

Title

Fostering Collaboration, Discussion, and Critical Thinking: Middle School Math (Grades 6-8)

Target Audience

This course is intended for Grades 6-8 pre-service and in-service teachers.

Course Description

Collaboration, communication, and critical thinking are essential in the mathematics classroom. This course presents proven strategies for incorporating critical thinking and cooperative learning into the mathematics curricula. Learners will analyze math lessons to identify these strategies so that they may use them in their own lessons. Learners will explore both software and Web activities specifically designed to support collaboration and problem solving in the classroom and then integrate these technology resources into their own curriculum.

As a final task, learners will develop math lessons that encourage higher-level thinking and discussion while also meeting the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics. This course requires learners to work with middle school students in order to complete some assignments.

Instructor/Facilitator

See instructor/facilitator sheet

Credits

To be determined by college or university

Learner Outcomes

Learners will:

- Understand how collaboration, communication, and critical thinking can increase student learning of mathematics.
- Be able to analyze math lessons to identify the critical-thinking skills and strategies developed.
- Be able to incorporate higher-level thinking questions into math discussions.
- Use technology to teach mathematics lessons incorporating collaboration, discussion, and critical thinking.
- Develop lessons incorporating features of successful collaborative learning and problem solving in context.

Outline of Content and Assignments

A summary of course content and assignments is outlined below. Details for each assignment, including locations of readings and Web resources, are in each part of the Course Content.

Part 1: Welcome to Collaboration, Discussion, and Critical Thinking

Learners will:

- Become familiar with the content, structure, and expectations of the course.



- Become familiar with TeacherLine tools used in the course.
- Reflect upon their own classroom practices and math lessons incorporating collaboration, discussion, and critical thinking.
- Communicate and discuss cooperative learning with online classmates after reading an article on cooperative learning.

Read

- "Part 1: Welcome to Collaboration, Discussion, and Critical Thinking!"
- "Cooperative Learning"

Take

- The *Course Pre-Evaluation Survey*, found in Announcements

Participate in the online discussion

- Introduce themselves in the "Virtual Cafe" discussion forum
- What are the benefits and/or challenges to cooperative learning? What have your experiences been?

Write in the Online Journal

- What are ways that you have incorporated collaboration, discussion, and critical thinking into your mathematics classroom? Have you used technology in any way to assist you in these lessons? How? What were the challenges? What were the successes?

Part 2: Thinking and Talking About Math

Learners will:

- Identify ways that communication in mathematics increases understanding.
- Reflect upon how students think critically in their own classroom.
- Identify critical-thinking skills and determine how they apply to mathematics.
- Determine ways to incorporate critical thinking into mathematics lessons.
- Analyze lessons and activities to determine the critical-thinking skills they teach.

Read

- "Part 2: Thinking and Talking About Math"
- "Beyond Numbers: Communicating in Math Class"
- "Critical Thinking: What It Is and Why It Counts" (pp 1-6)
- "Strategies for Teaching Critical Thinking"

Watch the videos

- "Math Talk in the Classroom"
- "Meeting the Standards"
- "Using Graphing Calculators"

Explore these Web resources

- NCTM Principles and Standards for School Mathematics – Communication
- NCTM Principles and Standards for School Mathematics – Communication Standard for Grades 6-8

Write in the Online Journal

- Think about the article, "*Beyond Numbers: Communicating in Math Class*" and the video "Math Talk in the Classroom." How could you facilitate the use of use communication in your own classroom to develop student understanding?

- Think about how you define critical thinking. How do you know when your students are thinking critically about an issue? What evidence of critical thinking can you find in your mathematics classroom?
- While reading the above article, pay close attention to the “hallmarks” of teaching critical thinking. Do you utilize any of these in your present teaching style? How could you implement these “hallmarks” in future math lessons?

Participate in the online discussions

- Go to the Discussion Board to share your thoughts on the article you just read, "Critical Thinking: What It Is and Why It Counts" (pages 1-6). How do the critical-thinking skills described in the article relate to Mathematics?
- How do the previous lessons develop critical-thinking skills through the use of collaboration and discussion? How were the critical-thinking goals you have for your students met?

Complete at least one of the activities

- New York Times Daily Lesson Plan - It's About Time!
- Fun with Probability! The Probable Pen in the Cereal Box
- The Cereal Box Problem: A Lesson in Expected Value
- Math Mysteries Online - Free Resource for Teachers to Use with Their Students

The following Web sites are additional recommended resources for learners to explore

- NCTM Position Statement - Teaching Mathematics in the Middle Grades
- NCTM Standards for School Mathematics

Part 3: Learning in Groups

Learners will:

- Reflect upon group learning in their own classrooms.
- Describe three grouping strategies, determine their differences, and identify how they can help achieve mathematical curriculum goals.
- Review a word problem for its effectiveness when solved in a student partnership vs. independently.
- Identify components of successful learning.
- Examine math lessons using Interactive Group Software.
- Determine the benefits of using technology for problem solving and group learning.

Read

- “Part 3: Learning in Groups”
- “Student Learning Groups That Really Work”
- “The Quiet Game”
- “Putting Cooperative Learning to the Test”

Watch the video

- “Interactive Group Software in the Math Classroom.”

Complete the following reflections in the Online Journal

- How do you feel about group learning in your math classroom?
- As you read the article (“*Student Learning Groups That Really Work*”), think about the differences between the three strategies and their effectiveness in the math classroom. How can these strategies help you achieve your math curriculum goals?
- Review the first word problem in Grade Seven Problems and then go to the Online Journal to record your reflections on the use of this problem by students in problem-solving partnerships.

- As you read the article (*“Putting Cooperative Learning to the Test”*), think about and record the defined key components of successful learning. Now, think about your own classroom. What are your own required components?
- When students work in teams to solve math problems, are they really learning? Why or why not? If you think they are, how can you be sure?
- Think about "The Quiet Game" and other word problem Web sites that you've explored as well as the software programs that you've seen in this section of the course. What are the benefits of using technology to teach cooperative learning and mathematical problem solving?

Explore the following Web site

- PrimeTime Math

The following Web sites are additional recommended resources for learners to explore

- Figure This!
- Ribbit's Math Adventures
- ABACUS International Math Challenge
- Fun with Numbers
- Numbers in Search of a Problem
- Math Mysteries
- Free Standing Structure

Part 4: Using the Web for Teamwork

Learners will:

- Analyze Internet lessons to determine the critical-thinking, collaborative, and math skills they teach.
- Learn about some characteristics of effective Web projects.
- Analyze and select a math Web project appropriate for developing student critical-thinking skills, collaboration, and discussion.
- Teach a Web lesson in his/her classroom.
- Write an analysis of the Web lesson.

Read

- “Part 4: Using the Web for Teamwork”
- “Implementing a Collaborative, Web-Based Project with Sixth-Grade Math Students”
- “Why WebQuests?”
- “Quality Assurance Criteria for Online Projects”
 - Read the section *Teaching and Learning Considerations*

Watch the video

- “Web Projects”

Write in the Online Journal

- In the video, how does the use of the Web enhance the project? How are students engaged in communication, critical thinking, and collaboration?
- As you read Implementing a Collaborative, Web-Based Project with 6th-Grade Math Students, determine what critical-thinking and math skills students would learn.
- How do WebQuests promote cooperative learning and group decision making? What critical-thinking skills were involved in Roller Coaster Madness? How can WebQuests help meet your math curriculum goals?
- How does UBUYACAR promote collaborative learning and group decision making? What critical-thinking skills are involved? How can problem-based learning activities help meet your mathematics curriculum goals?

Explore the following Web sites

- Roller Coaster Madness
- UBUYACAR

Participate in the online discussion

- What are the characteristics of effective math Web projects which incorporate discussion and critical thinking?

Examine 2-3 different Web projects from the sites provided and choose a project appropriate for their grade level and students, using their defined criteria

- Let's Make a Deal Math: The Study of Probability
- A Kid's Consumer Price Index (this is a PDF)
- E-Mail Math
- Invest Smart
- Noon Day Project
- How Fast is Too Fast?
- For Love of the Game?
- Look Who's Footing the Bill!
- MetricQuest
- Creative Construction
- The Titanic: What Can Numbers Tell Us About Her Fatal Voyage?
- Let's Have a Field Day
- Matrix of WebQuest Examples
- MetricQuest
- Global SchoolNet's Internet Project Registry
- Oz Projects

Teach the Web project

Write a brief overview of the Web lesson, answering the following questions in a 1-2 page document (lesson to be submitted to facilitator using email or the Digital Drop Box):

- What project did you choose?
- Which math standards did the project meet?
- What were the objectives?
- How did it go in your classroom? What went well? What parts need more attention next time?
- What higher-order thinking skills did you target in this project? How?
- How did you get your students "talking math"?
- What would you do differently next time?

The following Web sites are additional recommended resources for learners to explore

- WebQuest Page
- Filamentality
- MathNet 4 Kids
- Census Sense
- Technology Challenge Grants: WebQuests
- WebQuests
- Free Downloadable Demos

The following WalkThroughs (in PDF format) are provided as additional recommended resources for learners to explore:

- AppleWorks Charts & Graphs WalkThrough
- Microsoft Excel Charts & Graphs WalkThrough



- Graph Master A WalkThrough
- Graph Master B WalkThrough

Part 5: The Next Step

Learners will

- Create a technology lesson plan incorporating collaboration, discussion, and critical thinking to teach math standards.
- Teach and revise the lesson.
- Self-assess the lesson according to a rubric.
- Make recommendations to other learners by providing feedback about the critical-thinking skills developed in their lessons.

Read

- “Part 5: The Next Step”

Complete the Final Project (described in the next section) using the Technology Lesson Plan Rubric as a guide. Learners will submit their lessons to the facilitator using e-mail or the Digital Drop Box.

Participate in the online discussion

- Final Project Critical-Thinking Questions

Take the Course Post-Evaluation Survey, found in Announcements

Final Assignment

Learners will complete the final project as described:

Develop one technology-integrated lesson plan that addresses one topic in the math curriculum through the use of collaboration, discussion, and critical thinking. The lesson plan can incorporate preexisting Web projects and curriculum software programs (such as the programs described in Part 3.) The lesson plan should:

- Be one that you can use in your classroom right away, with technology presently available to you.
- Be based on the NCTM Communication Standard and math curriculum standards (NCTM or your district standards). The standards addressed by the lesson should be easily accomplished by your students and aligned with the technology used.
- Include clear and measurable objectives; a valid assessment; and a complete process. The overall objectives should be written in measurable terms, reflected in the lesson assessment, and clearly communicated to the students. The lesson procedure should provide a thorough explanation of the steps needed to accomplish the lesson and evaluate student understanding and mastery of concepts.
- Clearly address how you will implement group learning, and incorporate discussion and critical thinking. For instance, address the following questions for the groupwork: What strategy will you implement? How many groups of students will you create? How will you create the groups? How will your classroom be arranged? How will you allow for multiple learning styles?
- Contain an assessment which matches the learning objectives; clearly addresses specific, measurable, and attainable goals; and allows for multiple learning styles.
- Demonstrate use of resources from this course. For example, you might use a Web project from one of the recommended Web sites or a software program.

Once you have created your lesson plan, teach it to some students and revise your description accordingly. You should self-assess your lesson plan before submitting it, using the rubric provided as a guide. Make sure that you include all Web site addresses and software information as well as any other resources your lesson plan incorporates. The description of your lesson plan should be created in a word processing program.

Please submit your project to the facilitator using e-mail or the Digital Drop Box.

Technology Lesson Plan Rubric for Final Project

To what extent...	Extensively	Somewhat	Minimally
Is the overall objective: <ul style="list-style-type: none"> written in measurable terms? reflected in the lesson assessment? clearly communicated to students? 			
Are the standards addressed by the lesson: <ul style="list-style-type: none"> accomplished by the students? aligned with the technology used? 			
Do the assessments: <ul style="list-style-type: none"> match the learning objectives? clearly address specific, measurable, and attainable goals? allow for multiple learning styles? 			
Are the materials, preparations, and resources: <ul style="list-style-type: none"> adequate for the needs of the lesson plan? 			
Does the procedure: <ul style="list-style-type: none"> engage/excite students about the learning ahead? provide a thorough explanation of the steps needed to accomplish the lesson? address the objectives stated? include group learning? incorporate critical-thinking skills? integrate the technology into the lesson? evaluate student understanding and mastery of concepts? 			

Schedule

This course is scheduled to take approximately 15-20 hours to complete readings, activities, video, assignments, reflections and a final project.

Requirements

Learners are expected to:

- Complete all assignments
- Participate in all discussion boards

Facilitators are expected to:

- Provide feedback to learners
- Participate in discussions to keep them moving forward
- Provide assistance to learners who need it

Evaluation

Pass/fail upon satisfactory completion of assignments and discussion board participation

Materials (hardware, software, plug-ins)

Technical Requirements

- Word processor
- Internet service provider
- Email

Academic Dishonesty Policy

To be inserted by university institution only