USING GRAPHING CALCULATORS TO MOTIVATE STUDENTS IN A CALCULUS COURSE

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This paper grew out my teaching experience in the fall quarter of 1994 at Ohio State. The course was calculus with the use of graphing calculators. We used James Stewart's Calculus as the text book in order to be similar to the rest of the freshman class taking calculus. And we used TI-81, 82, 85 as our designated calculators.

So we did limits both ways, using the calculator and by hand, did derivatives by hand and checked answers by calculators. Then we came to second order derivatives and concavity. I explained the concept of concavity by using the calculator generated graph which was a great help and proved the second derivative test. But when I collected homework, I found students did the easy problems by hand and the hard problems just by looking at the graph. I felt I needed to do something about it. I wanted to show them that the calculator could not do everything for them. So I set out to find functions that comes up in the text book which are easy to handle by hand but could not be done easily on the calculator. The following functions are typical functions I found:

$f(x) = x - x^{1/3}$, $g(x) = x(1 - x^{-2/3}$, $h(x) = x^3/(1 + x^2)$, $l(x) = x^2/(1 + x^2)^{1/2}$, $z(x) = 1/1000(x^3 + x)^{1/3}$.

The reason I used these functions as homework is their graph looks like straight lines but none of them are. So students find it hard to get information out of the graph and I used that to motivate them to learn the computation. It is very easy to find the derivatives of these functions. They can be found by the power rule, product rule, quotient rule, quotient rule + chain rule and chain rule + power rule. Notice that f(x) and g(x) are the same. It's not hard to find the second derivatives by hand either.

After the TI-92 came out, I tried to do the same thing. But this time, I have to find functions that can not be handled by the symbolic capabilities too. One of the functions would be z(x). Let us look at the question of finding the critical points of z(x). First, if you graph z(x), it look like the straight line y=0.001x. Its derivative and its second derivative both have graphs that are quite misleading. There is also one other factor one needs to consider: the calculators graph these derivatives very slowly. So a beginning student would have a lot of trouble even getting the pictures to show up.

Once one understands how these functions were created, one can create many exercises like these.