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:

Read

- "K-4 Standard 7: Concepts of Whole Number Operations," from NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989)
- "Number and Operations Standard," from NCTM *Principles and Standards for School Mathematics* (2000)
- Number and Operations Standard PreK-2," 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
- "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

- What are the challenges you have found in teaching addition and subtraction computation skills in grades K-3? Give examples to support your response.
- What does classroom instruction look like if there is a balance between concept development and procedures in a standards-based curriculum? Follow the discussion board conversations and comment on the connections between your beliefs and experiences and those of fellow learners.
- Complete any online journal assignments

Session 2: Conceptual Understanding of Addition and Subtraction

Learners will:

Read

- "Teaching Mathematics for Learning with Understanding in the Primary Grades" by Thomas P.Carpenter et al. A paper presented at the Annual Meeting of the American Educational Research Association, 5-8 April 1994.
- "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," excerpted from an ETA/Cuisenaire video
- "Mathematics with Manipulatives: Six Models," excerpted from an ETA/Cuisenaire video

Examine technology enhancements for lessons

- Abacus
- Base Block Addition
- Base Block Subtraction
- Base Ten Blocks
- Counting Fun
- Number Line Arithmetic

Participate in the online discussion

After completing the review of the lessons, videos, and interactives, learners will go to the discussion board and post their response to the following questions:

- What is your belief about what fosters students' conceptual understanding of addition and subtraction, and what role manipulatives and technology play in students' understanding?
- How do students' representations help them communicate their mathematical understanding?

Check in on the discussion board conversation and comment on observations made by other learners.

Session 3: Addition Strategies

Learners will:

Read

- "K-4 Standard 8 – Whole Number Computation," from NCTM *Curriculum and Evaluation Standards* (1989)
- "Developing Computational Fluency with Whole Numbers in the Elementary Grades," by Susan Jo Russell in New England Mathematics Journal XXXII, Issue 2
- "What is the Role of Algorithms in Mathematics Instruction?" from *EDThoughts: What We Know About Mathematics Teaching and Learning*
- "What Criteria for Student-Invented Algorithms?" by Patricia F. Campbell, Thomas E. Rowan, Anna R. Suarez. From Chapter 6 in NCTM 1998 *Yearbook: The Teaching and Learning of Algorithms in School Mathematics.*

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?

Check in on the conversation and comment on thoughts of other learners.

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

Session 4: Subtraction Strategies

Learners will:

Explore subtraction strategies
- Direct Modeling
- Doubles and Near Doubles
- Flexible Equal Additions
- Adding Up
- Complement of 9
- Using Negative Numbers

Record in their online journal
- Become familiar with subtraction strategies by reading student explanations and by using the strategies to solve several practice problems. Then, explain why the methods work and send explanations and problems to the facilitator for review.
- After reviewing standard subtraction algorithms, explain how manipulatives may be used to teach these algorithms.
- After reviewing lessons, student work, and the various strategies children may use to solve subtraction problems, develop an addition and a subtraction problem and identify at least two strategies that students may use to solve each problem.

Review student work for the following mental strategies
- Complementary Addition
- Subtraction in Stages
- Rounding
- Renaming Principle
- Other methods

Review Web sites
- Decomposition /Renaming
- Equal Addition

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

Participate in the online discussion

After completing the other assignments in this part, learners will go to the discussion board and respond to the following question:
- How do invented strategies facilitate student understanding of computation, and what is the role the classroom teacher plays to facilitate student learning?

Check in on the conversation and comment on observations of other learners about the role of the teacher.

Session 5: Exploring Classroom Ideas from the Web

Learners will:

Read
- “How to Develop a Lesson Plan”
- “Guidelines for Evaluating Web Sites”
- “Web Site Evaluation & Internet Lesson Plan Guide”

Record reflections in their online journal

- What are the main topics to include in lesson plans?
- What are the main criteria for evaluating a Web site?
- What thoughts and or concerns do you have about the use of technology in implementing a lesson on addition or subtraction strategies?

Review lesson plans

- Modeling Subtraction
- Comparing Connecting Cubes
- Links Away

Explore, review, and evaluate Web resources

- Math Steps: Grade 1: Addition and Subtraction Facts to 20
- Family Education Network - Line Jumper
- Party Planners- Grandma Thora Appreciation Day
- Lets Add

Participate in the online discussion

After completing the readings, review of lessons, and exploration of Web resources, go to the discussion board and complete the following assignments:

- Choose an addition/subtraction lesson and identify what strategies that lesson would allow students to practice.
- Choose one web resource and describe how you would use that resource in your classroom to teach addition or subtraction.

Check in on the discussion board conversation to review comments and share connections between your experiences and those of fellow learners.

Session 6: Final Project – Assessment

Learners will:

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, student 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.

Record reflections in their online journal

- 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 regularly in discussion boards

Materials (hardware, software, plug-ins)

Technical Requirements

- Word processor
- Internet service provider
- E-mail

Academic Dishonesty Policy

To be inserted by the university institution only

Evaluation

This course can be taken for graduate credit on a pass/fail basis, or for a letter grade and graduate credit. See graduate credit details pertaining to specific graduate credit institutions.

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