support page on your MyMason homepage:



You may have to choose students link and choose the Students box as shown in picture or it may take you right to the next screen.



In the menu bar to the left you will find all the tools you need to become familiar with for this course. Take time to learn each. Make sure you run a system check a few days before class. To do this, click on Bb Collaborate and a dropdown menu will appear. Become familiar with the attributes of Collaborate and online learning.

**\*\*On class days, make sure to log on at least 10 minutes before class and check that you are set to go before class starts.**

## **VI. Course Requirements, Assignments, & Evaluation Criteria**

All assignments are to be posted directly to Bb assignment area (with the exception of the PBA which will be posted directly to Task Stream) 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. All classes will be recorded for make-up purposes. 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

### Assignment 1: Due Session 1 Beliefs VS Actions and Introduction Discussion

INFORMative Assessment p. 11 (5%)

\*\*\*Complete the chart on Bb under assignment 1 **and add your biography** to the discussion forum **before logging** on to our first session.

### Assignment 2: Due Session 5 Math Reasoning Inventory (20%)

<https://mathreasoninginventory.com> (sign in required)

Perform **three** clinical interviews and written assessments using the MRI online tools. Analyze results and present findings in a reflective paper.

### Assignment 3: Due Session 7 Group Presentation (20%)

Each group will be assign one of three chapters from How Students' Learn Mathematics: CH 6 -Whole Numbers, Ch. 7- Rational Numbers and Ch. 8- Teaching and Learning Functions.

### Assignment 4: Due Session 12 CRA methods for assessment (20%)

Performance Based Assessment for this course: Clinical Interviews with a student based on math trajectories and continuum of student learning. This assessment can be combined with information from the MRI used for assignment 2 but you will need to add a concrete portion to the assessment.

### Assignment 5: Due Session 14

#### International Math or Online Assessment Tool Group Presentation (20%)

Student groups (3 max per group) will explore and present information about standards, assessments and resources from an English speaking country outside of the United States or choose the one online assessment tool from a list to present.

### Class Participation: (20%)

Twenty percent of your grade comes from participation in the synchronous and asynchronous class sessions. Any homework (videos, discussions, class readings, blogs, wiki's etc.) are considered classwork and are required for you overall grade in this category.

Class	Due	Class Topic	Assigned
1 Jan-22 Jan-24	<b>Assignment 1</b> -Beliefs vs Actions -Discussion Board	<b>Synchronous:</b> Class Overview Technology Briefing <b>Asynchronous:</b> Assignment 1 Activity Math Reasoning Assessment	<b>Read:</b> HSL Ch. 1 and <a href="#">Mathematics Reasoning Inventory Report PDF</a> , <b>Assignment 2</b>
2 Jan-29 Jan-31	<b>MRI Student Responses</b>	HSL Introduction of Principles of Learning Theories in Mathematics, <a href="#">Learning Theories Overview</a>	<b>Read:</b> HSL Ch. 5, <a href="#">Jean Piaget's Cognitive Levels</a> <b>View:</b> Parts 1-4 Piaget video 1- <a href="http://www.youtube.com/watch?v=l1JWr4G8YLM">http://www.youtube.com/watch?v=l1JWr4G8YLM</a> 2- <a href="http://www.youtube.com/watch?v=Qb4TPj1pxzQ">http://www.youtube.com/watch?v=Qb4TPj1pxzQ</a> 3- <a href="http://www.youtube.com/watch?v=x9nSC_Xgabc">http://www.youtube.com/watch?v=x9nSC_Xgabc</a> 4- <a href="http://www.youtube.com/watch?v=cVSaEHhOEZY">http://www.youtube.com/watch?v=cVSaEHhOEZY</a>
3 Feb-5 Feb-7	<b>Piaget Discussion reflection and responses on discussion board.</b>	Introduction to Assessment Types of Assessment Assessment Online HSL Ch. 6,7,8 Asynchronous Video: (If needed) Basic introduction to Assessment <a href="http://www.rti4success.org/webinars/video/5058">http://www.rti4success.org/webinars/video/5058</a>	<b>Read:</b> K-2 pp. 1-19 (video clip A) Learning From Assessment PDF  <b>Assignment 3</b> Group Presentations HSL Ch. 6,7,8 Due dates vary by group: Sessions 6 (Ch. 6), 9 (Ch. 7) or 12 (Ch. 8).
4 Feb-12 Feb-14		Types of Assessments K-2 Assessments Individual Assessments, Student Notebooks and Checklists, Online K-2 Resources	<b>Read:</b> K-2 pp. 20 - 34 <a href="#">Schoenfeld 2007 Assessing Mathematical Proficiency.pdf</a> Kathy Rich The Research Basis for the Assessing Math Concepts PDF ( optional) <b>Assignment 5:</b>
5 Feb-19 Feb-21	<b>Assignment 2</b> Math Reasoning Inventory	K-2 Assessment Strategies 4-7, International Mathematics MRI Reactions	<b>Read:</b> HSL Ch.5  <b>Assignment 4</b>

6 Feb-26 Feb-28	<b>Group 1 Presentation Ch. 6 Whole Numbers</b>	<b>Group 1 Presentation</b> Analyzing Data and Discussion, HSL Whole Numbers, PBA explained	<b>Read:</b> INFORM Ch. 2
7 Mar-5 Mar-7		INFORM: What's Next?	<b>Read:</b> INFORM Ch. 3  Next week is break!
8 Mar-19 Mar-21		INFORM Learning Targets	<b>Read:</b> HSL Ch. 6
9 Mar -26 Mar- 28	<b>Group 2 Presentation</b>	<b>Group 2 Presentation</b> HSL Rational Numbers	<b>Read:</b> INFORM Ch. 4
10 Apr -2 Apr - 4		INFORM How Do I Assess: Oral Assessments	<b>Read:</b> INFORM Ch. 5
11 Apr -9 Apr 11		How Do I Assess: Written Assessments	<b>Read:</b> HSL Ch. 7
12 Apr -16 Apr-18	<b>Group 3 Presentation Assignment 4 PBA's</b>	<b>Group 3 Presentation</b> HSL Functions <u>INFORM Choosing Rich Tasks</u>	<b>Read:</b> INFORM Ch. 7
13 Apr -23 Apr-25	<b>Group 3's PBA's Due</b>	INFORM Student Self- Assessment PBA Discussion	<b>Read:</b> INFORM Ch. 8
14 Apr -30 May- 2	<b>Assignment 5</b>	INFORM Questions Leading to Assessment Info	<b>Read:</b> INFORM Ch. 9 and 10
15 May 7 May 9		INFORM Inferences and Long Term Success <b>International Group Presentations</b>	

		<b>Final Class: Make up and Reflections</b>	
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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](http://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**

Students' Descriptions:

Describe the five different 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 that enables you to move higher or lower based on the student. Be prepared for several levels up and several levels down. 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 these children 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:

Find an assessment from a reputable source and use this as your guide that fits the requirements below. Review the assessment and cite/highlight/discuss why it is the proper choice and how it fits the requirements below.

You must turn in that assessment and cite it. If the assessment you chose does not fit all the criteria, you may adapt it to make it concrete, pictorial or abstract as needed.

Chose tasks and questions that use three different forms of representation (concrete, pictorial, abstract symbols) to diagnose the child's understanding of ONE basic concept. Make sure the assessment allows for moving to a higher or lower level as needed by the individual child. 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) Choose a series of 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. Follow the plan on the assessment but feel free to ad lib if necessary. Make sure to note any additions.

(2) Choose a series of 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) Choose a series of 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.

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

Student Work Samples:

Take pictures of 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. Paste pictures into a Word document to allow for comments.

Question & Response Assessment segments

Video or 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:

Choose ONE child and develop a suggested instructional plan 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 these assessments 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?

**RUBRIC FOR ASSESSMENT REPORT**

<b>Criteria</b>	<b>Exceeds Requirements (A)</b>	<b>Meets Requirements (A-,B+,B)</b>	<b>Needs Improvement (C)</b>	<b>Inc.</b>	<b>Weight</b>
Is the required information present about the <u>child</u> assessed?	5 In addition to the required information, the Report includes information about the child's performance in other academic, social, or behavioral areas. Cite references.	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 <u>concept</u> and assessed the concept using three different <u>forms of representation</u> (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 <u>tasks and questions</u> 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 <u>work samples</u> 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 <u>transcript of excerpts</u> 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 <u>questions</u> 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 <u>evaluation</u> accurately represent the child's current level of understanding on this concept using supporting evidence and work samples from the assessment?	5 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	4    3    2 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	1 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	0	x .15 =

	supporting evidence for the evaluation of the child.	evaluation.	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 <u>evaluation</u> 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 =
<b>TOTAL SCORE</b>					
<b>A</b>	<b>5.0 – 4.5</b>				
<b>A-</b>	<b>4.49 – 3.5</b>				
<b>B+</b>	<b>3.49 – 2.5</b>				
<b>B</b>	<b>2.49 – 2.0</b>				
<b>C</b>	<b>1.99 – 1.0</b>				