George Mason University
Graduate School of Education

Expeditions in Science, Technology, Engineering, Arts through Mathematics
Special topics: MATH 600 001 (3 credits)
Spring/Summer 2014

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, COMPLETE Math Associate George Mason University	aweiss@flinthill.org
Scott Tennant, COMPLETE Math Associate George Mason University	scottenatural@gmail.com
Dr. Mike Long, COMPLETE Math Associate George Mason University	drmikelong16@me.com

I. Course Description

This course focuses on mathematical inquiry through STEAM 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:

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

Intel STEM
http://www.intel.com/content/www/us/en/education/k12/stem.html

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. STEM-Problem Solving Notebook & Journal Responses (30%)
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.

B. Collaborative STEAM Unit-Video Analysis (40%)
During the course, we will be examining a lesson with a focus on integrating STEAM into your teaching.

This assignment includes the following components:

1) Group STEAM UNIT (20%)
   As a collaborative team, you will develop a series of lessons using the "Thinking through a Lesson Protocol". This will be discussed in greater detail during the seminars.
2) Video Lesson Upload and Discussions (10%)
   Each teacher will teach the lesson in their respective classrooms, capturing the three phases of the lesson-(see Van de Walle guide). They will upload on the https://www.beasmartercookie.com/ for peer coaching.
3) Final Reflection and Analysis (10%)

Individually, you will analyze the implementation of the lesson, reflect on the collaborative process, and reflect on the implications to your teaching practices. This will be discussed in greater detail during the seminar.

C. STEAM and 21st Century Teaching and Learning Write up (20%)
Participants will analyze student work produced from problem-based tasks. During the collaborative lesson process, participants will monitor the learning of three pre-selected students. Participants will submit a final paper that analyzes the students' learning before, during, and after the implementation of the collaborative lesson plan. Discuss various STEM connection and how the teaching and learning specific learning objectives and the 21st century skills in student learning.

D. Final Content Exam (10%)
Students will take comprehensive exam covering the content studied in the course. The main focus of the exam will be on the mathematical content of the course. Students will be expected to demonstrate their own understanding and reasoning of the content as well as the knowledge and understanding needed by K-8 students in order to make sense of this content.

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).

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 9	Lesson Study & Planning Planning and Presenting Research Lesson	Lesson Study & Planning **Planning and Presenting Research Lesson**
Sessions 10-13	Designated Lesson study date Sessions 10-13	Lesson Study & Planning **Planning and Presenting Research Lesson**