Procedural Fluency Requires Conceptual Understanding

Students who understand why and how math works (conceptual understanding) coupled with understanding when, why, and how to apply mathematical procedures to solve problems (procedural fluency) are able to solve problems better (i.e., more efficiently, flexibly, and accurately), setting them up for immediate and long-term success.

When looking at a problem (like the ones below), Students with both conceptual understanding and procedural fluency…

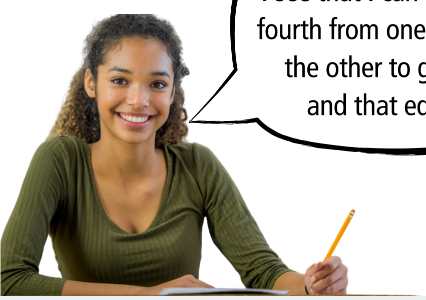
- Recognize there are options for how to approach the problem.
- Pause to decide on a 'good way' to solve a given problem.
- Select and effectively implement an efficient strategy or algorithm.
- Change to another option if the first strategy or algorithm isn't working out.
- Notice whether their answer is reasonable.

> *When procedures are connected with the underlying concepts, students have better retention of the procedures and are more able to apply them in new situations.*
>
> Fuson, Kalchman, and Bransford, 2005

Example #1: Adding Fractions

People without conceptual understanding commonly add numerators and denominators or add to get a fraction greater than 1 and regroup. Students who understand that fractions are parts of wholes have access to several efficient ways to solve this problem:

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



I see that I can move one-fourth from one number to the other to get $5 + 2\frac{1}{2}$ and that equals $7\frac{1}{2}$.

Since both numbers were $\frac{1}{4}$ away from the next numbers, I rounded up, added 5 and 3, then subtracted two-fourths to get $7\frac{1}{2}$.

I pictured a ruler. I added 2 to $4\frac{3}{4}$. That is $6\frac{3}{4}$. Then jumped up three-fourths to $7\frac{1}{2}$.

Example #2: Multiplying Two-Digit Numbers

People without conceptual understanding commonly stack and use the standard algorithm, sometimes losing track of place value. Students who understand that multiplication means equal groups or rows, have more efficient options.

$$6 \times 22$$

Idea #1:
22 can be decomposed into 20 + 2.

Solution process:
$(6 \times 20) + (6 \times 2) =$
$120 + 12 =$
132

Idea #2:
6 is 3 doubled.

Solution process:
$3 \times 22 = 66$
double 66 to get 132.

As educators, we need to support students to become confident decision makers as they engage in solving problems. Building conceptual understanding coupled with robust procedural fluency, including understanding why algorithms work, knowing when they are appropriate to use, and being able to apply them efficiently, flexibly, and accurately, provides the foundation students need each year to continue to develop their mathematics proficiency.

NCTM®

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NCTM Position on Procedural Fluency

Procedural fluency is an essential component of equitable teaching and is necessary to developing mathematical proficiency and mathematical agency. Each and every student must have access to teaching that connects concepts to procedures, explicitly develops a reasonable repertoire of strategies and algorithms, provides substantial opportunities for students to learn to choose from among the strategies and algorithms in their repertoire, and implements assessment practices that attend to all components of fluency.

Procedural Fluency in Mathematics
National Council of Teachers of Mathematics

Resources and References

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