Math Literacy News

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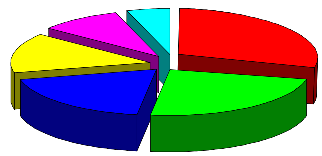
FRACTIONS

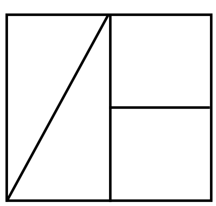


Fractions are a difficult concept for many adult learners. Too often, students rely on memorization and drill to "master" this area only to have to relearn procedures over and over.

Two concepts are necessary for an understanding of fractions:

- *The correct number of parts must make up the whole.*
- *Each part must be equal or a "fair share."*

Parts do not have to be the same shape; congruence is not necessary. Seldom are examples given where the parts are NOT the same shape, yet it is important to understand this concept. For example, this figure shows fourths:



There are many other fraction concepts that are often ignored in the adult education classroom. The time spent discussing and exploring these concepts will help the student "make sense" of fractions.

The size of the fraction piece increases inversely to the number of pieces.

While this may seem an obvious concept, for many learners the idea that five is greater than four, yet 1/5 is LESS than 1/4, is problematic at best. It helps to have students verbalize or write this concept. Posing a question such as "How can one seventh be larger than one eighth if EIGHT is larger than SEVEN?" forces the student to make sense of this apparent contradiction.

The fraction value changes as the "whole" changes.

By posing the question, "How can I have one eighth of a pizza and John have one fourth of a pizza and yet I have MORE than John?" the teacher forces the student to make sense of the fact that a larger pizza can result in more pizza with a smaller fraction.

Often the student is unclear what "whole" the teacher is referring to. When using fraction squares, fraction circles, cuisinnaire rods, tangrams, etc. the student can be directed to find fraction relationships with various pieces as the "whole."

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There are three models for fractions: area, linear, and sets.

Too often we only use the area or region model for fraction exploration, and then expect the student to transfer the concepts to ratio and proportion. Rather than relying exclusively on a "circle" model, other manipulatives such as pattern blocks, geoboards, and grid paper provide more flexibility. Paper folding is another model for area. (It can also be used to model multiplication and division of fractions.)

Length or measurement models are similar to area models except lengths are compared instead of area. Manipulative versions offer much opportunity for trial-and-error exploration. Fraction strips are easily made versions of Cuisenaire rods and are ten strips of paper that are one unit, two units, three units, four units, five units, six units, seven units, eight units, nine units, and 10 units long. Different colors allow for comparison. The number line is a more sophisticated measurement model that can transfer to other mathematical concepts.

Finally, in set models, the whole is understood to be a set of objects and subsets of the whole make up fractional parts. Any type of counter can be used to show fractional parts of sets; however, if the counters are colored in two colors on opposite sides, then they can be easily flipped to change color and model various fractional parts of a whole set. By using fraction parts of sets such as "what is one fourth of twelve?" the student begins to see the relationships most often expected and used in everyday life.

Comparing fractions is often easier by using visual models than by rote learning of cross-multiplication and/or common denominators.

Cross multiplication can be used to compare fractions, but too often neither the students nor the teacher truly understands why it works, resulting in memorization for a short time. This skill often is applied incorrectly and needs to be learned again and again. Here are some alternatives that can result in a greater understanding of why one fraction is larger than another. These conceptual thought patterns can be introduced and explored before finding common denominators.

1. ***More of the same sized parts***: When the pieces are the same size, then we can compare the number of pieces to determine which is larger. For example, 1/4 is less than 3/4 because we have only one piece, not three, just as one apple is less than three apples.

2. ***Same number of parts but parts are different sizes:*** This is the case where the numerators are the same, but the denominators are different. 4/5 and 4/9 can be compared by thinking about the relative size of the pieces.

3. ***More or less than one half or one whole***: When comparing 7/12 and 3/8, one can determine whether or not a fraction is greater or less than one half. One half of twelfths would be six, so 7/12 is greater than one half. One half of eighths would be four, so 3/8 is LESS than one half. These benchmark numbers of one half and one are useful for making size judgments with fractions.

4. ***Closer to one half or one whole***: When comparing 11/12 and 13/14, students can determine that since the 14^{ths} are smaller, and it only takes one more piece to get to one, that 13/14 will be larger than 11/12. Similarly, 5/8 is smaller than 4/6 since it is only one-eighth more than a half, while 4/6 is one-sixth more than a half. Other benchmark fractions such as 1/4, 1/3, 1/2, 2/3, 3/4, and 1 can be used to compare fractions.

Again, it is important to ask students to give reasons for their choices when comparing fractions. Class time devoted to discussions of methods used to determine relative sizes is time well spent.

The above concepts need to be explored before any paper and pencil methods are used. Many adult education students have never spent time with these concepts, so the time spent will make computation and problem solving with fractions more understandable.

Fraction activities that foster understanding are not difficult to develop. Some examples follow.

Activity 1:

Joan spends 1/2 of her income on food, 1/4 on clothing, 1/12 on entertainment, and saves $1200 per year. What is her yearly income?

Jane spends 1/2 of her income on food, 1/3 on clothing, 1/12 on entertainment, and saves $1200 per year. What changed for Jane? Is her income more or less than Joan's? Draw diagram to help explain. Find Jane's income.

Activity 2:

Determine which fraction is larger. Use a diagram, or explain your reasoning in a sentence.

(1) a. 3/8 and 5/8
b. 4/5 and 1/5
c. 7/10 and 3/10

(2) a. 3/8 and 3/5
b. 4/5 and 4/7
c. 1/2 and 1/3

(3) a. 3/5 and 2/7
b. 2/3 and 1/5

(4) a. 5/6 and 7/8
b. 2/3 and 1/5

Activity 3:

Write out three ways to compare fractions. Give examples.

Activity 4:

Put these fractions on a number line:

13/10	3/4	3/5
10/13	1/9	-7/11

Activity 5:

Use manipulatives to model fractions. Compare sizes of pattern blocks or tangrams. If the large square of a tangram is the whole, determine what the other parts are. Make a chart. If the large triangle is the whole, determine what the other parts are. Make a chart. Compare the two charts. Using pattern blocks (eliminate the tan rhombus and orange square) make a chart if the whole is the green triangle, the yellow hexagon, the red trapezoid, and the blue rhombus.

Activity 6:

Fold paper to show multiplication and division of fractions. For example, fold a paper in half. Without opening it, fold it in half again (1/2 times 1/2). Predict what fractional part will result. Open and check. Take 1/2 of 1/4 by folding in half again. Predict what fractional part will result. Open and check. Students can find 1/3 of 1/2, 2/3 of 1/4, etc. by folding and coloring paper.

Manipulatives such as pattern blocks and tangrams are available through many companies such as:

Tricon Publishing
2150 Enterprise Drive
Mt. Pleasant, MI 48858
(888) 224-8053

Dale Seymour Publications
P.O. Box 10888
Palo Alto, CA 94303
(800) 872-1100

Numeracy Listserv

There have been many interesting discussions on the numeracy list about various topics. One recent topic was fractions and the necessity of working with them in a GED classroom. Myrna Manly, GED math test consultant and author of the GED MATH PROBLEM SOLVER, offered this perspective:

"Ron and Betsy and Nancy have obviously spent a lot of time struggling with the "Why Fractions?" question. It actually seems to be two separate but related questions - "Why fractions in GED Prep?" and "Why fractions in LIFE Prep?" I am only an authority on the first, although I have also struggled with the second.

"For the GED, fractions concepts are important for the reasons others of you have already mentioned. When we discussed the importance of fractions at the round table in San Diego, we focused on the wisdom of spending so much of the limited time we have with the students on becoming skilled at the manipulations. The few

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Numeracy Listserv (cont'd from page 3)

pure fraction problems that appear on the math tests can readily be answered using estimation. I think the GED students are better served if we spend more time on developing a sense of the size of fractions, establishing the basis for proportions by working with equivalent fractions, and then forming critical thinking skills by estimating answers to real situations involving fractions. The recent discussions about using manipulatives were excellent examples.

"With regard to the LIFE prep, I would like to just add a small challenge or two to spark the discussion. Do workers have to find the exact answer to "How many 1 and 1/2 foot pieces of wood I can get from a 16 foot board?" (Answer 10 and 2/3) or is it enough to say , "I can only get 10."

"Who can come up with an everyday situation that would require one to add 2/5 and 1/3? In other words, write an item that would be accepted on the GED Test."

Shortly after Myrna's message, Eileen Simmons from Philadelphia replied, "I couldn't agree with Myrna more. What is important in learning fractions is to understand them in terms of their relative size. One piece of research asked students to add 7/8 and 5/6 mentally and gave four choices: 12, 14, 26, and 2. Each choice was equally likely to be picked. One 1/4 of the students could estimate the answer. That is scary! And I think it happens because the focus on teaching fractions is how to get the answer, not on understanding the underlying concepts of fractions.... I am a firm believer in 'playing with fractions' using manipulatives. My students and teachers in my training workshops get a much clearer picture of fractions and their operation when we play. But really understanding comes for some only after much seat time playing with different manipulatives. All this is by way of saying—'Myrna, I agree with you as I usually do—You are right on. Keep up the good work."

Join the numeracy listserv and add your voice to the discussions!

The GED MATH PROBLEM SOLVER by Myrna Manly is available from Contemporary Books, Department S 92, 180 N. Michigan Avenue, Chicago, IL 60601. (800) 621-1918

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Share tips for teaching and concerns about adult education classrooms with concerned educators from around the world! Recent topics have included fractions, learning disabilities, and integers.