

# Dynamic Engagement with Fractions using GeoGebra

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## INTRODUCTION

The purpose of this article is to share and describe a number of GeoGebra applets that have specifically been designed to allow students to engage with fractions in a dynamic way. The applets can be used to guide students in their conceptual understanding of fractions as they create and compare visual representations of fractions. Both the bar model and the circular model are used so that students become familiar with different representations of fractions early on.

## BAR MODEL

In the basic setting of the bar model applet (Figure 1), three rectangular bars are shown. The purpose of this basic setting is to compare and contrast unit fractions. The top bar is fixed and is provided for illustrative purposes. For the other two bars the denominator can be changed by using the sliders. The denominator represents the number of equal parts the rectangular bar is divided into. The numerator remains fixed at 1 so that different unit fractions (shown in pink and blue for their respective bars) can be compared. When the ‘show translation’ box is ticked the unit fraction from the bottom rectangle can be dragged upwards (using the slider on the left) so that it overlaps the unit fraction above it. This is useful when comparing the two unit fractions.

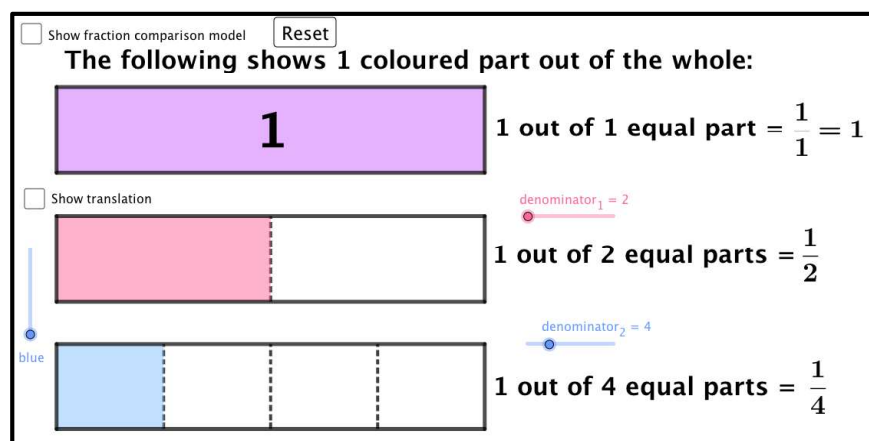


FIGURE 1: Bar model applet – basic setting

When the ‘Show fraction comparison model’ box in the top left corner is ticked one enters a more complex/flexible setting of the applet. In this ‘fraction comparison model’ two rectangular bars are shown, and the numerator and denominator of each can be changed using the sliders provided (Figure 2).

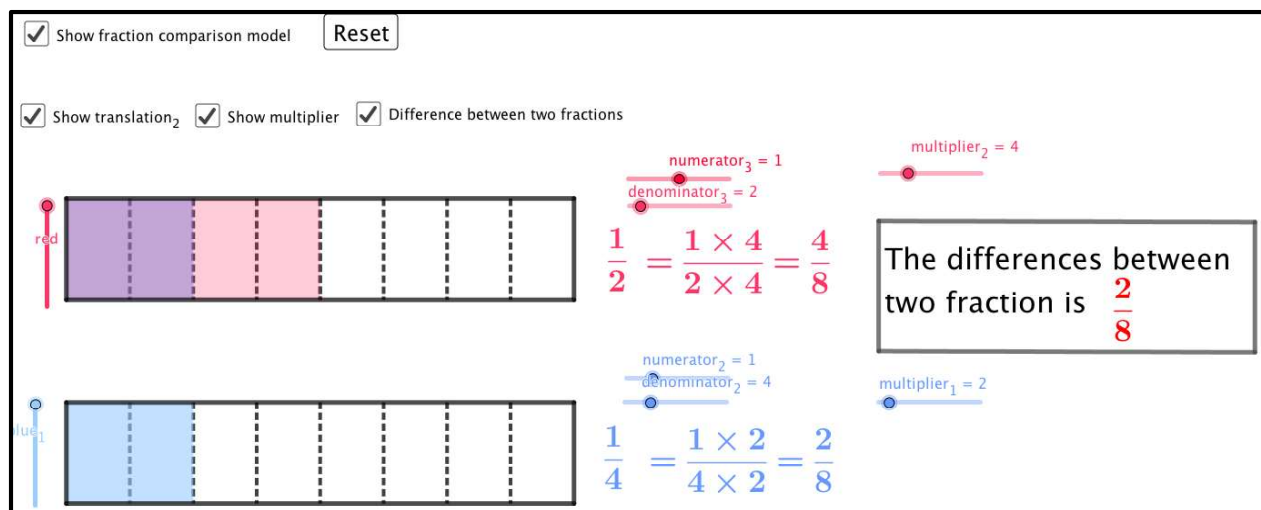


FIGURE 2: Bar model applet – fraction comparison model

A ‘show translation’ check box as well as two sliders on the left are provided to allow either shaded fraction to be superimposed on the other. A ‘show multiplier’ check box is also provided. When this box is ticked one can express each of the two fractions in different yet equivalent forms by scaling the numerator and denominator by the same constant. An extra check box labelled ‘Difference between two fractions’ is also provided. The bar model applet can be accessed and explored using the following link:

<https://www.geogebra.org/m/cgsraqzm>

### CIRCULAR MODEL

This applet makes use of circles rather than bars to illustrate fractions. In the basic setting of the circular model applet (Figure 3), two circles are shown. The top circle is fixed and is provided to illustrate one whole. For the second circle, sliders are provided so that both the numerator and the denominator can be changed. The numerator is restricted so that it can only take on values less than or equal to the denominator.

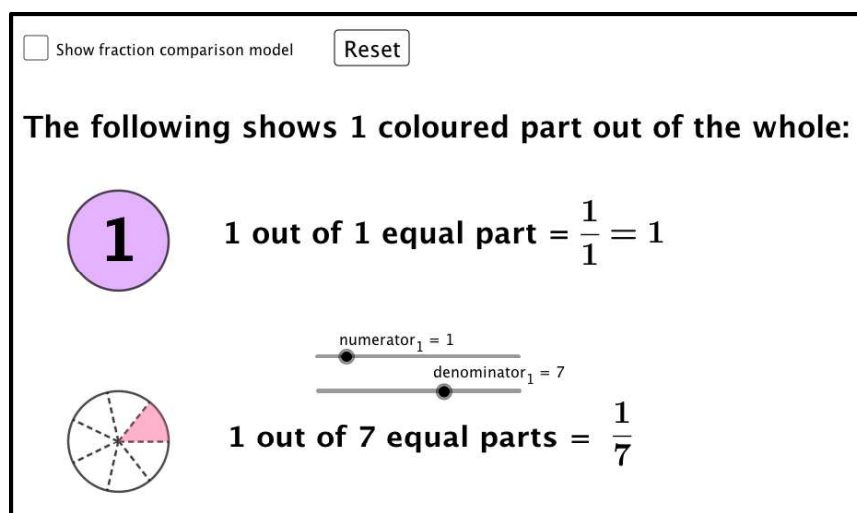
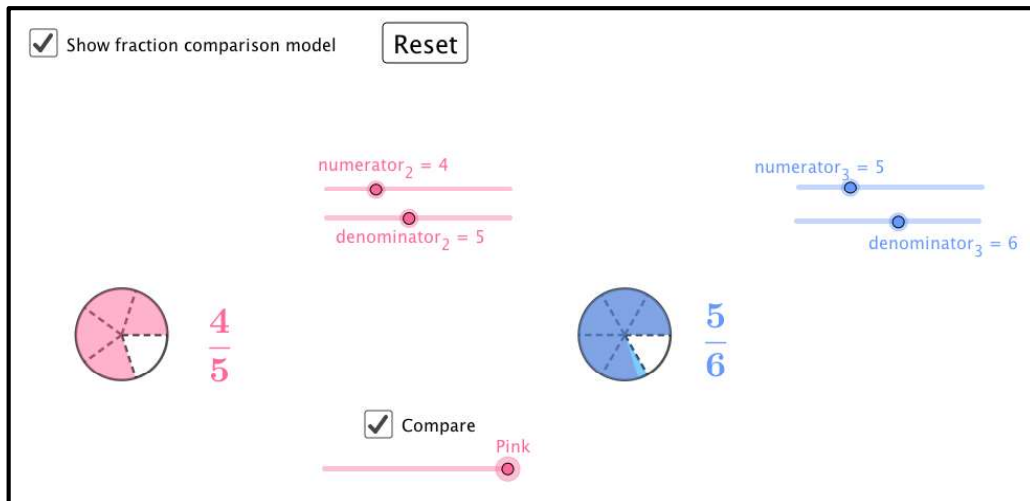


FIGURE 3: Circular model applet – basic setting

When the ‘Show fraction comparison model’ box in the top left corner is ticked one enters a more complex/flexible setting of the applet. In this ‘fraction comparison model’ two circles are shown, and the numerator and denominator of each can be changed using the sliders provided (Figure 4). In this setting of the applet one can also create improper fractions by setting the numerator to be greater than the denominator. When the ‘Compare’ box is ticked, the fraction on the left can be dragged across to the right in order to superimpose the two fractions. This is useful when visually comparing two fractions.



**FIGURE 4:** Circular model applet – fraction comparison model

The circular model applet can be accessed and explored using the following link:

<https://www.geogebra.org/m/hwfkq9bb>

#### USING THE APPLETS IN THE CLASSROOM

The different applets can be used flexibly, based on the needs of different students in the class. The applets can be used as an introduction to fractions – where pupils can individually explore the visual effect of changing numerators and denominators – or they can be used to support/initiate the following observations:

- When the numerators of the fractions are the same, the larger the denominator, the smaller the value of the fraction.
- When the denominators of the fractions are the same, the larger the numerator, the larger the value of the fraction.
- When the numerator is greater than the denominator, the fraction is greater than 1.
- When multiplying both the numerator and the denominator by the same number, the value of the fraction is not changed.

A useful approach when students engage dynamically with the fraction models is to compare fractions where the numerator is the same, and to compare fractions where the denominator is the same. One can then build on this by asking more complex questions, such as deciding which is the larger fraction,  $\frac{4}{6}$  or  $\frac{5}{7}$ . One could investigate this initially by overlaying the two fractions using the fraction comparison model (Figure 5).

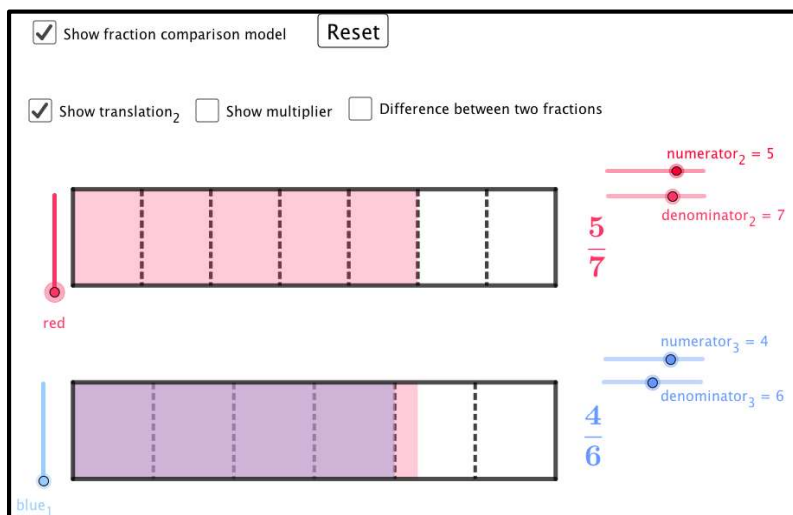


FIGURE 5: Comparing  $\frac{5}{7}$  and  $\frac{4}{6}$  using the bar model applet.

Having established visually that  $\frac{5}{7}$  is bigger than  $\frac{4}{6}$  one can turn the discussion to the non-shaded regions, as opposed to the shaded regions which represents the fractions. The non-shaded regions are  $\frac{2}{7}$  and  $\frac{2}{6}$  respectively. Since these two fractions have the same numerator we can compare them directly. Since  $\frac{2}{7}$  is smaller than  $\frac{2}{6}$  (since it has a larger denominator) it follows that that  $\frac{5}{7}$  is larger than  $\frac{4}{6}$ . This sort of reasoning can be supported by the dynamic exploration of fractions using these applets.

### CONCLUDING COMMENTS

The purpose of this article was to share and describe a number of specifically designed GeoGebra applets that allow students to engage dynamically with fractions. We have found these applets particularly useful as they add an important dynamic element to the pictorial visualization of fractions.

### REFERENCES

- Poon, KK (2018). Learning fraction comparison by using a dynamic mathematics software – GeoGebra. *International Journal of Mathematical Education in Science and Technology*, 49:3, 469-479, DOI: 10.1080/0020739X.2017.1404649