Title
Understanding Numbers and Operations: Addition and Subtraction in Grades PreK-3

Target Audience
This course is intended for pre-service and in-service teachers of primary grades PreK-3.

Prerequisites
To successfully participate in this course, you should be familiar with taking an online course or have completed the PBS “Practice Learning Online with TeacherLine” course.

Course Description
This course is designed to help elementary school educators better understand how students learn addition and subtraction, as well as the role and importance of computation strategies in mathematics. In this course, learners will learn more about students’ development of addition and subtraction concepts and strategies by studying NCTM standards and articles on learning with understanding; by reviewing various strategies and students’ use of strategies; by exploring lesson plans; and by examining Web resources. As a final task, learners will create and implement a lesson or series of lessons that integrate technology, manipulatives, and effective pedagogical strategies and that promote the vision of the NCTM Number and Operation Standards.

Instructor/Facilitator
See instructor/facilitator sheet

Credits
To be determined by college or university

Goals and Objectives
In this course, learners will:

• Develop an understanding of the student expectations specific to number and operations in grades PreK-3 from the NCTM Principles and Standards for School Mathematics.
• Understand the relationship of addition and subtraction computation and the connection to addition and subtraction mental arithmetic processes.
• Investigate and use multiple strategies for addition and subtraction computation.
• Integrate technology, manipulatives, and effective instructional strategies into classroom practices that promote the vision of the NCTM Number and Operations standards in teaching addition and subtraction.

Outline of Content and Assignments
This course consists of six sessions. In the sixth and final session, learners will complete the final project of the course.

Session 1: Understanding Numbers and Operations in Addition and Subtraction
Learners will:

• Define their professional goals and expectations for this course.
• Explain their prior knowledge and experiences about developing students’ understanding of whole numbers and the operations of addition and subtraction.
• Discuss balanced classroom instruction approaches.

Read
• “Number and Operations Standard,” from NCTM Principles and Standards for School Mathematics (2000)
• “Number and Operations Standards 3-5,” from NCTM Principles and Standards for School Mathematics (2000)
• Mathematics Education – Dialogues – Volume 3, Issue 1 Oct. 99 (choose two)
  • “What’s Basic in Math Education” by Martha Schwartz
  • “FORWARD, with Caution, to (the New) Basics” by Keith Devlin
  • “Basic Mathematics and the Public Perception” by Richard C. Cole
  • “The Basics: More Than Rote Learning of Basic Facts!” by Jacqueline Goodloe
  • “The Real Basics Are Children!” by Vicki Walker
• “Early Childhood Mathematics: Promoting Good Beginnings” from the NAEYC
• “What is the Role of Basic Skills in Mathematics Instruction?” from EdThoughts: What We Know About Mathematics Teaching and Learning

Participate in the online discussion
In the discussion forum, respond to the following questions:
• Introductions in the Virtual Café forum.
• What does classroom instruction look like if there is a balance between concept development and procedures in a standards-based curriculum?

Reflect
• Prior knowledge and expectations for the course.
• Respond to the following: Why do you think it is important for students in grades K-3 to develop understanding of whole numbers and the operations of addition and subtraction?

Additional Resources (not required)
• PBS Parents Child Development Tracker:
  o Mathematics from Age 4 to 5
  o Mathematics from Age 5 to 6
• PBS Parents Early Math:
  o PreK-K
  o Grades 1 & 2
• PBS Parents Grade By Grade Learning:
  o PreK
  o 1st Grade
  o 2nd Grade
  o 3rd Grade

Session 2: Conceptual Understanding of Addition and Subtraction

Learners will:

• Explain how to facilitate students' understanding of arithmetic concepts in the classroom.
• Discuss the role that manipulatives and technology play in students' conceptual understanding of addition and subtraction.
Read
• “Teaching Math in the Primary Grades: The Learning Trajectories Approach” from the NAEYC
• “What Role Does Active Hands-On Learning Play in Mathematics Instruction?” from Edthoughts: What We Know About Teaching and Learning

Review lessons
• Addition Stories
• Hidden Checkers
• Subtraction Stories

Explore Web sites
• Illuminations: Understanding a Child’s Development of Number Sense

Watch videos
• “Mathematics: Assessing Understanding, Part 1” excerpted from an ETA/Cuisenaire video
• “Mathematics with Manipulatives: Modeling Addends of ‘Six’,” excerpted from an ETA/Cuisenaire video

Examine Web-based interactives
• Electronic Abacus
• Base Blocks Addition
• Base Blocks Subtraction
• Number Line Arithmetic

Participate in the online discussion
In the discussion forum, respond to the following questions:
• How do students’ representations help them communicate their mathematical understanding?

Reflect
• Respond to the following: How might you help facilitate the students’ understanding (based on your observations of the students’ actions with the manipulatives in the video) and what would be your next steps for instruction?

Additional Resources (not required)
• Boohbah: Catching Apples
• Boohbah: Routine Math / Math Routines
• Sesame Street: Elmo and Zoe’s Magical Numbers Game
• Sesame Street: Egg Counting Elmo

Session 3: Addition Strategies

Learners will:
• Describe strategies used to encourage students in developing computational fluency and inventing algorithms.
• Discuss the role traditional algorithms play in understanding computation and the models that enable students to understand subtraction as an algorithm.
Read
- “What is the Role of Algorithms in Mathematics Instruction?” from EDThoughts: What We Know About Mathematics Teaching and Learning

Participate in the online discussion
In the discussion forum, respond to the following questions:
- What are some strategies that you can use in your classroom to encourage students in developing computational fluency and in inventing algorithms?
- What is the role traditional algorithms play in understanding of computation? Which model do you think best enables students to understand subtraction as an algorithm?

Investigate addition strategies
- Direct Modeling
- Counting On
- Double and Near Doubles
- Making Ten
- Splitting

Examine Web sites
- The How To of Algorithms
- Addition Algorithms

Review an addition activity
- Race to 50 Game

Additional Resources (not required)
- Cyberchase: Glowla’s Estimation Contraption

Session 4: Subtraction Strategies

Learners will:
- Reflect on strategies and activities that help students acquire the skills or number sense understanding that they need to use mental strategies.
- Develop a subtraction problem that can be solved using different strategies.
- Discuss how invented strategies facilitate student understanding of computation and the role of the classroom teaching in facilitating student learning.

Investigate subtraction strategies
- Taking Away
- Adding On
- Doubles and Near Doubles with Subtraction
- Flexible Equal Additions
- Adding Up
- Complement of 9
- Using Negative Numbers
- Survey of Mental Methods for Subtraction (choose three)
Complementary Addition
Subtraction in Stages
Rounding
Renaming Principle
Other Methods

- Breaking Apart/Separating
- Constant Difference

Reflect
- Respond to the following: Reflect on the types of strategies and/or activities you can use in your classroom to help students acquire the skills or understanding to use mental strategies. List one and how you would use it in your classroom to improve student learning.
- After reviewing lessons, student work, and the various strategies children may use to solve subtraction problems, develop a subtraction problem, and identify at least two strategies that students may use to solve each problem. Identify if using a manipulative would contribute to the students' understanding or use of the strategies.

Review lesson plans
- Illuminations Lesson Plan Series: Helping Students Understand Subtraction
- Separation Problem Lesson

Participate in the online discussion
In the discussion forum, respond to the following questions:
- How do invented strategies facilitate student understanding of computation, and what is the role the classroom teacher plays to facilitate student learning?

Additional Resources (not required)
- “Understanding and Recognizing: Math Disabilities” from PBS Parents

**Session 5: Exploring Classroom Ideas from the Web**

Learners will:
- Discuss your thoughts/concerns about the use of technology in implementing a lesson on addition or subtraction strategies.
- Assess lesson plans and web-based games for developing students’ addition and subtraction skills.

Read
- “Technology and Young Children” from the NAEYC
- "How to Develop a Lesson Plan" by ERIC Digests
- “Guidelines for Evaluating Web Sites” by ERIC Digests
- “Web Site Evaluation & Internet Lesson Plan Guide” by Kathy Schrock

Review lesson plans
- Modeling Subtraction
- Comparing Connecting Cubes
- Links Away
- PBS Teachers Web site

Explore, review, and evaluate Web resources
- PBS Parents: Early Math
- PBS KIDS Games: Math
Participate in the online discussion

In the discussion forum, respond to the following questions:

- What thoughts/concerns do you have about the use of technology in implementing a lesson on addition or subtraction strategies?
- Choose at least one lesson that you reviewed and identify what strategies that lesson would allow students to practice. Choose at least one web-based game and describe how you might use it with your students to teach addition or subtraction. Remember to include the URL for your chosen resources.

Additional Resources (not required)
- "National Educational Technology Standards for Students 2007"
- "NETS for Students 2007 Profiles"
- Math Steps Web site from Houghton Mifflin Harcourt’s Education Place

Session 6: Final Project

Learners will:

- Apply the content learned in the course to plan and implement classroom activities.
- Apply knowledge obtained in the course to critique classroom activities.
- Assess your learning in this course by comparing your prior knowledge and acquired knowledge.
- Analyze the learning experience in this course by reflecting about your professional goals and expectations.

Complete the following assignment and submit their final project to the facilitator.

- Create a lesson that integrate technology, manipulatives, and effective pedagogical strategies and that promote the vision of the NCTM Number and Operation standards.
- Implement the lesson, gather student work, identify in student papers three different strategies or error patterns, and reflect on students’ understanding of addition or subtraction.
- Write a 2-3 page paper that describes the strategies that students may use in the lesson. Include the results of using the lesson in the classroom, observations of students, student work samples, students’ comments on the lesson, and assessments. Also include comments on changes you would make for future lessons.
- Post the paper on the discussion board. Review papers from other learners and provide feedback, focusing on suggestions for adaptations, alternatives, or improvements, and remediation or extension activities.
- Submit the lesson plan, reflection paper, and optional student work to the facilitator.

Reflect

- Acquired Knowledge
- Professional Goals and Expectations

Schedule

This course is scheduled to take approximately 30 hours to complete readings, activities, video, assignments, reflections, and a final project.

Requirements

Learners are expected to:

- Complete all assignments.
- Maintain an online journal.
• Participate and actively engage in discussions with fellow learners while contributing to the social construction of knowledge.
• Be self-directed and self-motivated.
• Ask for assistance when they need it.

**Materials** (hardware, software, plug-ins)

**Technical Requirements**
• Word processor
• Internet service provider
• E-mail

**Academic Dishonesty Policy**
To be inserted by university institution only

**Evaluation**
This course is evaluated on a letter grade basis, and may be available for graduate credit. See graduate credit details pertaining to specific graduate credit institutions.