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Introduction to Mathematics Education
Spring 2015
Wednesdays 4:50 – 7:30 PM
GSE Room 225, CAC

Instructor: Marjory F. Palius	Email: marjory.palius@gse.rutgers.edu
Phone Number: 848-932-0803	Location: GSE Room 232
Office Hours: Wednesdays 3:00 - 4:30 PM (or by appointment)	Prerequisites or other limitations: NJ PEMSM participants only (exceptions if space available)
Mode of Instruction: ___ Lecture ___ Seminar _X__ Hybrid ___ Online ___ Other	Permission required: __ No _X_ Yes Directions about where to get permission numbers: email to Instructor

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentations: hhttps://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

Course Description

GSE course catalog description:
Required of all graduate students in mathematics education. Review and study of literature in mathematics education research and practice, including theoretical perspectives and empirical studies. Students develop projects on topics of current interest.

Additional description of course purposes, context, and methods:
This course is designed to introduce students to the field of mathematics education through a variety of activities in a hybrid format that blends on-campus sessions with online, asynchronous interactions through a course web site. Class sessions are primarily for working on mathematical problem-solving tasks to deepen understanding of math content and structure through reasoning and justification. Conversations beginning in class become extended through discussions online

where this is time for critical reflection and thoughtful analysis. Readings from the literature and illustrative examples from the Video Mosaic Collaborative (VMC) invite consideration of how K-12 students might engage with those tasks as they build justifications to challenging, open-ended problems. Readings also introduce theoretical perspectives on learning and research in mathematics education. Course activities support making connections to the NCTM Standards and Common Core State Standards for Mathematics (CCSS-Math), which will become explicit through projects in which students each create a multimedia artifact called a VMCAnalytic. Projects are collaborative in that students can share their work and comment on each other's VMCAnalytic in their workspace. Class time will be used to provide initial training in use of the tool, and video tutorials provide extra help on demand. Projects will be presented at the last class session. Your VMCAnalytic serves as a master's program requirement (as defined below). The final assignment is short reflection paper (1-2 pages) on what you learned in the course.

Note that this course includes a required portfolio contribution for students admitted to the Ed.M. program in mathematics education in the Fall 2013 term onwards, except those entering through the NJ PEMSM program, who instead have a master's project paper as (instead of a portfolio built with contributions over four particular required courses) culminating degree requirement.

Learning goals:

- Gain introductory knowledge of the field of mathematics education with a focus on learning and teaching mathematics at the elementary and secondary levels
- Build knowledge about mathematical structures underlying strands of problem tasks from 25+ years of longitudinal and cross-sectional research preserved at the Robert B. Davis Institute for Learning
- Become familiar with research about how students engage with open-ended, challenging tasks as they build justifications of their solutions to problems
- Learn about forms of K-12 students' mathematical reasoning through video study
- Become familiar with about research on learning and teaching through assigned readings and videos, and consider the relevance of this work to current teaching practices
- Attend to 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
- Critically reflect on the NCTM and Common Core State Standards and learn to recognize enactment of these standards through video study
- Learn how to use the RU Analytic tool and create a VMCAnalytic that demonstrates their understanding of the implementation of Standards in elementary/secondary learning

Required texts: All readings will be provided electronically, accessible via course web site.

Grading Policy

Evaluation of Course Work:
This course is designed for a community of learners so full and active participation is essential. Willingness to share ideas is highly valued, as is thoughtful critique and reflection on ideas put forth by others. In written work, which includes online discussion, VMCAnalytics, and final reflection papers, qualities such as clarity, conciseness, and relevance to the topic or prompt are

highly valued. Online discussion is less formal, yet it is still important to cite the source of ideas to which you refer in posts. Citations and references in VMCAnalytics need to follow APA style.

Grading Criteria:
Grades will be based on the quality of written work and the thoughtfulness of your contributions as both an active and a responsive member of a community of professional learners in the course.

Participation in the on-campus class meetings	35%
Participation in the online discussions	40%
VMCAnalytic project	25%
Final Reflection Paper	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.

Web sites:
https://sakai.rutgers.edu/portal *(Specific course access on Sakai is made available to students who have officially registered for this course.)*

Course Requirements

Successful completion of the course requires that you engage in all activities and complete all assignments. Specifically, you are expected to:

1. Attend and actively participate in all on-campus sessions for mathematical problem solving, discussions, collaborations, etc.

2. Actively participate in online discussions to critically reflect on our class-based activities, assigned readings, etc. by responding to guiding questions posted on the course website and to comments of your peers and instructor. Each participant is expected to make at least one original response posting per discussion topic and respond to at least two group member postings in that topic. Some weeks there will be only one topic of discussion; other weeks there may be a couple topics. Specific due dates appear on course website.

3. Be knowledgeable of all the assigned readings and video clip viewings.

4. Complete a project in the form of a multimedia narrative called a VMCAnalytic. Every student will complete an individual VMCAnalytic, yet may collaborate to help one another using the comments feature of the tool. Your VMCAnalytic should show the depth of your understanding about the learning of a particular mathematical concept through clear communication of ideas and focusing viewers' attention on key actions. There is choice of topic but it needs to be approved by the instructor. Projects will be shared during the April 29 class session and must be finalized no later than May 4.

5. Submit a short (1-2 page) reflection paper about what you learned in the course. 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. Submit electronically by May 10.

Attendance Policy:
Students are required to attend all class sessions and participate regularly during online sessions. Instances of severe weather may result in changing our schedule to switch on-campus meetings for online sessions, in which case you will be informed via email sent from course site on Sakai. 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.

Course Schedule and Assignments

In addition to the assigned readings, there will be online discussions every week. Students should make their initial posts by Saturday night, if possible, or by 12 Noon Sunday at the latest. That gives others opportunity to respond over the weekend with online discussion assignments due by 10 AM Tuesday. This regular schedule gives the instructor time to review, respond and plan for carrying forward key discussion points from week to week so that activities flow well. ***The following schedule is tentative*** *and may be adjusted as the course proceeds, with specific assignments clarified each week on the Sakai site.*

Weeks	Activities/Topics to be Covered	Reading Assignments
Jan 21	• Introductions • Course Overview • RBDIL research 25+ years and the Video Mosaic Collaborative (VMC) • Modeling with Cuisenaire rods to build understanding of numerical relationships	Erlwanger, S. H. (1973). Benny's Conception of Rules and Answers in IPI Mathematics. *The Journal of Children's Mathematical Behavior* 1(2), 7-26. Skemp, R. R. (1976). Relational Understanding and Instrumental Understanding. *Mathematics teaching*, 77, 20-26.
Jan 28	• Proportional reasoning and making sense of fractions • Studying video data to build knowledge about children's mathematical reasoning	Davis, R. B. & Maher, C. A. (1990). What do we do when we do mathematics? In R. B. Davis, C. A. Maher, & N. Noddings (Eds.), Constructivist Views on the Teaching and Learning of Mathematics*, Journal for Research in Mathematics Education Monograph No.* 4, 65-78. Reston, VA: National Council of Teachers of Mathematics. Steencken, E. P. & Maher, C. A. (2003). Tracing fourth graders' learning of fractions: Episodes

		from a yearlong teaching experiment. *The Journal of Mathematical Behavior, 22* (2), 113-132.
Feb 4	• Problem solving to build towers 5/4/3/n-tall • Extension to "Guess My Tower" • Share and evaluate solutions • Discuss ways in representations and strategies give windows into mathematical thinking • Study videos of students engaging in these tasks and reasoning about their mathematical ideas	Mueller, M., Yankelewitz, D. & Maher, C. (2011). Sense making as motivation in doing mathematics: Results from two studies. *The Mathematics Educator 20*(2), 33-43. Maher, C. A. (2009). Children's reasoning: Discovering the idea of mathematical proof. In M. Blanton, D. Stylianou and E. Knuth (Eds.), *Teaching and learning proof across the K-16 curriculum* (pp. 120-132). New Jersey: Taylor Francis - Routledge.
Feb 11 Online	• Online activities • Evaluate and discuss examples of students' work • Watch videos, do readings, discuss key ideas and observations	Maher, C. A. & Martino, A. M. (1996). The development of the idea of mathematical proof: A 5-year case study. *Journal for Research in Mathematics Education, 27* (2), 194-214. Yackel, E. & Hanna, G. (2003). Reasoning and proof. In J. Kilpatrick, G. W. Martin, and D. Schifter, (Eds.), *A Research Companion to Principles and Standards for School Mathematics* (pp. 227-236). Reston, VA: National Council of Teachers of Mathematics.
Feb 18	• Pizza problems: 2-toppings with halves, 4-topping pizza problem • Discuss notations, representations, strategies and solutions • Study videos of students engaging in these tasks and reasoning about their mathematical ideas	Maher, C.A. (1998). Constructivism and constructivist teaching - can they co-exist? In Ole Bjorkqvist (Ed.), Mathematics teaching from a constructivist point of view (pp.29-42). Finland: Abo Akademi, Pedagogiska fakulteten. Ball, D. L. & Bass, H. (2003). Making mathematics reasonable in school. In J. Kilpatrick, W. Martin & D. Schifter (Eds.) *A Research Companion to Principles and Standards for School Mathematics* (pp. 27-44). Reston, VA: National Council of Teachers of

		Mathematics.
Feb 25 Online	• Online activities • Evaluate and discuss examples of students' work • Watch videos, do readings, discuss key ideas and observations	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. Greer, B., & Harel, G. (1998). The role of isomorphisms in mathematical cognition. *The Journal of Mathematical Behavior*, *17*(1), 5-24.
Mar 4	• Work on box problem; discuss solution strategies • Discuss VMCAnalytics and the course projects • Learn how to use RU Analytic tool	Davis, R. B. (1992). Understanding 'understanding' (1992). *The Journal of Mathematical Behavior, 11*, 225-241.
Mar 11	• Towers of Hanoi • Consider how various learners approach the problem • Study video episode for insights on students' mathematical thinking	Gravemeijer, K. & van Galen, F. (2003). Facts and algorithms as products of students' own mathematical activity. In J. Kilpatrick, W. Martin & D. Schifter (Eds.) *A Research Companion to Principles and Standards for School Mathematics* (pp. 114-122). Reston, VA: National Council of Teachers of Mathematics.
Mar 18	• SPRING BREAK	
Mar 25 Online	• Online activities • Focus on classroom discourse • Watch videos, do readings, discuss key ideas and observations	Martino, A.M. & Maher, C.A. (1999). Teacher questioning to promote justification and generalization in mathematics: What research practice has taught us. *The Journal of Mathematical Behavior, 18*(1), 53-78. Lampert, M. & Cobb, P. (2003). Communication and Language. In J. Kilpatrick, G. W. Martin, and D. Schifter, (Eds.), *A Research Companion to Principles and Standards for School Mathematics* (pp. 237-249). Reston, VA: National Council of Teachers of Mathematics.

Apr 1	• Using games as context to explore probability ideas • Classroom problem solving, videos and reading for discussion online	Maher, C. A. (1998). Learning to reason probabilistically. In S. Berenson, K. Dawkins, M. Blanton, W. Coulombe, J. Kolb, K. Norwood, and L. Stiff (Eds.), *Proceedings of the 20th Conference of the North American Group for the Psychology of Mathematics Education, (1)*, 82-87. Raleigh, NC: North Carolina State University. Alston, A. S. & Maher, C. A. (2003). Modeling outcomes from probability tasks: Sixth graders reasoning together. In N. A. Pateman, B. J. Dougherty and J. T. Zilliox (Eds.), *Proceedings of the 27th Annual Conference of the International Group for the Psychology of Mathematics Education, (2),* 25-32. Honolulu, HI: CRDG, College of Education, University of Hawaii.
Apr 8	• Work on World Series Problem • Share representations, strategies and solutions • Examine how others have approached this problem and artifacts from their work	Francisco, J. M. (2013). Learning in collaborative settings: students building on each other's ideas to promote their mathematical understanding. *Educational Studies in Mathematics*, 82(3), 417-438.
Apr 15	• Look across various problem tasks and development of ideas over time • Focus on mathematical structures • Identify how students can make connections as well as notice when there are differences that matter	Maher, C. A. & Kiczek, R. D. (2000). Long term building of mathematical ideas related to proof making. *Proceedings from the 9th International Congress on Mathematics Education*, 82-87. Japan.
Apr 22	• Engage in critical reflection of what we have learned in light of current happenings in schools • Discuss implications for instruction and issues to explore further	Reading assignment to be determined and posted on course web site
Apr 29	• Presentations to share projects	• Final projects due no later than Monday, May 4
May 6	• Culminating discussions	• Reflection papers due by May 10