USING CALCULATORS TO MAKE GEOMETRY PLANE

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I attended the NSF Mathematics Institute* at Ohio University last summer (1978). Little did I suspect, coming out of the intensive four-week program all muddled, confused, and exhausted, that I would be using nearly everything I learned in a particular course, due to unforeseen circumstances. At a board meeting in August, just about a week before school was to begin, I was informed that there was simply no money for the purchase of new Geometry textbooks. I was going to be faced with 45 geometry students and a stack of numerous backs, fronts, and a sampling of scattered pages of what used to be 34 geometry textbooks--the latest edition of which was 1964. After the complete shock and panic of the situation began to subside, I said to myself, "Self, you are going to have to do something and pretty darn quick at that."

Recalling the advice of my high school chemistry and physics teacher who said that when you have a difficult problem, grab an apple, go sit in a corner by yourself and mull it over for awhile; I grabbed myself an apple, sat in a corner and mulled it over for awhile. Now I'm not saying which helped more, the advice or Ohio University's NSF program, but I am proud and extremely pleased with the results.

On the first day of school I discussed the problem with my students and sent home a letter to parents explaining the situation. I think that helped get things off to a good start. In the letter I requested $6.50 for two workbooks.[1,2] I also asked the students to talk with their parents about the possibility of our using calculators. I indicated that parents should feel free to call me at any time regarding the prospect of purchasing calculators. I explained to the students my opinion that if calculators

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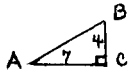
were used, there would be an important advantage if everyone had the same model. To make a long story short, within a month I found myself at Sun TV in Columbus with the money for all but one of 45 calculators (and I was reimbursed a little later for this one). Only one parent called me regarding the use of calculators. I listened to him and he listened to me with an end result that he decided it would be worth trying.

The calcualtors selected were TI30's which include a student mathematics kit.[3] I passed them out and advised students to list and save their serial numbers in a safe place. Since everyone was aware that serial numbers had been noted, I felt the chance of theft to be less. In that first period I had them punch in some simple things like $\tan(45^\circ)$ and $\sin(30^\circ)$ to insure that the calculators were functioning properly. Briefly, some of the more interesting topics we studied using calculators were the following:

1. Pythagorean Theorem and Pythagorean Triples--Teachers, it's really easy to give a quickie quiz because you don't have to think about making it come out "nice" so you save time. You can demand the accuracy you want because time is not as crucial, even for the slower thinker.
2. Geometric means--quickly recognized and checked with their TI's.
3. Development of algorithms for such things as finding a leg given one leg and the hypotenuse without writing anything on paper.
4. Interior and exterior angles and other ideas relating to polygons, particularly regular polygons.
5. Areas of geometrical figures.
6. Comparison of values of simplified radicals with unsimplified radicals to see if they have done the simplification correctly. (Some books leave answers in radical form; and I am not ready to break away from leaving answers in simplest radical form. The TI's provide a very fast way of comparing radicals with the actual approximate square root.)
7. The students developed their own trigonometric tables by using calculators to find sine, cosine, and tangent of angles from 0 to 90 degrees in increments of one degree. Later I had them

compare, for example, $\sin(30^\circ)$ in their tables with $\sin(150^\circ)$ on their calculators, etc. In this manner they seemed to understand the relationships between the quadrants and that only the signs of an angle and its reference angle change.

8. They developed algorithms for trig ratios; for example, finding $\angle A$ in the following triangle. They had to set up the equation mentally using the correct ratio (after some practice on paper, of course) and end up with the approximate value of $\angle A$ on their displays.



9. I also had them change degree measure to the corresponding radian measure in the range 0 to 90 degrees, a task too difficult with pencil and paper.

Many times throughout the year we have used the calculators and they have been a major part of the course. The last six weeks will be spent almost exclusively outside of the school building, armed only with calculators, metric tape measures, magnetic compasses, and home-made hypsometers. For the first time in my teaching career, I'm going to let the students find out that these geometric ideas really work!

Some things we are doing outside include the following:

1. Each student walked the length of the football field twice (200 yards provides a better average) and had his own conversion factor for number of yards per pace. This way each student can measure anything in paces and convert to yards with his calculator.
2. Verify trig ratios by calculating a side or an angle and then actually measuring it.
3. Kite flying contest--how high are the kites?
4. Estimate heights of flagpoles, trees, buildings, etc., using the shadow method and comparing with results from using the hypsometers.
5. Find areas and perimeters.

One deficiency (I hope the only one) is that I have not spent much time on proof. We did go through the congruence postulates and theorems and proved other theorems using these postulates in

an attempt to enhance organization and logic in the thinking of the students. We did not, however, spend much time on the longer, more involved proofs of theorems.

One characteristic of this class is that I use a lot of what I call "organized discovery." By this I mean that I have a path for them to follow. Because discovery usually takes more time than we have available, I often organize their procedures efficiently. The calculators have greatly decreased the time it takes to make discoveries and therefore increased the time we have for making other discoveries.

Another advantage is that I am going to have a larger number of students continuing on to Algebra II. I attribute the enthusiasm to this amazing gadget. I am not losing as many to Business Office Education as I normally do.

One further note: I also have a TRS 80 in my room and, although I teach seven classes per day and therefore have no time to work with many students, they have come to me on an individual basis. I provide them with texts and they practice a little programming on their own. My Algebra I students use the computer to check their work at the board. For example, I have a program ready to give the equation of a line if they provide two points. After the students put their problem on the board they input the points to check their work. It is interesting to note that, at first, if the results don't agree with theirs they are sure the computer made a mistake. Later they learn that the probability is that the error is in their work.

I am already making plans to purchase calculators for next year. I think geometry is a good place to start because there is not as much consistent use for calculators in Algebra I, and they might be more of a distraction than an asset. If any readers have questions or would like more information, feel free to contact me.

An Ode to Progress

This year, after teaching my geometry course,
I am ready to let go of the buggy and horse.

My only concern I feel I must tell,
That there's never a shortage of Everyready or Duracell.

Other than that, my students and I say,
There's nothing greater than an eight-digit display!

References

[1]Gawronski, J. D., and Prigge, G. R. Informal Geometry, J. Weston Walch, Publisher, 1977.

[2]Miller, Wm. A. Geometry Laboratory Activities, J. Weston Walch, Publisher, Portland, Maine 04104, 1975,

[3]TI30 Student Math Kit, includes TI30 calculator, case, manual, 224-page Calculator Math Book. Texas Instruments, Inc.

STATISTICS IN THE HIGH SCHOOL

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The high school mathematics curriculum is continually changing. One of the more recent changes has been the inclusion of a course in statistics, see Pieters (1976). As to the specific makeup of a high school statistics course, there is not likely to be agreement. As to the primary objective of such a course, there should be agreement. The purpose of this paper will be to look at the objective of a high school statistics course.

The key to the development of any course in statistics is deciding what statistics is. Statistics has, since the publication of R. A. Fisher's Statistical Methods for the Research Worker in 1925, been thought of as a set of research tools. In this regard statistics is the investigation of a population. The population of interest may exist or may be created by the researcher.

The study of an existing population is by a sample survey. A part of, or sample from a population is selected and studied. Examples of sample surveys include opinion polls, marketing research surveys, TV-viewing and radio-listening surveys, and preelection polls. A 100% sample is referred to as a census. Of interest in the study of sample survey techniques is how a survey