

**Rutgers, The State University of New Jersey**

**15:254:540:01 Introduction to Mathematics Education, 3 credits**

**Fall 2015**

**Mondays 4:50-7:30**

**Graduate School of Education, Room 30**

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Office Hours: by appointment	Prerequisites or other limitations: none
Mode of Instruction: <input type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input checked="" type="checkbox"/> Hybrid <input type="checkbox"/> Online <input type="checkbox"/> Other	Permission required: <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes Non-matriculated students may get permission number from Marjory Palius @ <a href="mailto:marjory.palius@gse.rutgers.edu">marjory.palius@gse.rutgers.edu</a>

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**Course Catalogue Description**

Introduction to Mathematics Education is designed to introduce students to the field of mathematics education through a variety of activities that blend in-person, on-campus sessions with interactions done asynchronously online through a course web site. The on-campus activities will include talks given by visiting scholars, class and project work in small groups on mathematical problem-solving tasks, video study, with consideration of elementary and secondary students might engage with those tasks as they build justifications to challenging, open-ended problems. The online course work will include reading assignments that introduce participants to theoretical perspectives on learning and research in math education, with guidelines for engaging in reflection and discussion of those readings and considerations of their relevance to teaching practices. Other online course work will include studying video clips of children engaged in math problem solving and talking about their mathematical ideas; through reflection and online discussion the videos will be connected to the readings and hands-on problem solving.

**Learning Goals**

1. Students will gain introductory knowledge of the field of mathematics education with a focus on learning and teaching mathematics at the elementary and secondary level.
2. Students will learn about mathematical structures underlying strands of problem tasks from the counting/combinatorics strand of the 25+ years of longitudinal and cross-sectional research preserved at the Robert B. Davis Institute for Learning

3. Students will be introduced to research about how students engage with open-ended, challenging tasks as they build justifications of their solutions to problems
4. Students will learn about forms of students' mathematical reasoning through studying videos
5. Students will learn about research on learning and teaching through assigned readings and videos, and consider the relevance of this work to current teaching practices
6. Students will learn about the richness of representations through engaging in reflection and discussion of their own problem solving in conjunction with the problem solving of colleagues and of elementary/secondary students
7. Students will learn about the NCTM and Common Core State Standards and learn to recognize enactment of these standards through video study
8. Students will learn how to build an RUanalytic and create an RUanalytic that demonstrates their understanding of the implementation of Standards in elementary/secondary learning

### **Required texts:**

All readings will be provided electronically

### **Grading policy:**

**Attendance** - Students are required to attend all class sessions and participate regularly during online sessions. If special circumstances (religious observance, school open house, illness) require absence, students are responsible to inform the instructor beforehand and to make up all work. It is suggested that each student identify a partner who can assist when one is unable to attend class.

Class participation and problem solving – 35%; Online participation– 30%; RUanalytic study project – 25%; project and reflections -10%

### **Academic Integrity Policy:**

Any violation of academic honesty is a serious offense and is therefore subject to an appropriate penalty. Refer to <http://academicintegrity.rutgers.edu/integrity.shtml> for a full explanation of policies.

### **Graduate Assistants**

Robert Sigley and Cheryl Van Ness

### **Course Requirements**

You are expected to be an active participant in the class through small group work in the classroom and through web-based discussions, projects, lectures and writing. Successful completion of the course requires that you engage in all activities and submit all assignments. You are required to:

1. Attend **all** on-campus sessions and submit all assignments **ON TIME**.
2. Actively participate in online discussions as you engage with assignments (readings and videos) and respond to guiding questions as posted on the eCompanion course web site. You are required to make at least one original posting and respond to at least two group member postings per week.
3. Be knowledgeable of all the assigned readings, problem tasks, videos, and RUanalytic work.
4. Complete an *Individual Project* about student argumentation using the *Video Mosaic* ([www.videomosaic.org](http://www.videomosaic.org)) resources to tell the story in a multimedia narrative called RUanalytic.
5. Complete a *reflection paper* and *exit questionnaire* about your work in this course to include online discussions about videos, problem solving, readings, and project work. This will be the

- final assignment and due no later than December 14. You should reflect on your knowledge of the mathematics, research on how students learn, and implications for teaching with regard to NCTM and Common Core Standards. You may review your postings on the course web site and notes from problem solving and sharing of solutions as you develop your reflective assessment.
- Complete **ALL** assessments.

**Description of Activities: See syllabus for course work and requirements. Other readings and video/RUanalytic viewings will be assigned throughout the course.**

Class sessions are held on campus in our regular classroom (GSE 030) except when indicated as **ONLINE** (10/5, 11/23, 12/14) in the following outline of activities. Every week includes online discussions in addition to activities conducted in a face-to-face setting.

**Classwork involves access to online resources. IT IS IMPORTANT THAT YOU BRING YOUR COMPUTER TO CLASS EACH WEEK BECAUSE THERE WILL BE REFERENCES TO ONLINE WORK.**

WEEK SESSION	IN CLASS ACTIVITIES	ASSIGNMENTS Drop Box Posts, Readings and Video and RUanalytic Viewing
<b>Week 1:</b> <b>Tuesday</b> <b>9/8/2015</b>	<b>Class Activities:</b> <ol style="list-style-type: none"> <li>Complete permission forms</li> <li>Introduction to: Syllabus; eCollege and on line discussion/ assignment formats; course requirements</li> <li>Introduction to RUanalytics</li> <li>Log in to RUanalytics using Net ID</li> <li>Complete in-class questions and submit to drop box (Cheryl)</li> <li>Introduction to research on children's reasoning using rods.</li> </ol>	<b>Drop Box:</b> Respond to the two questions on argumentation that are in the <b>Document Folder</b> and then submit to Drop Box. <b>Be sure to title with your name.</b>  <b>Readings for Week 2:</b> <ol style="list-style-type: none"> <li>Erlwanger, S. H. (1973). Benny's Conception of Rules and Answers in IPI Mathematics. <i>The Journal of Children's Mathematical Behavior</i> 1(2), 7-26.</li> <li>Skemp, R. R. (1976). Relational Understanding and Instrumental Understanding. <i>Mathematics teaching</i>, 77, 20-26.</li> </ol>
<b>Week 2:</b> <b>9/14/2015</b>	<b>Class Activities</b> <b>Part 1:</b> Cheryl <ol style="list-style-type: none"> <li>View as class RUanalytic (Fraction1)</li> <li>Describe argumentation for each event</li> <li>Complete as assignment if necessary</li> </ol> <b>Part 2:</b> Introduction to fraction/reasoning study	<b>In RUanalytic Workspace:</b> If necessary, complete RUanalytic by inserting text for (a) overall and event descriptions; (b) overall title and event titles. <b>When giving a title to your Fraction 1 RUanalytic, please precede the title with your name.</b>  <b>On Line:</b> Respond online to <b>discussion</b>

		<p><b>questions about</b> readings assigned on Week 1.</p> <p><b>Readings for Week 3:</b></p> <p>(1) Davis, R. B. (1992). Understanding ‘understanding’. <i>The Journal of Mathematical Behavior</i>, 11, 225-241.</p> <p>(2) Davis, R. B., &amp; Maher, C. A. (1990). Chapter 5: What do when we do mathematics"? <i>Journal for Research in Mathematics Education</i>. Monograph, 4, 65-210.</p>
<p><b>Week 3:</b> <b>9/21/2015</b></p>	<p><b>Class Activities</b></p> <p><b>Part 1:</b> Cheryl View as a class full RUanalytic (Fraction 2)</p> <p><b>Part 2:</b> Discuss Davis Readings</p> <p><b>Part 3:</b> View and discuss fraction RUanalytics from fraction/reasoning study.</p>	<p><b>Drop Box:</b></p> <p>(1) Study online RUanalytic (Fraction 2) <b>Event 1 through Event 7</b></p> <p>(2) Respond to questions 1-5 in the <b>Document Folder</b> and post response to Drop Box. <b>Be sure to title with your name.</b></p> <p><b>Reading for Week 4:</b> Common Core State Standards Initiative. (2010). See K-8 algebra standards:</p> <ul style="list-style-type: none"> <li>• K.OA.1-5; K.NBT.1</li> <li>• 1.OA.1-8; 1.NBT.1-6</li> <li>• 2.OA.1-4; 2.NBT.1-9</li> <li>• 3.OA.1-9; 3.NBT.1-3</li> <li>• 4.OA.1-5; 4.NBT.1-6</li> <li>• 5.OA.1-3; 5.NBT.1-7</li> <li>• 6.EE.1-9</li> <li>• 7.EE.1-4</li> <li>• 8.EE.1-8; 8.F.1-5; 8.G.6-8</li> </ul> <p>The Experiment. Sense publishing.</p>
<p><b>Week 4:</b> <b>9/28/2015</b></p>	<p><b>Class Activities</b></p> <p><b>Part 1:</b> Introduction to algebraic reasoning</p> <p><b>Part 2:</b> In class problems (Geese/Ladders)</p> <p><b>Part 3:</b> View and discuss in class Sigley/WilkinsonRUanalytic <a href="http://dx.doi.org/10.1016/j.jmathb.2015.03.001">http://dx.doi.org/10.1016/j.jmathb.2015.03.001</a></p>	<p><b>Drop Box:</b></p> <p>(1) Study online RUanalytic (Fraction 2) <b>Event 8 through Event 18.</b></p> <p>(2) Respond to questions 1-5 in the <b>Document Folder</b> and post response to Drop Box. <b>Be sure to title with your name.</b></p> <p><b>Reading for Week 5:</b> Sigley, R. &amp;</p>

		Wilkinson, L. C. (in press). Ariel's cycles of algebraic problem solving: An adolescent acquires the mathematics register. <i>Journal of Mathematical Behavior</i> .
<b>Week 5: 10/5/2015</b>	<b>ONLINE</b>	<b>Online:</b>  (1) Discussion of RUanalytic (Fraction 2) (2) Discussion of Sigley/Wilkinson paper and issues of language in mathematics learning
<b>Week 6: 10/12/2015</b>	<b>Class Activities</b> <b>Part 1:</b> Cheryl View as a class full RUanalytic (Stephanie 1) <b>Part 2:</b> View and discuss algebra RUanalytics regarding (a) Early algebra; (b) Experiential Learning, (c) Pedagogical Moves	<b>Drop Box:</b> (1) Study online RUanalytic (Stephanie 1) (2) Respond to questions 1-5 in the <b>Document Folder</b> and post response to Drop Box. <b>Be sure to title with your name.</b>  <b>Reading for Week 7:</b> Lampert, M. & Cobb, P. (2003). Communication and language. In J. Kilpatrick, G. W. Martin, and D. Schifter, (Eds.), <i>A Research Companion to Principles and Standards for School Mathematics</i> (pp. 327-249). Reston, VA: National Council of Teachers of Mathematics.
<b>Week 7: 10/19/2015</b>	<b>Class Activities</b> <b>Part 1:</b> Discussion of Language and Math Learning <b>Part 2:</b> Problem Solving (Counting Strand)	<b>Online Discussion:</b> RUanalytic (Stephanie 1)  <b>Reading for Week 8:</b> Combinatorics and Reasoning book (Maher, Powell & Uptegrove, Eds.): Chapter 1: <i>The Longitudinal Study</i>
<b>Week 8: 10/26/2015</b>	<b>Class Activities</b> <b>Part 1:</b> Cheryl View as a class full RUanalytic (Stephanie 2) <b>Part 2:</b> Problem Solving in Class (Counting Strand, continued)	<b>Drop Box:</b> (1) Study online RUanalytic (Stephanie 2) (2) Respond to questions 1-5 in the <b>Document Folder</b> and post response to Drop Box. <b>Be sure to title with your name.</b>  <b>Reading for Week 9:</b> Combinatorics

		and Reasoning book (Maher, Powell & Uptegrove, Eds.): Chapter 1: <i>The Longitudinal Study</i> .
<b>Week 9:</b> <b>11/2/2015</b>	<p><b>Class Activities</b></p> <p><b>Part 1:</b> Introduction to course <b>PROJECT:</b> Constructing your own RUanalytic on argumentation</p> <p><b>Part 2:</b> View Video: Gang of 4</p> <p>Identify and discuss arguments posed by the children as justification for their solution.</p>	<p><b>Online Discussion:</b> RUanalytic (Stephanie 2)</p> <p><b>Review Tutorial:</b> Making an RUanalytic</p> <p><b>Reading Assignment:</b></p> <p>Maher, C. A. &amp; Martino, A. (1998). "Brandon's Proof and Isomorphism". In C. A. Maher, <i>Can teachers help children make convincing arguments? A glimpse into the process</i>. Rio de Janeiro, Brazil: Universidade Santa Ursula.</p>
<b>Week 10:</b> <b>11/9/2015</b>	<p><b>Class Activities</b> (Cheryl)</p> <p><b>Part 1:</b></p> <p>(1) Revisit as class RUanalytic (Fraction1)</p> <p>(2) Revisit descriptions of argumentation</p> <p><b>Part 2:</b> Complete in-class question and submit to drop box</p> <p><b>Part 3:</b> Support from Cheryl and Robert for RUanalytic course <b>PROJECT</b> on argumentation</p>	<p><b>Reading Assignments:</b></p> <p>(1) Cobb, P., &amp; Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. <i>Educational psychologist</i>, 31(3-4), 175-190.</p> <p>(2) Greer, B., &amp; Harel, G. (1998). The role of isomorphisms in mathematical cognition. <i>The Journal of Mathematical Behavior</i>, 17(1), 5-24.</p> <p><b>Video Assignment:</b></p> <p>(1) Brandon's Proof and Isomorphism. Respond to online discussion questions.</p> <p>(2) Meredith removes the top cube.</p> <p>(3) Shirts and Pants from PUP Math</p> <p>(4) Stephanie and Dana working on the towers problem</p>
<b>Week 11:</b> <b>11/16/2015</b>	<p><b>Class Activities</b></p> <p>(1) Guess My Tower</p> <p>(2) Dice games and probability</p>	<p><b>Reading Assignment:</b></p> <p>Francisco, J. M., &amp; Maher, C. A. (2005). Conditions for promoting reasoning in problem solving: Insights from a longitudinal study. <i>The Journal of Mathematical Behavior</i>, 24(3), 361-372.</p> <p><b>Video Assignment:</b> View RUanalytic by Anthony Logothetis, <i>Discovering Probability with Dice Games and the</i></p>

		<i>Evolution of a Convincing Argument.</i> <b>Online Discussion:</b> Readings and RUanalytic
<b>Week 12:</b> <b>11/23/2015</b> <b>ONLINE</b>	<b>ONLINE</b> <b>Online Activities:</b> Complete RUanalytic <b>PROJECT</b> <b>Share</b> your RUanalytic with <b>at least one</b> other student in the class and provide <b>feedback to another</b> student's RUanalytic. Your RUanalytic should begin a title with your <b>NAME</b> . <b>Also</b> , share your RUanalytic for feedback with Cheryl, Robert and me.	<b>Assignment:</b> Complete RUanalytic <b>Project</b> <b>Reading Assignment:</b> Maher, C. A. & Ahluwalia, A. (2014). Counting as a foundation for learning to reason about probability. In E. J. Chernoff & B. Sriraman (Eds.), <i>Probabilistic Thinking: Presenting Plural Perspectives</i> (pp. 559-580). Springer: New York, NY. <b>Online Discussion:</b> Readings and RUanalytic.
<b>Week 13:</b> <b>11/30/2015</b>	<b>Class Activities:</b> Begin presentations, discussions and evaluations of RUanalytics on argumentation	<b>Reading Assignment:</b> Agnew, G., Mills, C. M., & Maher, C. A. (2010). RUanalytic: Developing a collaborative video analysis tool for education faculty and practicing educators.
<b>Week 14:</b> <b>12/7/2015</b>	<b>Class Activities:</b> Continue presentations, discussions, and evaluations. <b>Study Assignment:</b> Exit Survey	<b>Reflection Paper Assignment Due</b>
<b>Week 15:</b> <b>12/14/2015</b>	<b>ONLINE</b>	<b>Final Requirements due:</b> <b>(1) RUanalytic:</b> Revise and share with Cheryl <b>(2) Exit Questionnaire Due</b>

## READINGS AND REFERENCES

- Agnew, G., Mills, C. M., & Maher, C. A. (2010). VMCAAnalytic: Developing a collaborative video analysis tool for education faculty and practicing educators. In R. H. Sprague, Jr. (Ed.), *Proceedings of the 43rd Annual Hawaii International Conference on System Sciences (HICCS-43): Abstracts and CD-ROM of Full Papers*. IEEE Computer Society, Conference Publishing Services: Los Alamitos, CA.
- Ball, D. L. & Bass, H. (2003). Making mathematics reasonable in school. In J. Kilpatrick, G. W. Martin, and D. Schifter, (Eds.), *A Research Companion to Principles and Standards for School Mathematics* (pp. 27-44). Reston, VA: National Council of Teachers of Mathematics.
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- Maher, C. A. & Martino, A. (1998). "Brandon's Proof and Isomorphism". In C. A. Maher, *Can teachers help children make convincing arguments? A glimpse into the process*. Rio de Janeiro, Brazil: Universidade Santa Ursula.
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