

Fractions Learning Pathways Evidence

Use of Fractions Learning Pathways tasks can increase student learning and close gaps for Junior and Intermediate students

November 2015

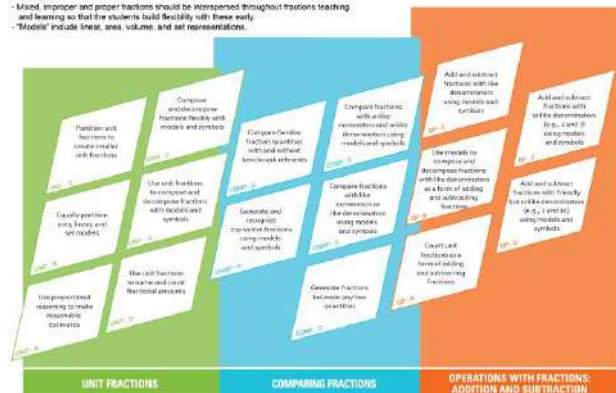
FRACTIONS LEARNING PATHWAYS FOR JUNIOR, INTERMEDIATE, AND SENIOR STUDENTS

The Fractions Learning Pathways (FLP) is an online interactive planning tool which provides educators with a research informed framework for teaching fractions. It includes a range of field-tested tasks (grades 3-10) that have proven to be effective in Ontario schools. The tasks are mapped to specific fractions concepts and can be modified and/or adjusted to fit teacher and student needs. Video and photos are also included to bring the learning to life. The FLP planning tool also includes one page summaries of key fractions math ideas as well as anticipation guides that feature Ontario students' thinking.

The Fractions Learning Pathways is available to educators at www.fractionslearningpathways.ca

Fractions Learning Pathways

Please Note:
- Mixed, improper and proper fractions should be incorporated throughout fractions teaching and learning so that the students build flexibility with these early.
- Models include linear, area, volume, and set representations.



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Fractions Learning Pathways are inspired by Dr. Cathy Bruce's work, based on international and Ontario classroom research, and informed by feedback from classroom teachers and student thinking.

WHO MAY BENEFIT FROM THE USE OF THIS RESOURCE?

Educators can use the FLP as a planning tool to ensure that fractions tasks focus on key learning and are aligned with student needs. The FLP explicitly identifies foundational concepts within each cluster and each task is built around proven high-yield instructional practices, to deepen student understanding.

HOW DID TEACHERS BENEFIT FROM USING FLP IN THEIR CLASSROOMS?

Teachers benefit from having a solid understanding of the multiple ways that fractions are used: to represent a part-whole relationship, to represent a part-part relationship, as a distance from 0, as an operator (to shrink or enlarge a quantity) and/or as a quotient (the numerator is divided by the denominator).

The trajectory really helped me to better distinguish between the many fractions concepts, to determine how various concepts supported and connected to others. Using the trajectory as a tool, I was better equipped to plan next steps (or to back up a bit) for my students. Examining the trajectory made it very evident the extensive background needed in order to perform operations with fractions. (Teacher, 2014)

WHAT EVIDENCE DO WE HAVE OF THE EFFECTIVENESS OF USING THE FLP?

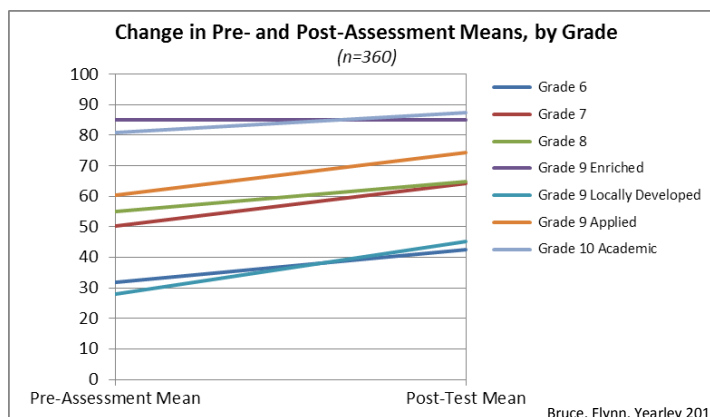
Four years of research in Ontario classrooms has clearly demonstrated that use of high quality fractions teaching and learning resources improves student achievement. Furthermore, use of these resources within a collaborative action research project leads to increased teacher efficacy and math knowledge for teaching.

Punctuated instruction (incorporating fractions learning in smaller chunks of time such as two or three days every two or three weeks) allowed students and teachers to connect fractions learning across the strands.

The biggest thing for me is peppering the fractions throughout the last three months. It has been awesome. I can see that the students are more flexible and it is way less stressful for me. I am looking forward to continuing to use some of the stuff we learned in the coming months. (Teacher, 2015)

FLP for All Students

In grades 3 through 10, the majority of students demonstrated improved fractions understanding. For example, in the 2014-2015 Collaborative Action Research Study, students ($n=360$) in grades 6 through 9 Applied mathematics across three district school boards had significant increases in their pre-assessment to post-assessment results.

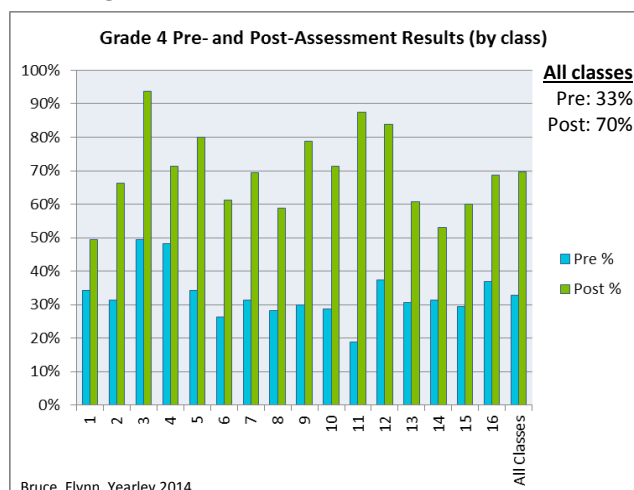


Teachers used tasks from the FLP across multiple grades, in particular those involving counting by unit fractions and composing/decomposing amounts. These results demonstrate that the gap in understanding can be closed at any grade.

Across school boards, schools and classrooms, very little difference was noticed in the needs of students with respect to fractions learning, in spite of perceived differences by school and board staff (see Digital Paper for more information). All students consistently demonstrated a lack of understanding of unit fractions and a limited use of number lines and rectangles to represent fractions.

"Adding, subtracting, multiplication and division [fractions] becomes intuitive when students master unit fractions and composing fractions." (Teacher, 2014)

One school board involved all grade four teachers in fractions professional learning which focused on building the foundational knowledge of students. Sixteen teachers administered the pre-and post-assessments, with the following results.



FLP for Students with Learning Disabilities

Students with learning disabilities were included in the research activities, including tasks and the pre- and post-assessments. Students were able to engage in the tasks given the multiple entry points and the hands-on, spatial aspects.

My key learning from the project was about the power of targeting select students by identifying gaps and intentionally selecting learning materials from the pathway to support growth in these areas. I learned that by taking even a few minutes regularly over time we can impact students' comfort level and facility with fractions. (Teacher, 2014)

WHAT ARE EIGHT CRITICAL COMPONENTS OF FRACTIONS TEACHING AND LEARNING?

Improved fractions learning can begin with increased precision in teaching. The following are examples of precision which teachers have reported as having high-impact on student understanding of fractions:

- Emphasize unit fractions**
 Unit fractions (i.e., a fraction with a numerator of 1) are foundational to fractions understanding. This understanding is built through tasks such as counting by unit fractions and composing/decomposing fractions.
- Use number lines and rectangles/ribbons**
 Linear models allow students to make sense of and solve mathematical tasks as well as explain their thinking. These models have longevity across grades, mathematical number systems, and contexts.
- Have students partition figures and paper fold**
 The action of partitioning figures, through drawing and paper folding, supports students in understanding the role of the denominator, and the relationship between unit fractions and the whole.
- Read a fraction as a number not two numbers**
 A fraction is a number and should be read as such. For example, $\frac{2}{3}$ is 'two thirds' (not 'two over three').
- Punctuate instruction**
 Allocating time differently, rather than allocating more time, benefited students. A few days every few weeks on fraction concepts and skills, resulted in enhanced student understanding.
- Find a common unit rather than a common denominator**
 If the denominator is considered the fractional unit, then 'finding a common denominator' is more aptly named 'finding a common unit'. This terminology allows students to connect to their knowledge of unit in other contexts, such as place value, money and measurement.
- Mix proper and improper fractions in tasks**
 Improper fractions include the whole. Mixing the two reduces the incorrect generalizations that students may make about fractions when only presented with proper fractions.
- Annotate fractions to clarify**
 A single representation can be interpreted multiple ways. Adding information about the characteristics (such as shaded equal regions for the numerator) ensures that students are attending to the same characteristics.