Using Graphic Calculators with Young Children

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Background

Graphic calculators are now widely used in upper secondary mathematics classrooms, and use has been reported with younger secondary pupils as well as older primary children [1,2]. However, little work appears to have been directed at assessing the potential of these machines with children at Key Stage 1 or early Key Stage 2. One reason may be that many of the functions available to the users of such machines are clearly not those normally associated with this age range. However, this genre of calculator possesses qualities that could enable younger pupils to develop their skills, concepts and knowledge.

What then might these qualities be? Most would seem to stem from the large graphic calculator screen. This allows the pupil to see both the expression and the result at the same time, as well as the ability to view up to 4 such calculations on one screen.

```
2*4=
        8.
3*4=
       12.
4*4=
       16.
5*4=
       20.
```

This opens the possibility of children predicting answers, exploring patterns in answers, and reviewing their answers. In undertaking such activity pupils may well engage in a range of process skills, develop their mental skills and appreciate the value of errors, whilst at the same time they are learning basic number facts.

The work in the classroom

The work reported here was undertaken with a group of 9 Year 2 and 3 children. A quick game of "beat the calculator", with some children using these 'new' machines and others working in their heads to provide answers for 'easy' table facts, gave opportunities for the children to become familiar with the calculator. As the children had shown a good knowledge of the table facts within the 2 and 5 times tables, this was used as the first starting point. The children started by entering 5 times and 2 times table facts, and were encouraged to examine the answers for any possible patterns. Within the 5 times table in particular, almost all the children noticed the 0 followed by 5 pattern, and were able to predict ahead. This process appears to be encouraged by the ability to see a list of answers on the screen, and at the touch of a button to continue the sequence of expressions and answers. This desire to go on meant that all the children chose to extend beyond 10×5, many up to 30×5, and beyond. They were pleased that the pattern continued beyond the table facts they knew, and they appeared confident with the larger number involved. In particular, many of the children articulated the patterns as "it's always adding five", hence reinforcing the idea of multiplication as repeated addition.

One child brought over her calculator showing $30 \times 5 = 150$, clearly pleased to have reached so far. She was then asked to put 3×5 on the machine, so that both expressions were visible at the same time. In discussions she was able to point out the similarities between the two, in particular the recognition that the same starting digits in the expression, in this case 3 and 5, give the same starting digits in the answer. This would have been much more difficult to reflect upon using the conventional one line calculator. When 300×5 was entered, she was able to predict that the answer would start with 15, even though she was unsure as to the exact answer.

The children were then asked to explore the 11 times table, as most of them had not seen this table before and would therefore be unaware of possible patterns in the answers. All the children were able to spot and predict the patterns in the early stages, in most cases by looking down the digits of the answers they could see on the screen, and then looking across to the numbers in the expression.

```
3*11=
        33.
4*11=
        44.
5*11=
        55.
6*11=
        66.
```

The children tended to lose the pattern at 10×11, but re-established it when they noticed the digit patterns with later multiples:

```
12*11=
        132.
13*11=
        143.
14*11=
        154.
```

Seeing the products on the screen enabled them to move down the digits and make predictions. One boy predicted that 19×11 would be 210, clearly using the result
$10 \times 11 = 110$, but when looking at the digit patterns
$18 \times 11 = 198$
$19 \times 11 = 209$
he was able to see that he had made a mistake.

Two children decided to explore larger multiples of 11, in particular 20, 30, 40, etc. Again they were encouraged to enter each of these together with the related single digit multiplier, and to discuss the patterns.

```
80*11=
        880.
8*11=
        88.
```

One of the children was unsure how to say 880, and much discussion followed. This opportunity to look at large numbers and ideas of place value was extended further by looking at numbers like 880, 8800, 8080, and attempting to say them and give meaning to them. At this point we returned to the earlier problem, and putting the following on the screen, asked for predictions.

```
8*11=
        88.
80*11=
        880.
800*11=
```

One child said he thought it would be 8 thousand 8 hundred and 80, but he wrote down 80080. Completion of the operation on the calculator allowed him to see the correct answer, and more discussion followed.

These children now needed to consolidate their learning in this area with other activities such as building these numbers in base 10 apparatus, using arrow cards, etc. The work on graphic calculators provided a 'different' approach to such concepts.

Other children explored in different ways; sometimes errors led them to new starting points. One child for example, when attempting to enter 4×6, in fact entered 4×96, which led her to explore the 96 times table! Other children asked how much the calculators cost (parents beware!) and worked out the cost of the class set. Some of the greatest interest was generated by Katie, who, after multiplying two very large numbers together and seeing the result, decided she had invented a new number!

Written recording was not imposed on the children, and at first children were happy not to record. Later however, children realised that the work was lost once it 'left' the screen, and when given paper, they chose to record. The idea of recording thus came from the children, but it did not appear to interfere with the mental processes they were engaged in.

Allowing a reasonable amount of free exploration did mean that the children sometimes moved away from the main focus, but against that the children showed great interest and enthusiasm, which continued even into assembly.

From this brief session of work, it does seem the graphic calculators have indeed something to offer the younger pupil, and that further exploration is called for.

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[1] Gretton and Challis, 1996, Travels with the TI82, *Micromath* 12.1, pp 27-29.
[2] Ruthven, K., 1995, Graphic Calculators as a Personal Resource in the Lower Secondary School, *Micromath* 11.2, pp 25-27.

The work described here was carried out at Gilthwaites First School, Denby Dale, Huddersfield, West Yorkshire. Thanks are due to the staff and pupils for their help and support. The calculators used were Sharp EL-9200.