Operations with Fractions - *An Exploratory Project*

The goal of this project is to explore the questions:

What does it mean to understand *fraction addition and subtraction*?
What does it mean to understand *fraction multiplication*?
What does it mean to understand *fraction division*?

In working through this project you will have the opportunity to reflect on your own understanding of fractions. Part One of the project focuses on developing further your ideas about what students understand or should understand about fractions. Part Two of the project focuses on develop new ways of teaching for and assessing those understandings.

PART ONE: Developing an Understanding of Fractions

Section A: Your Understanding of Fractions

- Make up a story problem for $\frac{2}{5}+\frac{4}{5}$. Use your story problem and use pictures to explain clearly why it makes sense that the answer to fraction addition is $\frac{2+4}{5}$.
- Make up a story problem for $\frac{2}{3}\times\frac{3}{4}$. Use your story problem and use pictures to explain clearly why it makes sense that the answer to fraction multiplication is $\frac{2\bullet 3}{3\bullet 4}$.
- Make up a story problem for $2\div\frac{1}{4}$. Use your story problem and use pictures to explain clearly why it makes sense that the answer to fraction division is $2\times\frac{4}{1}$.

- For each of the problems above:
  - Highlight the particular mathematical language used when describing each situation.
  - Explain how aspects of each of the problems above are related to (1) the fractions and (2) the operation (addition/multiplication/division).

Section B: Students' Understanding of Operations with Fractions

- Give an example of a mathematics problem that demands a deep understanding of one of the fraction operations. Explain why this problem demands a deep understanding.

- Choose to work through *one* of the activities below – either activity (a) focused on sample student work or activity (b) focused on two short interviews with students:

    a. Consider the examples of student work posted at the following web address: http://www.math.vt.edu/people/hagen/Numbers/index.html. For each student whose work is shown, answer the following questions:
        - What does the student appear to understand, or not understand, about fractions in general, and about the fraction operation they are working with in particular?
        - How do you know?

    b. Watch the videos found at the URLs listed below:
    Fraction addition: http://www.sci.sdsu.edu/CRMSE/IMAP/vid_frac_add.html
    Fraction division: http://www.sci.sdsu.edu/CRMSE/IMAP/vid_frac_div.html

        - For each video, describe the nature of the students' understanding of fraction addition or fraction division.

Section C: Storytelling

- Write a 2-page short story in which one or more students appear to be exhibiting a deep understanding of one of the fraction operations (fraction addition and subtraction/fraction multiplication/fraction division). The story could be written from the perspective of a student or a teacher or an objective narrator, but should clearly exemplify what it would mean for a student to exhibit a deep understanding of fractions in the classroom.

- Write a 2-page short story in which one or more students do *not* appear to exhibit deep understandings of one of the fraction operations.

PART TWO: Creating Lessons and Assessments

Section A: Lesson Plans

Drawing upon the first part of this project and the work you've done throughout the course, you will create a three-day lesson plan focused on fractions. Guidelines for the lesson plans are as follows:

- Each day must focus on a different operation with fractions – in other words, you will have one lesson on fraction addition and/or subtraction, one lesson on fraction multiplication, and one lesson focused on fraction division.

- Each day should draw on different resources as follows:
  - One lesson should include some problems, activities, or explorations we *have* focused on in class
  - One lesson should include some problems, activities or explorations from class that we *have not* focused on (i.e., problems from the curriculum books that we have not covered or problems in the activities file not assigned)
  - One lesson should utilize an entire lesson or parts of several lessons from the Virginia Department of Education's compilation of lesson plans titled "Thinking Rationally about Fractions, Decimals, and Percents." Feel free to modify as you see fit, but please make sure to reference the original lesson(s). This document can be accessed at the following URL: (www.pen.k12.va.us/VDOE/Instruction/Math/FractionsDecimalsPercent.pdf).

- For each lesson you create (whether it be from class activities or the DOE lesson plans), include *at least* the following components:
  - A description of lesson goals and objectives for each day
  - A set of problems or activities to use with students each day
  - A teacher's guide component, including things such as discussion questions, a rationale for particular problems and activities, and written up answers (or possible answers) for each problem or activity

Section B: Assessment Tools

- Then create some type of assessment tool to go along with your lessons. Be as creative as you'd like!