Graphical Transformations with Year 9 and Texas Calculators

At ATM conference (Chester) two teachers decided to work together in the classroom. The first meeting in November was used to establish:

- the school
- the class
- the activity

Year 9 at Cheshunt School was decided upon and the topic would be graphs. If we could borrow a set of Texas TI-83 plus during January 2002 we would be able to follow the departmental plan to look at graph identification in Key Maths.

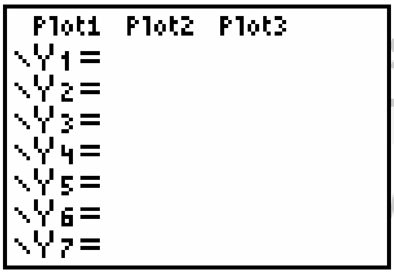
A logical starting point was established: using the calculators to explore the straight-line graphs using the families:

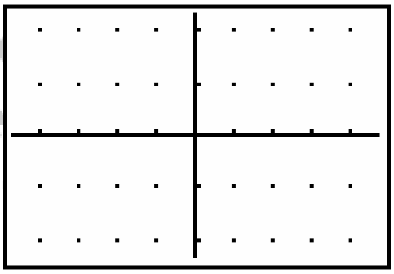
$y = mx$

$y = x + c$

$y = mx + c$

We prepared screen shots using the computer-connector and TI-software .





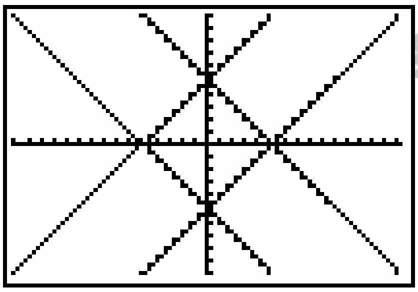
These allowed easy plotting from the calculator screen and the students used TRACE to find the co-ordinates of particular points. TRACE shows clearly that there is an infinite set of points on a line and dismisses a false perception of a graph only having points with integers co-ordinates.

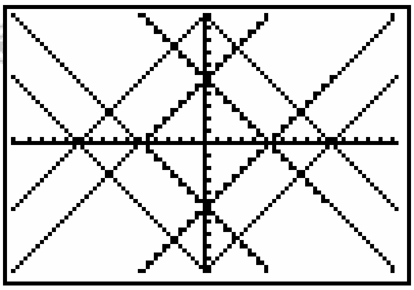
The students were very involved with the activity and were interviewed about their thoughts:

"What comment can you make about the value of m ?"

"What can you say about the value of c?"

"Can you make the screen show these sets of lines?"





The first lesson ended on that note and there were murmurs of "….can we use the calculators next lesson, Miss?"
After a review of the key features of the straight line graphs we established the vocabulary needed:

- intercept on the $y-axis$
- gradient

and then we moved on to the families of parabolas:

$y = ax^2$

$y = x^2 + b$

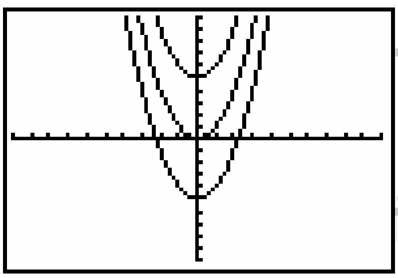
Again the students were interviewed after some minutes during which they had responded to the instruction:

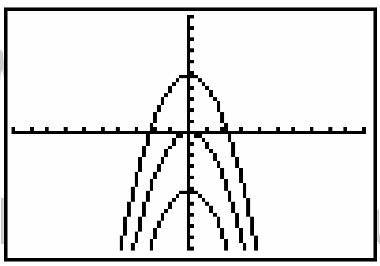
"Complete the statement in you own words.
*As the value of a ____________. *"
This led to a variety of responses:
"As the value of a goes up the curve steepens and curls";
"The value of a determines how steep the curve is, as the value of a goes up the line gets steeper";
"As the value of a goes up the steeper the image gets".

The investigation continued as we focused on b, the instruction was:

"Complete the statement in you own words.
*As the value of b ___________. *"
This led the students to making statements such as:

"The value of b is the lower number";
"The value of b determines how high the loop meets the $y-axis$";
"The value of b determines how high up the $y-axis$ the intercept of the parabola is"
How can we reflect parabolas in the $x-axis$?





After these two lessons:

- the first on straight lines and
- the second on parabolas

the next two lessons were taken for looking at related SATs questions and the graphs of some other curves.

$y = \frac{1}{x}$

$y = x^3$

Some time in each of these lessons was spent without the calculators and then they were used to help comparisons to be made.

The final lesson was targeting translations of graphs and the equations of the resulting graphs. The vehicle was straight lines and parabolas.

"If the line $y = 2x$ is translated to pass through (0,5)
What is the equation of the new line?"

"If the line $y = 2x$ is translated to pass through (5,0)
What is the equation of the new line?"

Through these questions the idea of replacing the variable x by $(x+5)$ was established as a way of recording a translation along the $x-axis$, parallel to the $y-axis$. As parabolas were translated the method became more familiar to the students and the final part of the lesson was a challenge to obtain a screen shot. This had been prepared from of the parabolas:

$y = (x+5)^2$

$y = (x-5)^2$

$y = -(x+5)^2$

$y = -(x-5)^2$

The majority of students had obtained the image after 3 minutes.

Working in pairs and using the calculators for a few lessons (5 hours) this Year 9 class gained a familiarity with algebraic graphs, which is more usual in older students. More importantly, perhaps, they enjoyed the challenge of "Can you get your calculator screen to look like this". The manual process of drawing graphs is slow and often interferes with gaining this level understanding.

All this without moving from the classroom! Thank you Texas for your generous loan scheme that helps us to move mathematics from the desiccated regions of target setting to the rich pastures of excitement.

Christine Atkinson and Claire Beckett