Title

Fostering Cooperative Learning, Discussion, and Critical Thinking in Elementary Math (Grades 2-5)

Target Audience

This course is intended for pre-service and in-service 2-5 teachers.

Course Description

This course presents model elementary math lessons and activities which incorporate cooperative learning, critical thinking, and problem solving enhanced by today's classroom technology. Learners will explore software and Web activities specifically designed to support collaboration and problem solving within the math curriculum, and help students meet the National Council of Teachers of Mathematics (NCTM) Principles and Standards. The NCTM Principles and Standards for School Mathematics state that "communication is an essential part of mathematics and mathematics education." Activities will be explored that help students organize and consolidate their thinking, communicate their ideas clearly to others, analyze and evaluate the ideas of others, and use the language of mathematics to precisely express mathematical ideas. At the end of the course, learners will develop one technology-integrated lesson plan ready for immediate implementation that addresses one topic in the math curriculum through the use of teamwork, discussion, and critical thinking.

Instructor/Facilitator

See instructor/facilitator sheet

Credits

To be determined by college or university

Goals

By the end of this course, learners will:

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

Outline of Assignments

A summary of course content and assignments is outlined below:

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

The learners will:

- Become familiar with the content, structure, and expectations of the course and the TeacherLine tools used in the course.
- Reflect on classroom practices and math lessons incorporating teamwork, discussion, and critical thinking.
- Discuss cooperative learning with online classmates.

The learners will:

Read
- "Part 1: Welcome to Teamwork, Discussion, and Critical Thinking!"
- The documents in Course Information
- "Cooperative Learning," by David A. Dockterman, Ed.D.

Watch the video
- "Using Elementary Graphing Programs"

Take the Course Pre-Evaluation Survey (#5a)

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

Participate in the online discussion
- What are the benefits and/or challenges to cooperative learning?
- What have your experiences been?

Part 2: Thinking and Talking About Math

The learners will:

- Reflect on how students think critically in the classroom
- Identify the critical-thinking skills and determine how they apply to mathematics
- Determine ways to incorporate critical thinking into mathematics lessons
- Analyze the relationship between critical thinking and communication

Read
- "Part 2: Thinking and Talking About Math"
- "Critical Thinking: What It Is and Why It Counts," by Peter Facione (pp. 1-6)
- "Math—Writing and Thinking"
- "Strategies for Teaching Critical Thinking," ERIC/AE Digest (Potts, 1994)

Watch videos
- "Math Talk in the Classroom"
- "Meeting the Standards"
- "Technology and Critical Thinking"

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Explore Web sites
- NCTM Standards for School Mathematics
- NCTM Principles and Standards for School Mathematics – Communication
- NCTM Principles and Standards for School Mathematics – Communication Standard for Grades PreK-2
- NCTM Principles and Standards for School Mathematics – Communication Standard for Grades 3-5

Respond in online journal
- 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?
- Do you utilize any of the "hallmarks" of teaching in your present teaching style? How would you implement these hallmarks in future math lessons? Write two specific examples of how you will utilize the hallmarks of teaching critical thinking in your next math lesson.

Participate in the online discussion
- What are your thoughts on "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?
- What is the relationship between critical thinking and communication in mathematics?

Part 3: Problem Solving and Cooperative Learning

The learners will:

- Identify components of successful learning
- Determine the critical-thinking skills that are essential for students to successfully solve mathematical story problems
- Examine lessons using Interactive Group Software and the Internet
- Determine the benefits of using technology for problem solving and cooperative learning
- Create a technology-based math activity which applies the three components of cooperative learning

Read
- "Part 3: Cooperative Learning and Technology"
- "Harvard Education Letter—Putting Cooperative Learning to the Test"

Watch the video
- "Interactive Group Software: *Fizz & Martina's Math Adventures*"

Explore and analyze either of the following Web activities
- Lemonade Stand
- Lemonade Stand Game

View the following Web sites
- Aunty Math
- Ides of March Challenge
- Fizz and Martina's Math Adventures

Create a technology-based math activity which applies the three components of cooperative learning: Shared Goal, Independence, and Individual Accountability. You may try adapting an activity originally intended for individual students as a cooperative activity. Write a description of your activity in paragraph format, answering the following questions:
- What activity did you choose? Describe the activity, providing any Web sites or software information.
- What are the objectives of the activity?

- How does each of the components of cooperative learning apply to the activity?
- How does technology help you in meeting the objectives?

Respond in the online journal
- How do you feel about cooperative learning in your math classroom?
- Record the defined key components of successful learning from the article you read.
- What are the required components of successful learning in your own classroom?
- What critical thinking skills are essential for students to be able to successfully solve story problems?

Participate in the online discussion
- What are the benefits of using technology to teach cooperative learning and mathematical problem solving?
- Post the description of your technology-based activity. Then, respond to at least one other participant. You might consider the following when responding: How do the three components of cooperative learning apply to the posted math activity? How does technology enhance the project? What additional recommendations would you make?

Optional activities
   Review the following Web sites
- Using a Computer to TV Connection
- TVAtor

Part 4: Using the Web for Teamwork

The learners will:

- Analyze Internet lessons to determine the higher-level thinking and math skills they teach.
- Create student discussion questions for Web projects that require higher-level thinking skills.
- Determine the characteristics of effective Web projects.
- Analyze and select Web projects appropriate for developing student critical-thinking skills.
- Teach a Web lesson.
- Write an analysis of the Web lesson.

The learners will:

Read
- "Part 4: Using the Web for Teamwork"
- "I Lost My Tooth"
- "Quality Assurance Criteria for Online Projects" (section titled "Teaching and Learning Consideration"
Watch the video
- "Web Projects"

Review 2-3 different Web projects from the sites below and choose a project appropriate for your grade level and students, using your defined criteria
- Global SchoolNet's Internet Project Registry
- Education Place Mathematics Projects
- MathMagic!
- Oz Projects
- Let's Make a Deal Math: The Study of Probability
- Solve It! (PDF taken from *Net Lessons*)

Teach the selected Web project class or a group of students. Write a brief overview of the Web lesson. In a 1-2 page document, answer the following questions, and then submit the article using the Student Drop Box.

- What project did you choose?
- What math standards were learned?
- What criteria did the project meet?
- How did it go in your classroom?
- What is it lacking?
- What higher-order thinking skills did you target in this project? (Give three examples of questions you asked your students.)
- How did you get your students "talking math"?

Respond in online journal

- In the video, what activities are students engaged in? How are students engaged in higher level thinking skills? How does the teacher use a weather site to teach probability?
- What critical thinking and math skills would students learn as they participate in "I Lost My Tooth"?
- From the examples you have seen, what do you think are characteristics of good Web projects to teach math through discussion and critical thinking?

Participate in the online discussion

What questions would you ask your students, as you look at the "Tooth Tally" data and graphs, to encourage higher-order thinking skills and promote discussions? Create two questions and post them. Be sure to read and think about what your classmates have written. Do you think their questions encourage critical-thinking and discussion?

Optional activities

- AppleWorks Charts & Graphs WalkThrough
- Microsoft Excel Charts & Graphs WalkThrough
- The Graph Club WalkThrough

Part 5: The Next Step

The learners will:

- Create a technology lesson plan incorporating teamwork, discussion, and critical thinking to teach math standards, and then teach and revise the lesson
- Self-assess the lesson using a rubric
- Make recommendations to other learners by providing feedback on critical-thinking questions they have created for math/technology lessons

Read

- "The Next Step"

Complete the Final Project (see Final Project section of this document.)

Participate in the online discussion

Final Project: Critical Thinking Questions - As you create your lesson, please post the critical-thinking questions you will ask your students. Post a reply to another learner—if possible, chose one who teaches at a similar grade level.

Take the *Course Post-Evaluation Survey* (#5b)

Final Project

Learners will complete the final project as follows:

Develop one technology-integrated lesson plan that addresses one topic in the math curriculum through the use of teamwork, discussion, and critical thinking. The lesson plan can incorporate pre-existing Web projects and curriculum software programs (such as the simulations 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 cooperative groups and incorporate discussion and critical thinking. For instance, address the following questions for cooperative groups: What cooperative 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 in your classroom 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.

Submit your project to the facilitator using the Student Drop Box.

Technology Lesson Plan Rubric for Final Project

To what extent...	Extensively	Somewhat	Minimally
Is the overall objective: • written in measurable terms? • reflected in the lesson assessment? • clearly communicated to students?			
Are the standards addressed by the lesson: • accomplished by the students? • aligned with the technology used?			
Does the assessment: • match the learning objectives? • clearly address specific, measurable, and attainable goals? • allow for multiple learning styles?			
Are the materials, preparations, and resources: • adequate for the needs of the lesson plan?			
Does the procedure: • engage/excite students about the learning ahead? • provide a thorough explanation of the steps needed to accomplish the lesson? • address the objectives stated? • include cooperative 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

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

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Academic Dishonesty Policy

To be inserted by university institution only