Title
Developing Algebraic Thinking in Grades 3-5

Target Audience
This course is intended for pre-service and in-service teachers, grades 3-5.

Prerequisites
To successfully participate and complete the assignments in this course, the learner must:
• Have past experience using the classroom computer.
• Have past experience working with the Internet.
• Be familiar with taking an online course or have completed the PBS “Practice Learning Online with TeacherLine” course.
• Be familiar with elementary grade 3-5 mathematical content.

Course Description
This course focuses on strategies for incorporating algebra in the classroom. Learners will explore the algebraic content present in the activities they currently use with students, and develop ways to encourage students to think algebraically. Learners will solve mathematical problems in order to better understand patterns, analyze situations using algebra, and practice representing relationships with mathematical models. As part of the course assignments, learners will practice their newly developed strategies on 3-5 grade students, monitoring their learning process, and assessing their understanding of algebra.

This course is aligned with the recommended standards of the National Council of Teachers of Mathematics (NCTM). By analyzing these standards and principles, learners will have a good understanding of what third, fourth, and fifth graders need to learn to prepare for more advanced algebra in middle school. As a final project, learners create a sequence of three problems whose use in the classroom will help students develop their algebraic thinking.

Instructor/Facilitator
See instructor/facilitator sheet

Credits
To be determined by college or university

Goals
At the end of this course learners will:
• Gain a deeper understanding of the potential for algebraic thinking in many activities involving number sense in grades 3-5
• Experience listening with an analytical ear to children’s thinking to better assess what they do and do not know
• Learn strategies for bringing out algebraic thinking in the classroom
Outline of Content and Assignments

After previewing the course introductory information, learners will proceed to the Content section to complete the following six sessions, working through each part in order. In these sessions, they will solve mathematical problems that involve algebraic thinking. They will use that experience as the basis for understanding what students do and do not know about such problems, and for developing strategies that can lead them to further algebraic thinking. Learners will also read NCTM's Principles and Standards of School Mathematics in order to see how the kinds of thinking students are doing in grades 3-5 will help them think more algebraically in middle school. As a final task, they will generate and justify a sequence of problems that can help students develop ways of thinking algebraically.

Session 1: Orientation

By the end of this session learners will be able to:
- Define your professional goals and expectations for this course in your online journal.
- Explain previous knowledge about developing algebraic thinking in grades 3-5.
- Read current research related to algebraic thinking in the upper elementary grades.

Read
- “Building a Foundation for Learning Algebra in the Elementary Grades”

Write in online journal
- Reflect on expectations for the course.
- Reflect on prior knowledge.

Participate in an online discussion
- Introduce themselves to other learners.

Session 2: Getting Started with Patterns and Relations

The standards emphasize the role of patterns as a basic foundation for mathematics. Without patterns, there would be no mathematics; even the simplest mathematical activity, counting, relies on finding and extending a pattern. This session examines patterns of multiples and challenges learners to think about more than one multiples pattern at once.

By the end of this session learners will be able to:
- Identify and reason about patterns of multiples;
- Create appropriate problems about patterns of multiples to pose to students.

Read
- National Council of Teachers of Mathematics’ (NCTM) Principles and Standards for School Mathematics (PSSM 2000):
  - “General standards on algebra—sections on patterns in the number system; finding and generalizing patterns”
  - “Grade 3-5 standards—section on patterns, relationships, and functions” (pp. 158-163).

Complete activity
- Solve Mystery Multiples Problems
- View Mystery Multiples Applet
- Create three Mystery Multiples Problems to use with students.
- Implement multiples problems with students by Session 4.
Write in online journal
  • Solutions to mystery multiples problems.

Participate in an online discussion
  • Discuss working with patterns of multiples.

Session 3: Properties of Our Number System
By the end of this session learners will be able to:
  • Work with properties from our number system that can support algebraic reasoning.
  • Learn how the distributive property works by using an array model for multiplication.
  • Learn how to use "cluster problems" to help students use what they know about multiplication to do more complex problems.

Read
  • "Properties of Multiplication"
  • "Properties of the Number System."
  • Commentary

Complete activity
  • View "Matching Arrays" applet
  • Complete Cluster Problems Activity
  • Implement cluster problems with a group of students by Session 5

Write in online journal
  • Reflect on the cluster problems.

Participate in an online discussion
  • Discuss properties of our number system.

Session 4: Reflecting on Students' Ideas, 1 of 2
By the end of this session learners will be able to:
  • Identify a range of strategies students can use in working on Mystery Multiples Problems;
  • Observe and critique the role of the teachers' questions in supporting students' algebraic thinking;
  • Consider the role of questioning in their practice.

View video
  • “Array Cards”

Participate in online discussions
  • Reflecting on students' ideas, part 1, Mystery Multiples Problems
  • Reflecting on students' ideas, Part 1, Array Cards

Session 5: Reflecting on Students' Ideas, 2 of 2
By the end of this session learners will be able to:
  • Observe and critique a teacher's strategy for determining the depth of students' understanding
  • Apply these insights to their own practice by comparing their approach to the teacher's approach in the video.

View video
Session 6: Working With Variables and Planning an Activity Sequence

By the end of this session learners will be able to:

- Explore how algebraic thinking is presented on state assessments;
- See an example of the ways students in grade 3 think about variables;
- Create and justify a sequence of problems to support students' learning about algebraic thinking.
- Assess your learning in this course by comparing your prior knowledge and acquired knowledge in your online journal.
- Analyze the learning experience in this course by reflecting on your professional goals and expectations in your online journal.

Read

- “Algebra in the Early Grades”
- Algebraic Problems on State Assessments

Participate in an online discussion

- Discuss algebraic knowledge used in solving the Piggy Bank Problem

Complete assignment

- Final Project: design a series of problems for a Teacher's Guide on algebraic thinking in grades 3-5.

Write in online journal

- Assess learning by comparing prior knowledge and acquired knowledge.
- Reflect on professional goals and expectations.

Schedule

It will take about 30 hours to complete this course. The number of hours identified for each course reflects time spent online, but does not reflect the total time spent completing offline coursework and assignments. All learners are different and learners will likely spend double the indicated number of hours completing all coursework depending on learning styles and work habits.

Requirements

Learners are expected to:

- Complete all assignments.
- 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.