George Mason University
Graduate School of Education

Part of a Non-degree Outreach Course

Exploration in Science Technology Engineering Education through Mathematics
Special topics: MATH 600 6M1 **(3 credits)**
Spring 2013

Instructor:

Padmanabhan Seshaiyer, Professor of Mathematical Sciences George Mason University	pseshaiy@gmu.edu
Jennifer Suh, Associate Professor of Mathematics Education George Mason University	jsuh4@gmu.edu
Andrea Weiss	aweiss@flinthill.org
Scott Tennett	scottenatural@gmail.com

Class Meets: 1st &3rd Monday 4:30-7:10PM

I. Course Description

This course focuses on mathematical inquiry through STEM Problems and 21st Century Skills: Creativity, Critical Thinking, Communication and Collaboration

II. Student Outcomes

At the conclusion of this course, students should be able to:

A. Promote a better understanding of the nature of mathematics and mathematical inquiry
B. Demonstrate problem-solving strategies in various mathematical content areas and methods for cultivating problems solving, reasoning and communicating skills
C. Foster an understanding of how children's mathematical thinking develops
D. Articulate methodologies for teaching mathematics more effectively to children with various abilities in Grades K-6; Plan effective mathematics instruction for students from diverse populations with a variety of learning needs

III. Nature of Course Delivery

The delivery of this course combines methods of seminar, online sessions, active learning, discussion, independent work, student presentation, mathematical problem solving, and writing.

The course is designed both in structure and process to engage students in dialogue at the individual, group, and collective levels. Different formats will be used to help build both the capacity of the learning community. Readings and lectures will precede and focus class on-line discussions and interactive forums. This course relies on your willingness to participate in all class and team discussions. You will be asked to complete weekly reading assignments and offer key ideas on how the readings inform professional experience. The syllabus lays out an initial plan for our work and may be revised during the course to meet students' needs and interests. Students are expected to be independent thinkers, intellectually curious, and responsible to each other for the quality of classroom learning. This calls for both purposeful collaborative work as well as deep individual reflection. The course is designed to enhance both of these skill sets. You should expect to spend time in between classes to reading/viewing/listening to assigned materials, conducting research and completing assignments, completing reflections, problem solving and simulations, and participating in substantive on-line discussions.

IV. Texts and Readings:

Required Text:

Trilling, B. & Fadel, C. (2009). 21st Century Skills: Learning for Life in Our Times.

Wagner, T. (2012). *Creating innovators: The making of young people who will change the world*. Scriber, New York, NY. ISBN 978-1-4516-1149-6

Internet Resources for Content Background and research

Phet
http://phet.colorado.edu/

Explorelearning(Gizmo)
www.explorelearning.com

AIMS
http://www.aimsedu.org/

Tinkerplot
http://www.keycurriculum.com/resources/tinkerplots-resources

Buck Institute
http://www.bie.org/

Engineering is Elementary
http://www.mos.org/eie/

Middle school Contextualized Problems
http://www.mmmproject.org/data.htm

Model Eliciting Tasks
http://crlt.indiana.edu/research/csk.html

STEM video clips
www.futureschannel.com

Environmental Awareness Unit
http://www.futureinconstruction.com/greenConst.aspx
House Math: Making Your House Energy-Efficient
Financial Literacy

V. Course Requirements and Assignments

The assignments across the semester are intended to improve your strategies as a mathematics teacher and to develop your skills in the interpretation, critique and synthesis of mathematics education research. All assignments are to be completed on time so that class members might benefit from the expertise and contributions of their colleagues.

A. Problem Centered Unit- Lesson Study (40%)

You will work within groups to create/describe a STEM related problem/project based learning activity. Plan and teach a problem centered unit with 4-5 authentic learning tasks using the criteria listed for the assignment. Design Process – Rubric
Problem-centered teaching opens the mathematics classroom to exploring, conjecturing, reasoning, and communicating. This model will look at instruction in three phases: launching, exploring, and summarizing. Preview this website to get an idea of how your unit can be designed. http://www.math.msu.edu/cmp/StudentMaterials/ProblemCentered.htm

B. Lesson Study Planning & video clips (20%)

You will choose on of the lessons from a problem centered unit you develop in your group and conduct a lesson study in the spring. Short video clips will help other teachers teach this lesson and observe how students think through the task.

C. STEM-Problem Solving Notebook & Responses (20%)

Keep a notebook with solutions to problems presented in class. This problem solving notebook will illustrate your problem solving strategies and reflections. It will also archive the problems and solutions shared in class. During each class session, students participate in activities that are documented as a record of their individual contributions to the class. Students are evaluated on these contributions. The following activities are included in the Response Record for the class: (1) Students will be randomly selected to provide an overview of key points in the readings during class discussions, (2) Students will be randomly selected to discuss their Research Synopsis Assignments on the dates these assignments are due, (3) Students will share lesson plans, problem solving activities and teaching ideas from their classrooms.

D. Project SHARE- (10%) Teachers sign up to showcase a novel resource to use in teaching 21st century skills by researching best practices and evaluate resources. Prepare a handout or a weblink on our course site. Sign up sheet will give you a time and the estimated sharing time will be about 15 minutes.

E.Concept Maps (4 Maps) 10%
You will have the opportunity to develop a STEM concept map throughout this course. The first map will be made using your existing knowledge of STEM. The second map will be expanded from the first map, by incorporating the readings from ther text and the first month of the course. The third map will be expanded from the second map, by incorporating the readings from the activities. The fourth map will be expanded from the third map. You may draw the maps in any program you wish, or by hand. Inspiration Maps is a great program for this purpose, that can be downloaded on your iPad (http://www.youtube.com/watch?v=SfYQB01JbJ8).

VI. Evaluation Schema

Determination of the Final Grade:

Graduate Grading Scale

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

VII. UNIVERSITY POLICIES
The university has a policy that requests students to turn off pagers and cell phones before class begins.

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, and on 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 703-993-2474, or the University Equity Office at 703-993-8730.

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).

TASKSTREAM REQUIREMENTS

Every student registered for any MEL course with a required performance-based assessment (will be designated as such in the syllabus) is required to submit this assessment (*Professional Development Grant Proposal*) to TaskStream (regardless of whether a course is an elective, a onetime course or part of an undergraduate minor). Evaluation of your performance-based assessment will also be provided using TaskStream. Failure to submit the assessment to TaskStream will result in a the course instructor reporting the course grade as Incomplete(IN). Unless this grade is changed upon completion of the required TaskStream submission, the IN will convert to an F nine weeks into the following semester.

GMU POLICIES AND RESOURCES FOR STUDENTS

a. Students must adhere to the guidelines of the George Mason University Honor Code [See http://oai.gmu.edu/honor-code/].
b. Students must follow the university policy for Responsible Use of Computing [See http://universitypolicy.gmu.edu/1301gen.html].
c. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
d. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See http://caps.gmu.edu/].
e. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform teir instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu/].
f. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
g. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See http://writingcenter.gmu.edu/].

PROFESSIONAL DISPOSITIONS

Students are expected to exhibit professional behaviors and dispositions at all times.

CORE VALUES COMMITMENT

The College of Education & Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles. http://cehd.gmu.edu/values/

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See http://gse.gmu.edu/].

VIII. Course Schedule List possible topics

Class meets 4:30 – 7:10 PM, Monday

Calendar

Session	Topic/Learning Experiences & Assignments	Readings and Resources to visit
Session 1	Introduction-21st century skills and engineering-Design process	**http://dschool.stanford.edu/dgift/** **http://alumni.stanford.edu/get/page/magazine/article/?article_id=28385** **http://designthinkingforeducators.com/DTtoolkit_v1_062711.pdf**
Session 2	Roller coaster Design (Physics and Math)	http://www.learner.org/interactives/parkphysics/parkphysics.html http://phet.colorado.edu/
Session 3	Roller coaster Design (Physics and Math)	http://www.learner.org/interactives/parkphysics/parkphysics.html http://phet.colorado.edu/ Guest speaker Math in the Park
Session 4	Golden Ratio-Beauty in Mathematics (Nature, Art and Math)	Fibonacci Problems Guest speaker: Alexander Zeller
Session 5	Relating math to real life:	Articles from MTMS Real life Math
Session 6	Ratio and proportions	Rockets and Mixture problems
Session 7	Ratio and proportions	Quarter Scale and Gear Problem
Session 8	Math, Physics and Algebra	Lever and Algebra balanace
Session	Lesson Study &	Lesson Study & Planning

9	Planning Planning and Presenting Research Lesson	**Planning and Presenting Research Lesson**
Sessions 10-13	Designated Lesson study date Sessions 10-13	Lesson Study & Planning **Planning and Presenting Research Lesson**
April 2013	Spring Conference at the MASON INN	Lesson Study & Planning Planning and Presenting Research Lesson

HOW LESSON STUDY WILL WORK

Collaborative Planning Activity
This assignment will take place during the face to face sessions. Small groups (Lesson Study Teams) will select a topic to design an activity using a specific structure introduced during the second session in the fall. Lesson Study Teams will meet throughout the fall to continue to plan and refine their collaborative lesson. Lesson Study Teams are required to participate in all discussions including face-to-face, synchronous online, and asynchronous online.

Follow-Up Meeting: Lesson Study Teams (after seminars but before Lesson Study Day)
Each Lesson Study Team will need to meet to finalize plans for the Lesson Study Day. Teams may meet in person, online, or over the phone. Each member of the Lesson Study Team is responsible for full participation in the group.

Lesson Implementation (Lesson Study Day)
On the Lesson Study Day, one team member "the host" will teach the lesson to his or her group of students. The other members of the Lesson Study Team, as well as the Course Instructors, will be in attendance. The principal and math specialist of the Host School may be invited and encouraged to attend. In the morning, the Lesson Study Team will meet prior to the teaching of the lesson. During the lesson, the other Lesson Study Team members will be assigned a group of students to observe. After the lesson, the Lesson Study Team will meet to "debrief" and discuss what changes they would make. This revised lesson will be submitted to course instructors (see D.3 above)

Re-teaching the Lesson Plan
Each Lesson Study Team member (other than the host teacher) will use the collaborative lesson plan with their own students. Team members will be given time in the final class to share their experiences with the team.

Written Lesson Study Reflections
Participants are required to write 2 brief reflection papers (See D.4 above) in response to the lesson study experience. These reflections will be written and submitted to the course instructors only. (Since the host teacher will not re-teach the lesson, he or she will write a reflection using work samples from the public lesson.)

NAME: _____ Lesson Study Assignments Rubric TOTAL SCORE: __/40_points

Criteria	Meets Expectations	Partially Meets Expectations	Does Not Meet Expectations
	10-8	7-5	4-1
Original Lesson Plan (Group) __/10 points	Used Lesson Planning Template The Lesson Plan Goal is focused, specific, and grade appropriate. The task clearly aligns with the goal of the lesson. The Lesson Plan provides specifics about the launch, exploration, and closure of the lesson. Provides questions that the teacher can use to move the students through the task. Predicts students' misconceptions and confusions. Provides suggestions for what lesson observers should look for.	Used some parts of Lesson Planning Template The Lesson Plan Goal is somewhat focused, and grade appropriate but may lack detail. The task clearly aligns with the goal of the lesson. The Lesson Plan provides some details about the launch, exploration, and closure of the lesson but those details may not be sufficient to gain a clear understanding of the lesson. Provides some questions that the teacher can use to move the students through the task but may not address both children that are struggling as well as students that need to be pushed for deeper understanding. Predicts some students' misconceptions and confusions. Provides limited suggestions for what lesson observers should look for.	Used few parts of Lesson Planning Template The Lesson Plan Goal is not focused and grade appropriate and may lack detail. The task is weakly aligned with the goal of the lesson. The Lesson Plan provides limited details about the launch, exploration, and closure of the lesson. Provides limited questions that the teacher can use to move the students through the task and does not address both children that are struggling as well as students that need to be pushed for deeper understanding. Predicts few students' misconceptions and confusions. Provides limited suggestions for what lesson observers should look for.

Criteria	Meets Expectations	Partially Meets Expectations	Does Not Meet Expectations

Points	5-4	3	2-1
Revisions to the Lesson (Group) ___/5 points	Clear and strong evidence that the lesson has been revised based on what was learned during the public lesson. Revisions to the lesson are likely to lead to more efficient and effective student learning.	Some evidence that the lesson has been revised based on what was learned during the public lesson. Revisions to the lesson are may lead to more efficient and effective student learning.	Little evidence that the lesson plan has been revised based on the public lesson. Revisions to the lesson are not clearly linked to the public lesson or to the research.

Criteria	**Meets Expectations**	**Partially Meets Expectations**	**Does Not Meet Expectations**
Points	5-4	3	2-1
Presentation (Group) ___/5 points	Clearly describes all of the following: • Discuss professional learning goal • Discuss student learning goal • Explains mathematical task • Analyzes 2-3 samples of student work • Explains revisions to original lesson • Explains how lesson study supported your professional learning • Describe further questions to explore based on your lesson study experience	Addresses all of the items or clearly describes some of the items.	Describes some of the items

Criteria	**Meets Expectations**	**Partially Meets Expectations**	**Does Not Meet Expectations**
Points	5-4	3	2-1
Modeling Math Assignment (Group) ___/5 points	Lesson Study Presentation includes a video clip or voiced over PowerPoint of at least 2 student work samples. The description analyzes the role models played in the student's thinking. Presentation is uploaded to the COMPLETE center website.		

Criteria	Meets Expectations	Partially Meets Expectations	Does Not Meet Expectations
	10-8	7-5	4-1
Lesson Implementation Reflection (Individual) __/10 points	2-3 pages, 11-12 Times New Roman font, 1 inch margins, double spaced Professionally written, 0-3 spelling/grammatical errors Clearly describes specific changes to the original lesson and why the changes were made. Thoughtful reflection of implementing the lesson in your classroom. Detailed analysis of student learning including and commenting on at least three examples of student work in the analysis	2-3 pages, 11-12 Times New Roman font, 1 inch margins, double spaced Some spelling/grammatical errors Describes specific changes to the original lesson and why the changes were made. Reflection of implementing the lesson in your classroom. Analysis of student learning including and commenting on at least three examples of student work in the analysis	Does not meet the page, font requirement Numerous spelling/grammatical errors One or more areas are not addressed Two or more areas are not fully addressed.

Criteria	Meets Expectations	Partially Meets Expectations	Does Not Meet Expectations
	10-8	7-5	4-1
Lesson Study Process Reflection (Individual) __/10 points	2-3 pages, 11-12 Times New Roman font, 1 inch margins, double spaced Professionally written, 0-3 spelling/grammatical errors Specific details related to your observations during the lesson Summary of the mathematical ideas and their relationship to the lesson goal that were addressed during the lesson debriefing. A specific statement about your lesson study experience. Thoughtfully discusses how the lesson study might benefit teachers.	2-3 pages, 11-12 Times New Roman font, 1 inch margins, double spaced Some spelling/grammatical errors Details related to your observations during the lesson are general. The mathematical ideas and their relationship to the lesson goal that were addressed during the lesson debriefing are partially addressed or the connection between the mathematics and the goal are not made clear A general statement about your lesson study experience. Discusses how the lesson study might benefit teachers.	Does not meet the page, font requirement Numerous spelling/grammatical errors One or more of the areas are not addressed. Two or more areas are not fully addressed.