

**University of Massachusetts at Boston  
College of Education and Human Development**

**Critical and Creating Thinking  
Mathematics Thinking Skills  
CRCRTH 650  
Fall 2013**

Instructor: Karen M. Crouse  
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Class Time: Wednesdays, September 4 – December 11, 2013, 4:00 – 6:45pm  
Class Room: To Be Determined  
Website: <http://crcrth650.wikispaces.umb.edu>

**Course Overview**

What are the critical and creative thinking skills used by mathematicians to understand concepts and solve problems? How do we develop these skills? In this course, we will begin with an exploration of our own backgrounds in mathematics to understand where our perceptions of and emotions toward mathematics began. We will then focus on different topics in mathematics allowing us to delve into problem solving and reflect on our thinking. Through experiential learning, students will build their understanding of mathematical ideas and highlight their own thinking skills. Next, we will explore the development of skills including math education historically and around the world. Readings, discussion, research and problem-solving are used to understand both historical and present-day understandings of what is important in mathematics learning. Finally, students will synthesize their understanding of mathematical thinking in a culminating in-class presentation on a mathematics topic of interest. The objective of this course is for students to build an understanding of and appreciation for mathematical thinking and incorporate these skills into their own

**Learning Outcomes**

At the end of this course, students will be able to

1. Reflect on their own mathematical development and perceptions
2. Describe key critical and creative thinking skills used in mathematical problem solving
3. Explain how the brain learns mathematics
4. Describe different points of view in mathematics education
5. Explore an area or solve a problem in mathematics and describe the mathematical thinking skills required

**Accommodations**

Sections 504 and the Americans with Disabilities Act of 1990 offer guidelines for curriculum modifications and adaptations for students with documented disabilities. If applicable, students may obtain adaptation recommendations from the Ross Center (287-7430). The student must present these recommendations to each professor within a reasonable period, preferably by the end of the Drop/Add period. If you have a disability that may have some impact on your work in

this class and for which you may require accommodations, please contact the Ross Center for Disability Services. The Ross Center for Disability Services is located in the Campus Center, UL 211. You can contact them by calling: 617-287-7430 or sending an email to: ross.center@umb.edu. Once you have received your accommodation letters, please meet with the instructor to discuss the provisions of those accommodations as soon as possible.

## Overview of Classes

### Part I: Introduction to Mathematical Thinking

Class Date	Topics/Activities	Assignment Due
Class 1: September 4, 2013	Theme: What is Mathematics? <ul style="list-style-type: none"> <li>▪ Overview of Course/Syllabus</li> <li>▪ Problem Solving Activity – Crossing Over</li> <li>▪ Exploring Mathematics Anxiety</li> <li>▪ Mathematics Autobiographies</li> </ul>	None due
Class 2: September 11, 2013	Theme: Historical Problems in Mathematics <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ History of Math - Video</li> <li>▪ Stations – Historical Problems and Solutions</li> <li>▪ Overview of Thinking Skills</li> </ul>	Class Reflection Mathematics Autobiography Readings: History of Math article
Class 3: September 18, 2013	Theme: What do Mathematicians Do? <ul style="list-style-type: none"> <li>▪ Speaker – Mathematics Professor</li> <li>▪ Debrief</li> <li>▪ Student Presentations</li> <li>▪ Overview of Thinking Skills</li> </ul>	Class Reflection How to Solve It, Polya, Chapter
Class 4: September 25, 2013	Theme: Introduction to Problem Solving <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Problem Solving Activity</li> <li>▪ Text-Based Discussion – How to Solve It</li> </ul>	Class Reflection Reading: How to Solve It, Polya, Chapter
Class 5: October 2, 2013	Theme: More Problem Solving <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Problem Solving Activity</li> <li>▪ Hyde's Strategies – KWC</li> <li>▪ Applying Hyde's Strategy</li> </ul>	Class Reflection Reading: Comprehending Math, Hyde

## Part II: Developing Mathematical Thinking – Movements in Mathematics Education

Class 6: October 9, 2013	Theme: Math Learning and the Brain <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Math Learning and the Brain</li> <li>▪ Applying theory to practice</li> </ul>	Class Reflection Reading: Math Learning and the Brain
Class 7: October 16, 2013	Theme: Mathematics Education around the World <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Jigsaw – Math Education around the World</li> </ul>	Class Reflection
Class 8: October 23, 2013	Theme: Models of Mathematics Education in the U.S. Student Presentation <ul style="list-style-type: none"> <li>▪ A Nation at Risk</li> <li>▪ Stand and Deliver</li> <li>▪ Skills-Based</li> </ul>	Class Reflection Reading: Skills-Based Mathematics Education
Class 9: October 30, 2013	Theme: More Models of Mathematics <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Text-Based Discussion – A Mathematician’s Lament</li> <li>▪ Model of Teaching – Exeter Academy</li> </ul>	Class Reflection Reading: A Mathematician’s Lament
Class 10: November 6, 2013	Theme: Constructivist Approach <ul style="list-style-type: none"> <li>▪ Student Presentations</li> <li>▪ Text-Based Discussion – Constructivist Approach in Mathematics</li> <li>▪ How to Shrink It?</li> <li>▪ Operations with Integers – The Chef’s Story</li> </ul>	Class Reflection Reading: Constructivist Approach in Mathematics
Class 9: November 13, 2013	Theme: Debate – Models of Mathematics Education <ul style="list-style-type: none"> <li>▪ Debate Preparation</li> <li>▪ In-Class Debate</li> </ul>	Class Reflection
Class 10: November 20, 2013	Theme: Newest Movement in U.S. Mathematics Education <ul style="list-style-type: none"> <li>▪ Student Presentation</li> <li>▪ Speaker: Department of Education, PARCC</li> </ul>	Opinion Paper – Models of Mathematics Education

### Part III: Application of Mathematical Thinking Skills

Class 12: November 20, 2013	Student final project presentations	
Class 13: December 4, 2013	Student final project presentations	
Class 14: December 11, 2013	Student final project presentations Course Evaluation <a href="http://bit.ly/CCTEval">http://bit.ly/CCTEval</a>	Final project, written assignment and reflection due.

#### Grading System

Students will be assessed based on the following assignments:

##### Class Reflections (10 points each/ 100 points total)

Through reflecting on the mathematics and methods in each class, students will gain a deeper understanding of how they understand mathematics. The journal should be written as a weekly reflection of class activities. The journal should include your reaction to class activities and thoughts about your own understanding of the ideas presented.

##### Article/Problem Summary (25 points each/ 50 total points)

To become familiar a variety of problems and methods for solution, students will be responsible for both a written summary and an oral presentation of an article or problem of their choice from one of the on-line class resources. The written piece should summarize the article or problem as well as give a personal reflection as to why the article or problem was chosen and the student's view on the content. Students will be responsible for 2 article summaries throughout the semester.

##### Opinion Paper – Models of Mathematics Education (50 points)

Several models of mathematics education will be discussed in class. In this opinion essay, you will examine the models to answer the question “How should mathematical thinking be taught?” Although this is an opinion piece, be sure to use resources and research to support your opinion.

##### Mathematics Problem Presentation and Written Assignment (100 points)

The final presentation should be in the form of a lesson about a problem; students will present to the class about a specific situation in mathematics. Ideas for topics can be selected from one of the on-line class resources provided. In addition, if you have a topic in mind and need resources, please ask! I have a library of mathematics book available for use. The written portion of the Student Presentation includes a summary of your presentation and the types of mathematical thinking required for your problem.

### End of Course Reflection (50 points)

The end of course reflection should focus on the question “What are mathematical thinking skills and how are they developed?” This paper should include general reflections about class activities as a whole as well as your reflection about understanding mathematics thinking and how it developed throughout the course.

Your grade for the semester is based on the percentage of points that you earn. The total number of points possible is 350 points. The following are percentage thresholds for each letter grade:

A Range	A 95% A- 87.5%
B Range	B+ 80% B 72.5% B- 65%
C Range	C+ 57.5% C 50%

### **Resources for Math Problems**

Illustrative Mathematics

<http://www.illustrativemathematics.org/>

Mathematics Assessment Project/MARS

<http://map.mathshell.org/materials/index.php>

Linking Math with Art Through the Elements of Design

<http://www.share2learn.com/asilomar07packet.pdf>

Ohio Resource Center's Problem Corner

[http://www.ohiorc.org/for/math/problem\\_corner/](http://www.ohiorc.org/for/math/problem_corner/)

NRICH: Enriching Mathematics

<http://rich.maths.org/frontpage>

The Math Forum @ Drexel

<http://mathforum.org>

The Problem Site

<http://www.theproblemsite.com/problems/mathhs/>

Mathwire

<http://www.mathwire.com/problemsolving/probs.html>

Balanced Assessment

<http://balancedassessment.concord.org/>

National Council of Teachers of Mathematics - Illuminations

<http://illuminations.nctm.org>