The Task Analysis Guide

Lower-Level Demands	Higher-Level Demands
Memorization • involve either reproducing previously learned facts, rules, formulae or definitions OR committing facts, rules, formulae or definitions to memory. • cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure. • are not ambiguous. Such tasks involve exact reproduction of previously-seen material and what is to be reproduced is clearly and directly stated. • have no connection to the concepts or meaning that underlie the facts, rules, formulae or definitions being learned or reproduced.	Procedures With Connections • focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas. • suggest pathways to follow (explicitly or implicitly) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts. • usually are represented in multiple ways (e.g., visual diagrams, manipulatives, symbols, problem situations). Making connections among multiple representations helps to develop meaning. • require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding.
Procedures Without Connections • are algorithmic. Use of the procedure is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task. • require limited cognitive demand for successful completion. There is little ambiguity about what needs to be done and how to do it. • have no connection to the concepts or meaning that underlie the procedure being used. • are focused on producing correct answers rather than developing mathematical understanding. • require no explanations or explanations that focuses solely on describing the procedure that was used.	Doing Mathematics • require complex and non-algorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instructions, or a worked-out example). • require students to explore and understand the nature of mathematical concepts, processes, or relationships. • demand self-monitoring or self-regulation of one's own cognitive processes. • require students to access relevant knowledge and experiences and make appropriate use of them in working through the task. • require students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions. • require considerable cognitive effort and may involve some level of anxiety for the student due to the unpredictable nature of the solution process required.

The Four Levels of Cognitive Demand of Multiplication of Fractions Tasks

Lower-Level Demands

Memorization

What is the rule for multiplying fractions?

Expected Student Response:

You multiply the numerator times the numerator and the denominator times the denominator.

OR

You multiply the two top numbers and then the two bottom numbers.

Procedures Without Connections

Multiply: $\frac{1}{6} \times \frac{1}{2}$

$\frac{2}{3} \times \frac{3}{4}$

$\frac{4}{9} \times \frac{3}{5}$

Expected Student Response:

$\frac{1}{6} \times \frac{1}{2} = \frac{1 \times 1}{6 \times 2} = \frac{1}{12}$

$\frac{2}{3} \times \frac{3}{4} = \frac{2 \times 3}{3 \times 4} = \frac{6}{12}$

$\frac{4}{9} \times \frac{3}{5} = \frac{4 \times 3}{9 \times 5} = \frac{12}{45}$

Higher-Level Demands

Procedures With Connections

Find 1/6 of 1/2. Use pattern blocks. Draw your answer and explain your solution.

Expected Student Response:

First you take half of the whole which would be one hexagon. Then you take one-sixth of the half. So I divided the hexagon into six pieces which would be six triangles. I only needed one-sixth so that would be one triangle. Then I needed to figure out what part of the two hexagons one triangle was and it was 1 out of 12. So 1/6 of 1/2 is 1/12.

Doing Mathematics

Create a real-world situation for the following problem: $\frac{2}{3} \times \frac{3}{4}$.

Solve the problem you have created without using the rule and explain your solution.

One Possible Student Response:

For lunch Mom gave me three-fourths of the pizza that we ordered. I could only finish two-thirds of what she gave me. How much of the whole pizza did I eat?

I drew a rectangle to show the whole pizza. Then I cut it into fourths and shaded three of them to show the part mom gave me. Since I only ate two thirds of what she gave me, that would be only two of the shaded sections.