

## Title

Rational Numbers, Fractions, Decimals, and Percents in Grades 5-8

## Target Audience

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

## Course Description

This course is designed to give middle school educators new strategies for teaching the concepts of rational numbers. Learners will analyze sample problems in order to better understand how their students approach the study of fractions, decimals, and percents. Learners will learn common misconceptions that students have, such as viewing fractions as portions and not as quantities. Learners will read the NCTM Standards in order to be sure their students will meet expectations at the middle school level and that they will be ready to meet expectations when entering high school. As a final task, learners will create a rational number lesson plan that begins with a student assessment and includes the flexibility to address common weaknesses that may be diagnosed in the assessment.

## Facilitator

See instructor/facilitator sheet

## Credits

To be determined by college or university

## Goals and Objectives

Learners will gain:

- A deeper understanding of the underlying mathematics of rational numbers.
- Practice in understanding what middle school students commonly understand and misunderstand about fractions, decimals, and percents.
- Strategies to improve the way they teach fractions, decimals, and percents.

## Outline of Content and Assignments

After previewing the course introductory information (Overview, Goals, Session Summary, Assessment, and Competency Map), learners will proceed to the Content to complete the following six sessions, working through each in order. In these sessions, they will solve mathematical problems and then use that experience to reflect on the misconceptions these problems generate and discuss strategies for helping students overcome them. The last session provides instructions for the final project, which learners should complete and deliver as indicated. The sessions are as follows:

Session 1: Orientation

Session 2: Examining Fractions as Portions

Session 3: Exploring Fractions as Quantities

Session 4: Decimals and Percents



Session 5: Fraction-Decimal-Percent Connection

Session 6: Final Project

## Session 1: Orientation

Learners will:

Test their computers

- Install all required plug-ins to run PBS TeacherLine courses

Become familiar with the course Web site

- Download a copy of the learning log, used to describe how the math problems presented in this course were solved
- Open the learning log to get acquainted with the kinds of questions that learners will answer throughout the course

Read

- "Linear Frameworks" By Catherine Twomey Fosnot and Maarten Dolk (excerpted from *Young Mathematicians at Work: Constructing Fractions, Decimals, and Percents*).

Watch

- a short, informative video about preparing themselves to think like a learner as well as a teacher for this course
- "Teacher Reflections," to meet one teacher and learn about her experiences with students

Collaborate

- Introduce themselves on the discussion board
- Learn how to communicate by posting messages on the board

Respond in the Online Journal

- Expectations for the course
- Prior knowledge of the content

## Session 2: Examining fractions as portions

Learners will:

Read

- "The Math Congress." This article from *Young Mathematicians at Work: Constructing Fractions, Decimals, and Percents* describes a partitioning task and different ways used by two groups of students to solve the task.
- "Modeling Actions and Situations." This article from *Young Mathematicians at Work: Constructing Fractions, Decimals, and Percents* illustrates the difference between partitive division or fractions (a sharing model) and quotative division (measurement).

Analyze

- Student misconceptions with equal sizes of fractional parts
- Whole-Part-Fraction problems
- The Area and Length Models problem
- The Ohlsson Five-Quantity Method

View videos

- "Fraction Comparisons"



Record in their learning log

- After viewing the “Fraction Comparisons” video, learners will take notes and identify each instructional approach as *procedural* or *conceptual* and explain which approaches do more to show the students’ understanding of fractions.
- After reviewing the “Whole-Part-Fraction” problems, learners will respond to four questions focused on the learning of fractions.
- After reviewing the “Area and Length Models” problem, learners will write about the importance of recognizing alternate interpretations of area models for fractions.

Participate in the online discussion

- Upon completion of all the assignments and readings, learners are to go to the discussion board and share ideas regarding their view on using the “Ohlsson Five-Quantity Model” with middle school students.

### Session 3: Exploring Fractions as Quantities

Learners will:

Read

- “Understanding Fraction Amounts.” This article from *Making Meaning for Operations Casebook, Developing Mathematical Ideas: Number and Operations, Part 2* describes research about student use of fractional notation to understand fractions.

Complete activities

- “Fraction Strips”
- “Number Line.” This Web-based interactive presents a dynamic number line to be used to explore fractions.

View

- The “Fractions” video. This video presents a situation that can cause student misconceptions.

Record in their learning log

- After completing the math activities, learners will describe the benefits these activities may have on deepening students’ understanding of fractions.
- After watching the video, learners will write about student assumptions.

Participate in an online discussion

- After completing the readings, math activities, and learning log entries, learners will go to the discussion board and share ideas for when students ought to have an understanding of fraction notation based on the content of the session.

### Session 4: Decimals and Percents

Learner will:

Read

- “Generalising Whole Number Place Value Properties.” This article, from the *Teaching and Learning About Decimals* project at the University of Melbourne (Australia), describes some important concepts basic to decimals and the difficulties some students have with those concepts.
- “Unitising.” This article, also from the University of Melbourne, discusses the difficulty of unitizing.



Solve

- Two common problems that test students' understanding of decimals. These are:
  - The "Number Expansions" problem
  - The "Squares and Strips" problem

Participate in the online discussion

- After completing all readings and activities, learners will go to the discussion board and discuss student knowledge of percents and ways to modify or extend an activity to deepen student understanding of percents.

Session 5: Fraction-Decimal-Percent Connection

Learners will:

Read

- "The Decimal-Fraction Link." This article, from the *Teaching and Learning About Decimals* project at the University of Melbourne (Australia), describes the difficulties students have connecting decimal and fractional representations and ways in which the same cognitive difficulties in working with one representation can cause similar difficulties in working with the other representation.

Solve

- Converting among the forms (fractions-decimals-percents)
- "The Abacus" activity
- "Decimals to Fractions" problem

Record in their learning log

- After completing math activities, learners will describe methods for solving conversion problems and any insights gained into the process of making these conversions.
- Learners will write about bringing meaning to the conversion process for the learner and for students, and when to teach students about certain decimal and fraction equivalents.

Participate in the online discussion

- After completing all readings and activities, learners will go to the discussion board and share ideas for guiding or directing a classroom discussion focused on appropriate uses of fractions, decimals, or percents in the world.

Session 6: Final Project

Learners will:

Read

- *PSSM 2000 Number and Operations Standard, Grades 3-5*. This standard will help learners to understand what students in grades 3-5 are expected to understand about fractions, decimals, and percents.
- *PSSM 2000 Number and Operations Standard, Grades 6-8*. This standard will help learners to understand what students in grades 6-8 are expected to understand about fractions, decimals, and percents. Learners should think about the misunderstandings that students may have about rational numbers when transitioning between elementary school and middle school mathematics.



Complete

- Sample State Assessment Problems - “How Fractions, Decimals, and Percents Appear on State Assessments”

Participate in the online discussion

- After completing all readings and activities, learners will go to the discussion board and share ideas on various methods for solving a problem that is then shared with students.

**Final Project**

Learners will complete the following assignment and submit the project to the facilitator. Learners will write a short unit reviewing rational numbers that focuses on the number sense that students need to have before moving on to a unit where they are introduced to operations. (Learners should include notes for the teacher so that another teacher would be able to use this unit successfully) The unit will include:

- A pre- and post-test that can be used to determine students' weaknesses in their understandings of rational numbers, with notes about what wrong answers may indicate
- At least one review activity for each representation (fraction, decimal, and percent)
- At least one activity addressing equivalence and comparison among the representations
- Notes about optional ways to address common weaknesses that may be diagnosed from the pre-test
- Plans for what to do with any student whose number sense is not strong enough to understand the operations work, even after the review activities

Submit the paper, lesson plan, and samples of student work (if possible) to the facilitator.

Record in their Online Journal

- Respond to the following question: What one or two ideas from this course will be of most use to you in your classroom and why?
- Goals Achieved and Acquired Knowledge

**Schedule**

This course is scheduled to take approximately 15 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 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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