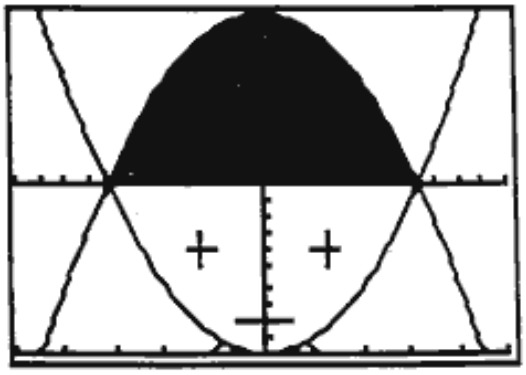
Open Calculator Challenge

Alan Graham

Over the past two years, I have worked with students and teachers in a variety of schools on the use of the graphics calculator in mathematics learning. One feature that has stood out for me has been the excitement and enthusiasm of students and teachers alike. And, it must be said, excitement and enthusiasm in mathematics learning are delicate flowers which, when they do come along, need careful nurturing.

Here are two pieces of work from a school which I recently visited in Northern Ireland; they were both created by year 10 pupils attending St. Colman's High School, in Ballynahinch. St. Colman's is one of ten schools which took part in an innovative and successful graphics calculator initiative titled 'Supercalculators through the curriculum' coordinated by Martin Fitzpatrick (Stranmillis College, Belfast) and Ken Houston (University of Ulster at Jordanstown, Newtonabbey). All ten classes used Texas Instruments TI-82 graphics calculators.



Paul's car was one of a number of excellent drawings produced by students in this class. Experience of using graphics calculators with this age group suggests that the Draw facility, used in 'direct' mode, tends to be the first feature that students will use spontaneously. (On TI machines, there are two modes for using Draw: 'direct' and 'command' mode. The former comes into operation when drawing commands are accessed directly from the graphing screen.) Not surprisingly, Paul and his classmates were rather proud of their efforts and were not over-keen to clear their drawings in a subsequent mathematics lesson in order to investigate quadratic graphs. This is an issue which a number of teachers have already faced. Fortunately, with certain graphics calculators like the TI-82 (and, of course, its recent replacement, the TI-83) there are ways of dealing with this problem. One approach is for the student to save the drawing as a Pic file in the calculator's memory – a very straightforward procedure. The second, as was done here, is to transfer the file, via a link cable, to a computer. From here it can be incorporated into a text document, scaled up or down or printed off directly to be displayed on the wall or placed in the student's file.

What I see on the right as a drawing of a girl's face (others may see a Viking!) is particularly interesting from the point of view of how it was created by the student, Pauline Nesbitt. Notice the outline of the face and 'pigtails' are constructed from two quadratic graphs entered in the Y= screen. So, Pauline needed to understand how to tailor the parametric values of a and b in the equation $Y = aX^2 + b$ in order to achieve the desired result and make it fit exactly onto the screen. The dark hair (or helmet) is created using one of the Shade commands and this required an understanding of inequalities. The mouth, eyes and neck are formed using the Line command in the Draw menu.

Overall, Pauline appears to have mastered a range of calculator skills as well as considerable mathematical understanding in order to produce this masterpiece. Even more impressive is that

mathematical thinking required was entirely self-generated and intrinsic to the task. In short, she did it to a high standard because firstly, she wanted to do it, and secondly, because she was able to, having already acquired a confident grasp of the technology and relevant mathematical principles.

It seems to me that these student activities contain several highly desirable qualities which contrast sharply with much of the mathematical work children usually do in school. As well as being fun, the mathematics encountered was seen to be relevant and helpful in solving a challenge of the student's own making. Nurture that flower!

Finally, here is a third example of the motivating power of the graphics calculator which I observed recently. This classroom was not part of the 'Supercalculators through the curriculum' initiative, but one that I was visiting as part of my own research – again, a year 10 class. On the first day of introducing the graphics calculator to the class, a particular group of five boys at the back of the room were showing the familiar signs of alienation from school in general and mathematics in particular. I was assured by the teacher that this had been their response all year to anything he had done with them. The gang leader, Martin, had a central role in anything that the others did and most of their behaviour seemed designed to win Martin's approbation. However, a strange thing happened over the next few lessons. Martin, who was actually a rather bright student, suddenly got hooked on programming the graphics calculator. He made rapid progress, began asking 'real' questions and concentrated on tackling a variety of programming challenges which he and I devised together. Needless to say, this caused considerable consternation to the remaining members of the gang of five and they really didn't know how to respond to his change of attitude. For a while, they looked nervous and ill at ease, trying to cajole Martin back to the fold. However, in this they failed and, before long, some of them started teetering on the edge of applying themselves to classroom work – something I would never have believed possible at the outset of the project.

It was experiences like these which encouraged me and my Open University colleague, Barrie Galpin, to find a way of encouraging students to tackle challenging mathematics through the medium of the graphics calculator. As a result, from September 1996, we have set up a national 'Open Calculator Challenge' (OCC) trial scheme along similar lines to the Duke of Edinburgh awards scheme, but based on the demonstration of skills using a graphics calculator. Candidates will progress through Bronze, Silver or Gold awards and the certificates gained could form part of their Record of Achievement. We would expect that students (typically KS4, i.e. years 10/11 but there is no age restriction) would volunteer on an individual basis to take the awards. Further information about the Open Calculator Challenge scheme is provided below.

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Open Calculator Challenge

An initiative to inspire children to become actively involved in mathematics through using a graphics calculator.

- Participants work for **Bronze, Silver** and **Gold** awards by demonstrating their skills using a calculator.
- Participants are typically Year 9-10 pupils but can be of any age. They volunteer on an individual basis to take the awards. OCC can be run as part of a maths club or can be used within timetabled lessons.
- At each level, participants must complete four challenges: one each in the content areas of **programming, graphing and statistics** and one further challenge consisting of a "performance".
- For Bronze and Silver awards, participants must convince their teacher that they have completed the challenges. The certificates are presented in school.
- Gold awards are awarded centrally by OCC.
- A registration fee of £50 includes a full pack of materials including 75 calculator challenges, 28 "How-to" cards, advice on running the scheme, case studies, certificates and the necessary forms to keep administration simple.
- Any make of graphics calculator may be used.

Until August 1998 the scheme will be run, in the form of an extended trial, by the Centre for Mathematics Education, Open University. The aim is to set up a more formal national awarding body to administer the scheme after 1998.

For more details and an order form phone **01908-653550** or write to: **OCC, Centre for Mathematics Education, Open University, Milton Keynes MK76AA.**

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