

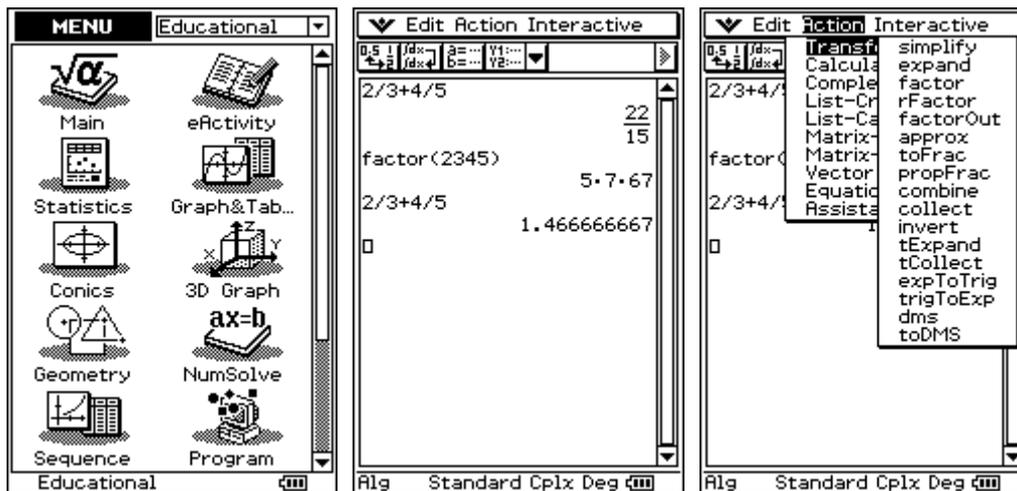
# Interactive learning on a *ClassPad 300*

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## 1. Getting oriented

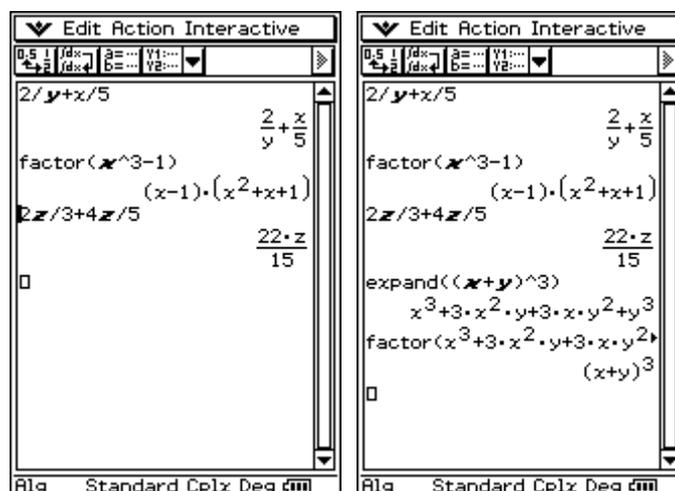
Use the stylus to tap the Menu icon at the bottom of the screen to see various applications. In the right screen below, the Main icon has been tapped



The *factor* command has been entered by tapping the sequence Action > Transformation > factor.

The approximate result for the fraction computation was obtained by first tapping the approximation icon in the top left corner.

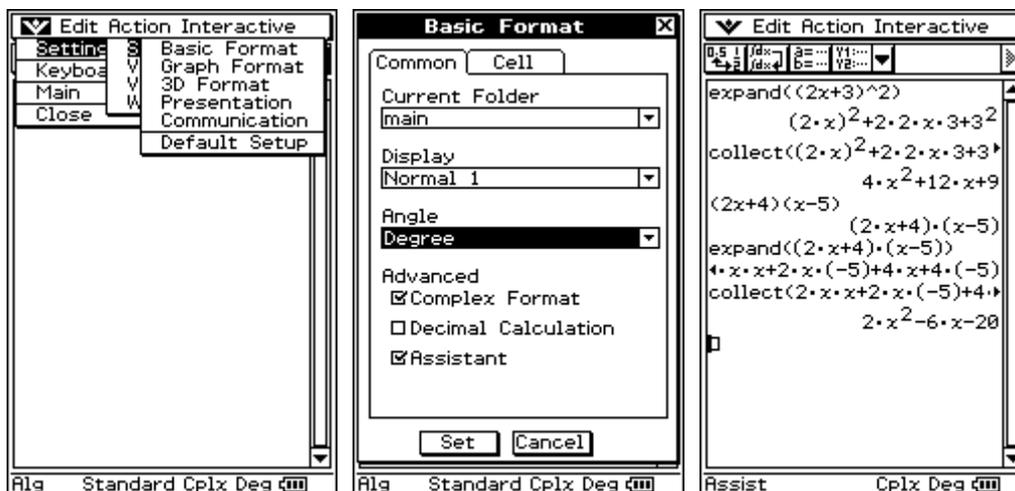
Note that the Edit menu allows for cutting and pasting items selected by tapping or dragging, and that it is possible to enter algebraic variables as well as numbers via the keyboard. Previous commands and results can be edited and then recalculated with EXE. The keyboard has a backspace and cursor keys for ease of editing. The screen below shows some examples.



Experiment within this screen and the Transformation menu to explore the number and algebra concepts and operations of relevance to the students you teach.

## 2. Algebra assistant

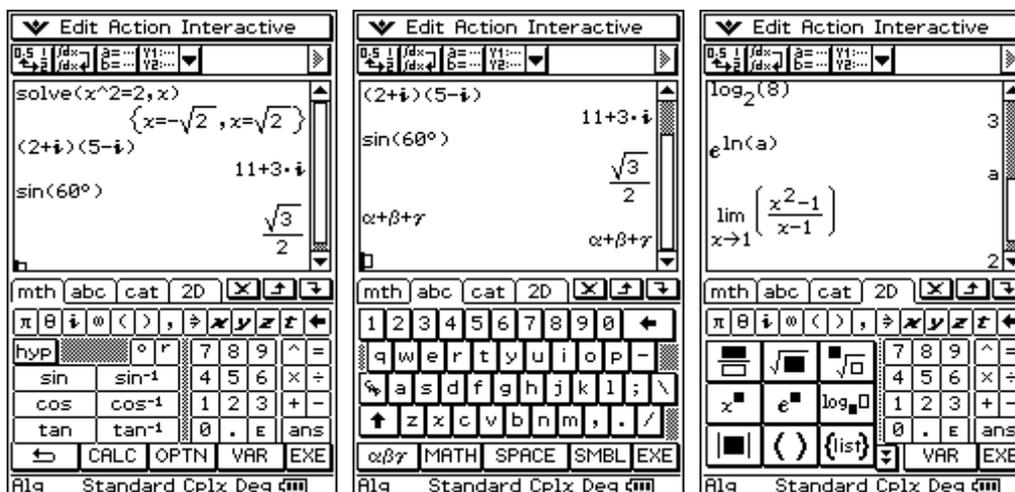
In the screens above, algebraic results are obtained and simplified automatically. The Alg indicator at the bottom of the screen indicates this status. To assist students to see what is happening, and prevent automatic simplifications, you can change to Assistant Mode, as shown below. Start by pressing Settings in the menu at the bottom of the screen:



Some consequences of setting the *ClassPad 300* to this mode are shown in the right screen above.

## 3. Keyboards

More complicated expressions and various other mathematical functions are accessible via the soft keyboards. The Keyboard key below the screen toggles the keyboards on and off the bottom of the screen. The three examples below show the maths keyboard, the alpha keyboard and the 2D keyboard, from which a huge assortment of mathematical expressions can be obtained. Once the keyboard is visible, the tabs at the top (labelled mth, abc, cat, 2D) provide access to variations.

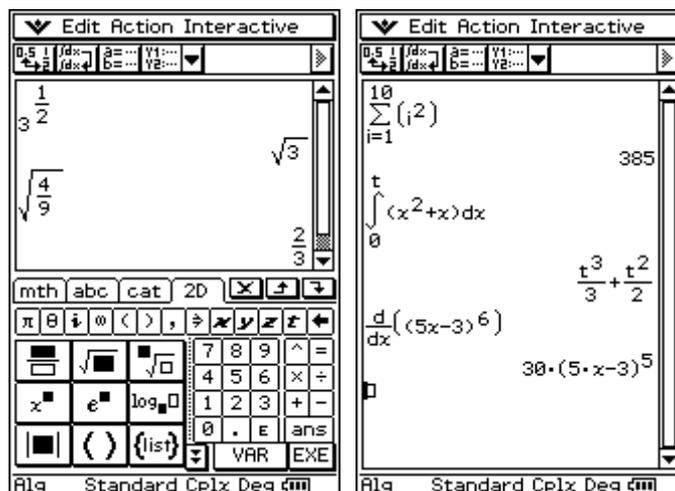


Use the stylus to move between keyboards and to enter commands into the Main screen for computation or analysis.

Notice the TRIG, CALC and OPTN tabs at the bottom of the math keyboard and the various symbolic options at the bottom of the abc keyboard.

The math and 2D keyboards both have an *ans* key to enable previous answers to be used in subsequent commands (as on a graphics calculator)

The 2D keyboard is especially useful for constructing mathematical expressions in conventional syntax, and thus also avoiding the need to remember how to enter these directly into the *ClassPad 300*. Tap the relevant icon to enter templates onto the screen and then enter desired values before evaluating expressions with EXE. A few examples are shown below:

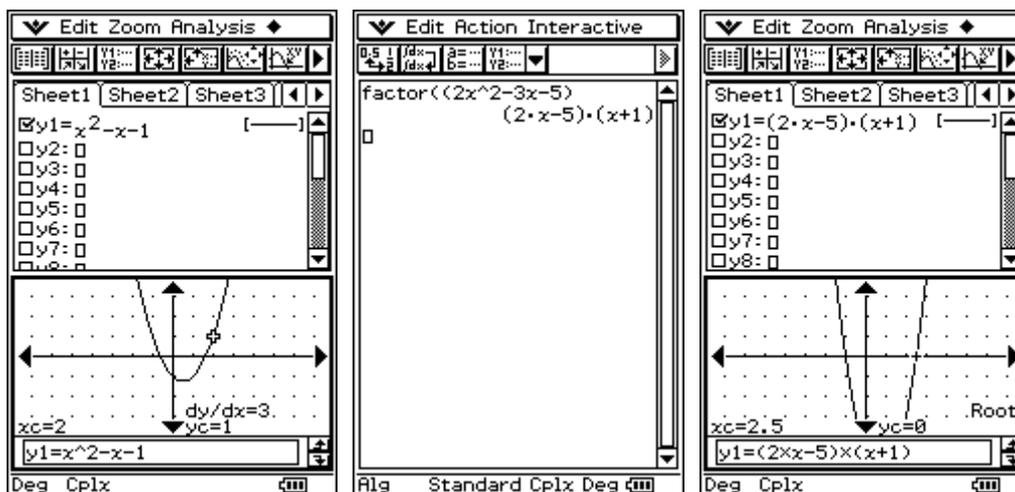


Experiment with these keyboards to construct expressions relevant to the students you teach and consider how the interactive nature of the device allows for meaning to be created from the symbolic expressions involved. Once evaluated, a command can be readily edited and re-evaluated in order to make clearer what is going on.

#### 4. Graphing functions

From the Menu (icon at the bottom of the screen), other applications can be chosen. A fully functioning graphing and tabulation suite is available by tapping the Graph&Tab icon.

Various capabilities are accessed via the Toolbar at the top as well as the menus.

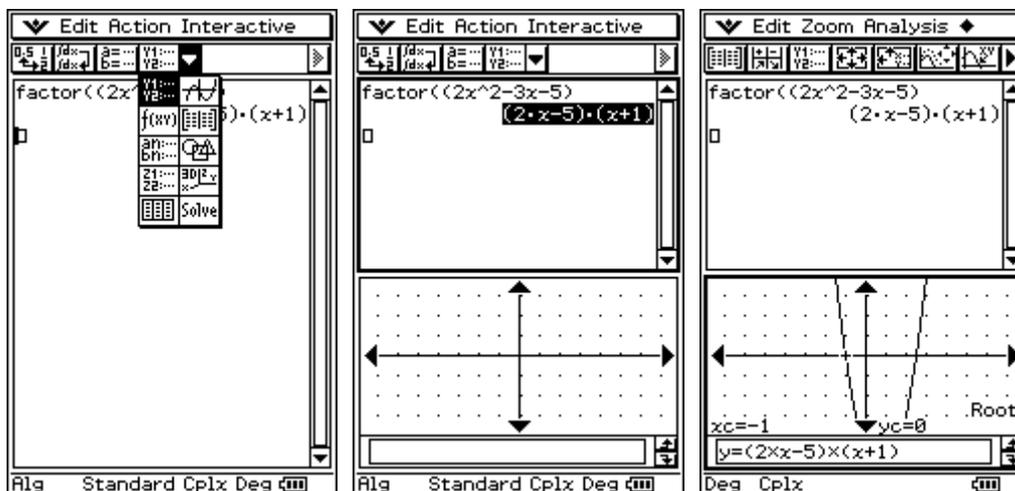


Of particular significance is the fact that expressions can be copied and pasted from one part of *ClassPad 300* to another.

The two screens on the right above show an example of this, related to finding roots of a quadratic. The expression obtained in the Main screen has been copied and then pasted into the function list for graphing and analysis, in this case exposing links between factors and roots.

## 5. Dragging and dropping

An alternative to cutting and pasting for exploring links between mathematical objects involves dragging and dropping. In the Main screen, tap on the Y1..Y2 toolbar icon to see that other applications can be opened simultaneously. Choose the graphing icon to show the graph window at the bottom of the screen, as shown in the middle below. Tap between the windows to notice that the active window is the one with a bold outline

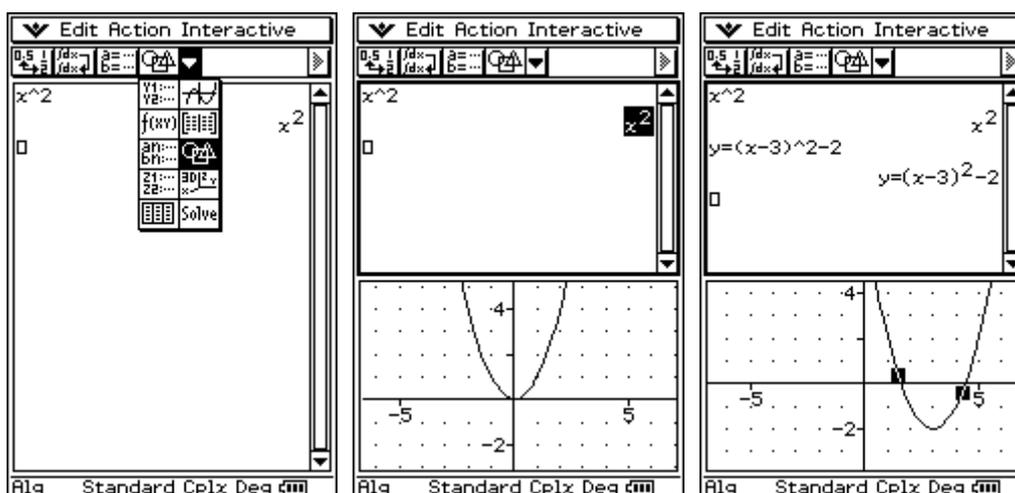


Highlight an expression (involving  $x$ ) in the Main screen and then drag it to the graph screen, where it will be graphed and can be analysed, as suggested by the third screen above.

## 6. Interactions between algebra and geometry

A powerful variation on the operation of dragging and dropping involves using the Geometry application instead of the Graph&Tab icon. The first two screens below show that the process looks similar to that used with the Graph application.

In the Geometry window, the window parameters can be adjusted from the View menu. You may need to experiment a bit with Pan, Zoom in and Zoom out in order to choose satisfactory domain and range. The Integer Grid has also been selected in the example below.

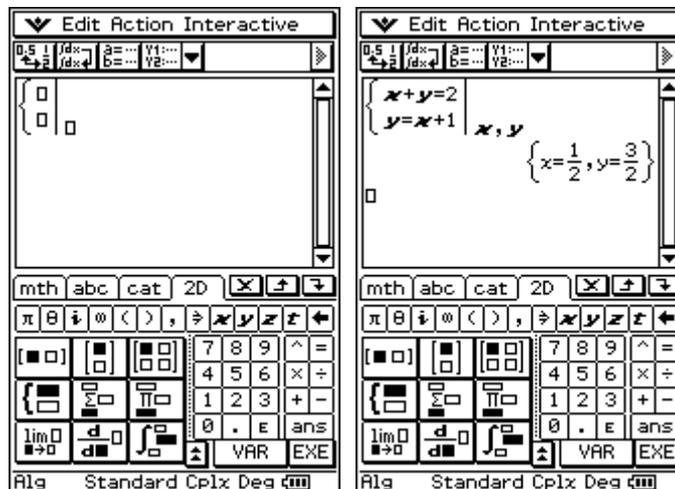


A difference between the Geometry and Graph applications is that the parabola itself can be manipulated in Geometry. Select and then drag the parabola to a new position. Then drag it to the cursor location in the Main screen and press EXE to see the translation algebraically. (An alternative is to Copy and Paste the parabola from Geometry to Main screen.) Either way, the results are shown in the right screen above, suggesting many productive learning possibilities.

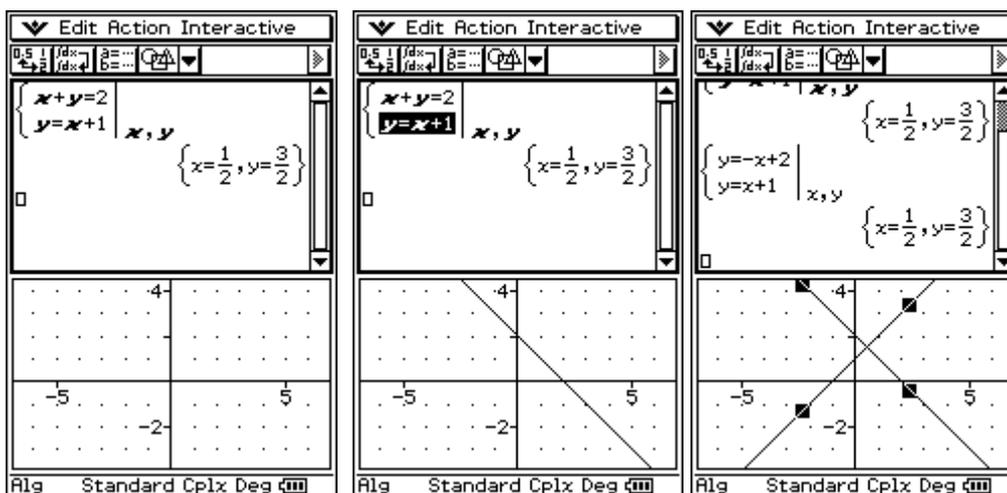
## 7. Interacting with a system of linear equations

Interactive opportunities for linking algebraic and geometric perspectives are illustrated for the case of solving linear systems.

The screens below shows the use of the 2D keyboard in the Main screen to enter and solve simultaneously a pair of linear equations. (The icon needed is the one just above the limit icon.)



Hide the keyboard and access the Geometry window, as previously



The equations can be dragged one-by-one from the Main window to the Geometry window. The middle screen above shows the situation after the first equation has been dragged. (Notice that the equation is not written in function form, but implicitly:  $x + y = 2$ .)

The final screen shows the situation after both equations have been dragged (or copied and pasted) between the windows.

To show the algebraic results associated with the geometric objects, first select *both* lines by tapping them. Then drag the pair from the Geometry window to the Main screen to see them represented as a linear system, which can be solved algebraically with the EXE key.

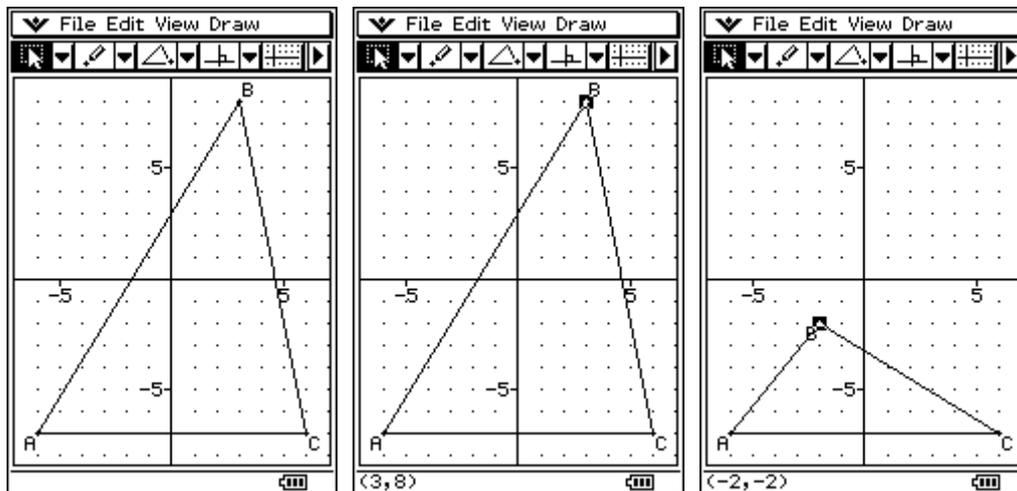
Now see what happens if you first move one of the lines to a new position, and then repeat the process of selecting the pair and dragging them to the Main window.

Experiment with this environment to imagine what this adds to student experiences.

## 8. Measuring geometric objects

Various kinds of geometric objects can be drawn in the geometry window and manipulated in a variety of ways. Space precludes a full treatment of the possibilities. To see some of these, go to the menu with the Menu icon at the bottom of the screen and then tap on the Geometry icon to open the application. Use Clear All in the Edit menu to start with a clean sheet.

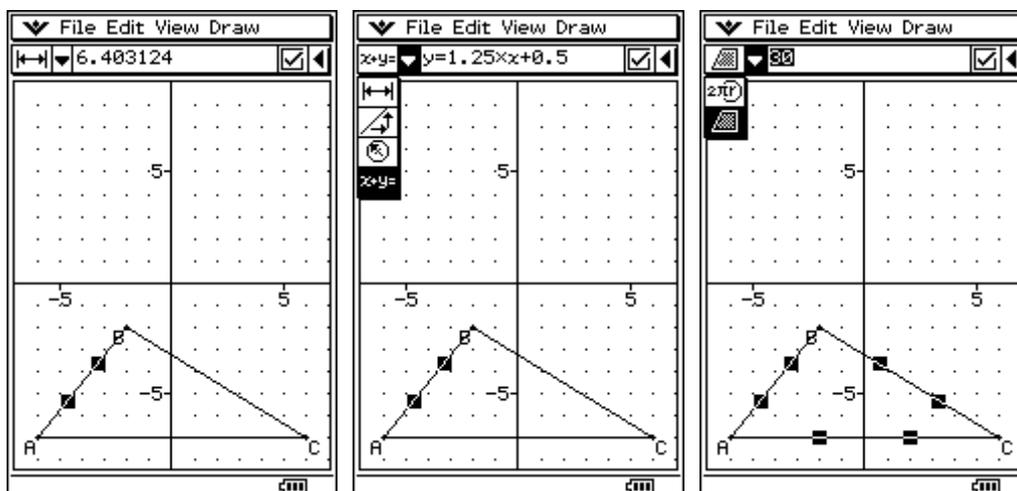
Use Draw > Special Shape > Triangle and tap in the window to draw a large triangle, as shown at left below.



Tap on a vertex once to select it and then remove the stylus. Now use the stylus to drag the highlighted vertex to a new location, as shown in the right screen above. Notice that when B is selected, in the middle screen above, its coordinates are shown at the bottom of the screen.

One way to interact with geometric objects (such as line segments, points, triangles, etc) is to make measurements of suitable aspects of them. To do this, first select the arrow at the top right of the toolbar, to see the Measurement Toolbox. Then, when an object is chosen in the window, any available measurements related to it are shown in the Measurement toolbox.

For example, the first screen below shows that AB has length of approximately 6.403 units. The second screen makes clear that other possible measurements of AB include gradient, angle of inclination and equation. In this case, AB lies in the line given by  $y = 1.25x + 0.5$ .

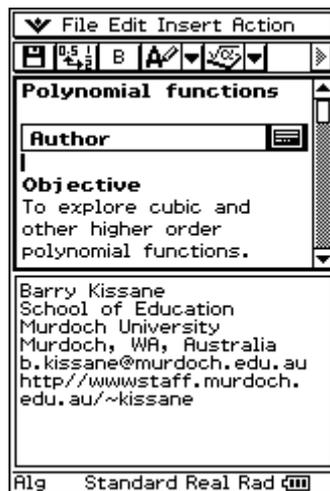


Other choices of objects allow other measurements. The third screen shows that selecting all three sides allows for the area (in this case 30 square units) or the perimeter of the triangle to be obtained.

## 9. Using an eActivity

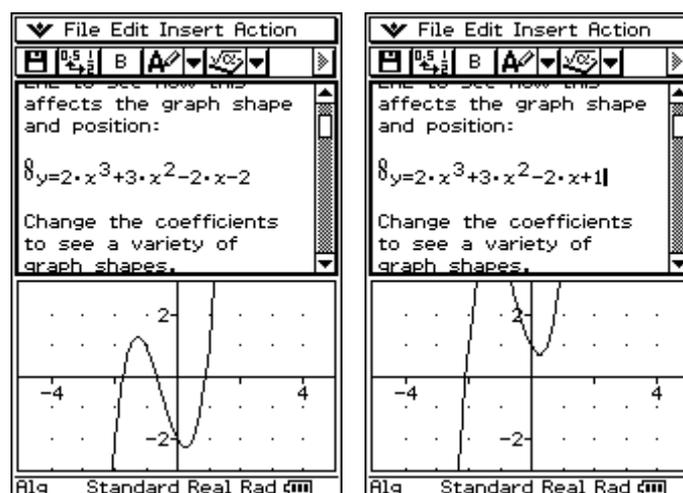
Various *ClassPad 300* features can be used to construct an eActivity to provide some pre-packaged explorations. As its name suggests, an eActivity is an electronic activity designed for a particular learning purpose. Teacher's eActivities can be shared between *ClassPad 300* hand sets and also transmitted electronically (eg over the Internet) via the *ClassPad Manager* software.

To illustrate, consider an eActivity, *Polynomial functions*; to access this, return to the Menu and select the eActivity application. Under the File menu, select Open and navigate to find the eActivity called *Polynomials* copied to your *ClassPad 300*.



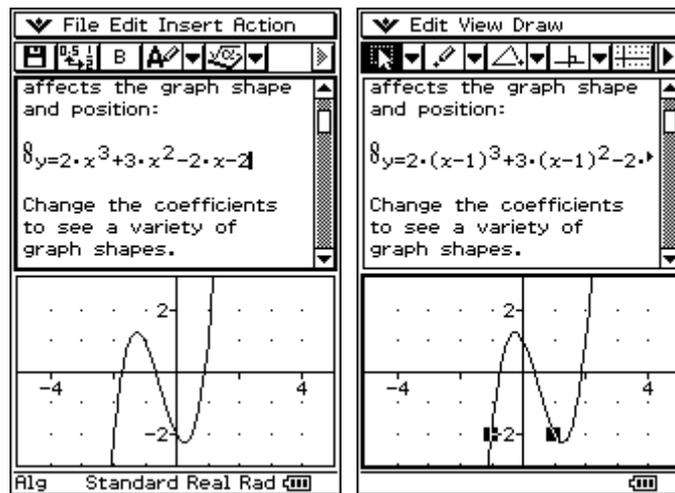
The example is intended to be self-explanatory for someone without very much familiarity with *ClassPad 300*. A useful interactive feature of this eActivity include the use of a Geometry Link (not available for other *ClassPad 300* uses, but only accessible within an eActivity.)

An example is given in the next pair of screens, indicated by the symbol (like a vertical infinity sign, not unlike an '8'). When the cubic function parameters showing in the geometry link are changed in the upper window, and EXE pressed, the graph below it automatically changes accordingly:

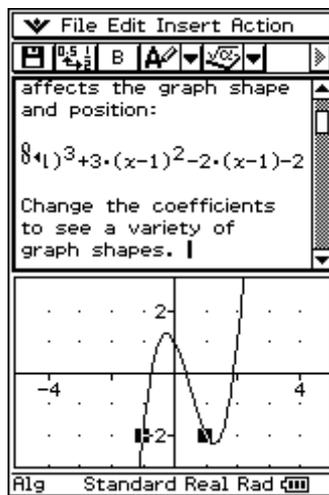


In this case, the graph is translated three units upwards by the change of constant from -2 to +1.

The geometry link works in the opposite way, too: when the graph itself is moved, the associated function is updated suitably, as the next screens show.



In this case, the horizontal translation has resulted in replacement of  $x$  with  $x-1$ .



Notice that the corresponding symbolic function exceeds the screen width, requiring a tap on the right arrow to reveal the rest of it, as the screen above shows:

Other eActivities can be designed by a teacher (or even a student) to organize and constrain interactions with the *ClassPad 300* for some particular purpose. Many of these are available on the Internet (eg, at <http://classpad.org> or at <http://classpad.net>.)

## Conclusion

There are many new ways here in which the *ClassPad 300* can be used by students to learn about mathematics through interactive experience. Similarly, a teacher might use the emulator in the *ClassPad Manager* software for demonstration purposes with a whole class. The examples given here are intended only to suggest some possibilities, and do not claim to exhaust them all.