THE EL-5200 GRAPHIC SCIENTIFIC CALCULATOR:
PRECALCULUS-TEACHER-GENERATED CURRICULUM IDEAS

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During the Summer semester, 1988, fourteen (14) students in a MAT program at the University of West Florida participated in a two-week long seminar in which the impact of an enhanced scientific calculator with graphics capabilities (the Sharp EL-5200 graphic scientific calculator) on the pre-calculus mathematics curriculum was explored and discussed.

The seminar consisted of ten four-hour days. Approximately the first three days were used to familiarize the participants with the EL-5200, six days were used to explore and highlight its capabilities in the context of the standard pre-calculus curriculum, and one day was used to summarize our findings and discussions. The main objective of the seminar was to cause the participants to think about possible curriculum changes and how the EL-5200 could be effectively implemented in the classroom. As part of the seminar requirements, each participant was to produce a mini-curriculum project which dealt with a specific area of the pre-calculus curriculum. The participants were told to assume every student had access to an EL-5200 and that all students had been taught how to use it. With these assumptions in mind, the participants produced projects which addressed both computational and graphical aspects of the curriculum. Some of the projects used the programming capabilities of the EL-5200 as a springboard for applying pre-calculus mathematics. Other projects combined the matrix-handling and graphing capabilities of the EL-5200 to alter the way we teach the solving of systems of equations; while others simply took another look at how we teach the concept of function. And still others addressed how conic sections could be effectively taught using the EL-5200. It is the teaching of conic sections, specifically the parabola, and concerns of the

participants on which the remainder of this paper will focus.

Using the EL-5200 in the teaching of the properties of the parabola can be accomplished in any number of ways; however, many of the participants suggested the following:

(1) Use the EL-5200 to graph a significant number of parabolas in a given form;

(2) Use the trace and zoom features of the EL-5200 to explore and analyze properties of the given parabola (i.e., find values of the vertex, axis of symmetry, etc.);

(3) Provide the definition of the parabola; and

(4) Derive equations of parabolas.

Some participants suggested that the directrix and focus of the parabola also be graphed using the LINE and PLOT features of the EL-5200.

An example will serve to illustrate the progression outlined above. After graphing several parabolas whose equations are all of the form $y = ax^2$, students would analyze the graphs in order to understand the significance of the value of "a". Next, students would be asked to graph several parabolas of the form $y = ax^2 + k$ in order to determine the effect the constant k has on the parabola. At this point, students would be asked to use the trace and zoom features in order to find the coordinates of the vertex. Next, students would graph several parabolas of the form $y = a(x - h)^2$ to gain an understanding of the effect the value of h has on the parabola. Again students would be asked to use the trace and zoom features to determine the coordinates of the vertex of each parabola. Finally, students would graph parabolas of the form $y = a(x - h)^2 + k$ and use the trace and zoom features to find that the coordinates of the vertex are (h,k). Thus, after such a learning sequence, students would have an understanding of the significance of the constants found in the standard form of the equation of a parabola. It should be noted that parabolas of the form $y^2 = 4px$ could also be graphed simply by transforming the equation into $y = \pm\sqrt{4px}$. Even if $p < 0$, the correct graph can easily be obtained since the EL-5200 will ignore any value of x in the given range

which give non-real values. After students have explored and analyzed many parabolas written in standard form, they would be asked to (1) graph some in the form $y = ax^2 + bx + c$, with a $\neq$ 0; (2) use the trace and zoom features to find the coordinates of the vertex; and (3) transform the given general equation into the standard form $y = a(x - h)^2 + k$. This activity would further strengthen their understanding of the significance of the constants a, h, and k.

Max-min problems which give rise to quadratic functions can be solved quite efficiently by graphing the quadratic function involved and using the trace and zoom features to determine the coordinates of the vertex. Consider an example: "Suppose we have 200 feet of fencing and want to enclose a rectangular region of maximum area. Find the dimensions of the rectanglar region." A solution might progress in the following manner: (1) write an equation which describes the situation; (2) decide on a sensible range for each of the variables involved [note: this step is usually overlooked by students]; (3) graph the function (equation) which models the problem; and (4) use the calculator to find the required extreme value. Thus, the graphic calculator allows students to focus on the solution process and not be concerned with the algebraic and/or computational aspects of the situation.

In conclusion, I would like to cite some issues or concerns expressed by the seminar participants. Initially, there was some concern that students would not be willing to purchase a graphic scientific calculator. However, this concern moderated somewhat once the usefulness of the calculator was demonstrated. Another concern was one of competence. That is, participants asked "how proficient must I be with such a device?" As the seminar came to a close, most felt that there must be a basic level of proficiency in order for them to be able to demonstrate and use the machine in its various modes. Probably the biggest concern surrounded the unrestricted use of a graphic scientific calculator by students. There seemed to be a consensus that the teacher should actively guide students in its intelligent use and seek to

highlight traditional topics which could be best taught and learned with the aid of a graphic scientific calculator. Indeed, all of the participants felt that the precalculus curriculum could be enhanced by introducing students to the many capabilities of a graphic scientific calculator.