CAI in Precalculus
Bob Tilidetzke

This study is a modification of a study done in 1988. In the earlier study a different and much shorter range of topics were used with students in four sections of Precalculus. There were two instructors who each taught one control and one experimental section. The students in the experimental section were excused from classes for two days and received all of the instruction via CAI. During the same two days, the students in the control sections received the instruction on the same topics in class. No significant differences were found.

This study was motivated by the need to cover a lengthy syllabus effectively in the allotted time. Since Precalculus, or its equivalent, is a prerequisite for Calculus, it is not possible to address the problem of a shortage of time by deleting topics. Moreover, students in some majors, such as business, use the Precalculus course as the terminal math course for their students. Thus, it is important to cover all of the topics these students need to be exposed to in this course. A better approach would be to incorporate the use of computer-assisted instruction (CAI) as a means of expediting the delivery of instruction.
A pilot study was done during the Fall 1993 semester to compare two sections of a Precalculus course. One section received the usual classroom instruction on the topics designated for the study. The other section received only a short introduction to the topics in class, and worked on computer labs that utilize Derive to receive the rest of the instruction. In the experimental class a demonstration of Derive was given in the class period just preceding the introduction of the first topic, graphs of functions. Both classes were given the same homework assignments from the textbook. Necessary adjustments were made in the labs and classroom instruction before carrying out the study during the Spring 1994 semester. For example, a due date for turning in each lab was set and the graded labs were returned to the students. so they could review them and get feedback. Extensive changes were made in the pretest and posttests. Three open-ended graphing problems were deleted due to the difficulty in scoring these problems objectively. The tests included questions in multiple choice, true/false, and fill-in-the-blank formats. The number of questions of each type was increased to provide adequate coverage of the concepts covered by the deleted open-ended questions.

The topics selected for this study are:

1. Graphs of functions.

This section includes the concepts of increasing/decreasing functions, symmetry with respect to the origin or the y-axis, and odd or even functions. One lab is designed to establish graphically the connection between odd or even and symmetry with respect to the origin or y-axis, respectively. A second lab is designed to enable students to distinguish between functions whose graphs are

linear and those whose graphs are not linear. Students have a tendency to graph every function as a straight line. This lab is designed to convince them that this is not the case.

2. Graphing techniques.

This section introduces six basic functions (identity function, constant function, absolute value function, squaring function, square root function, and cubing function). Then the techniques of shifting, stretching or shrinking, and reflection are presented to obtain the graph of a given function by relating it to one of the basic functions. The lab for this section presents these concepts via the graphing capabilities of Derive.

3. Quadratic functions.

This section contains the notions of vertex, minimum/maximum values, and whether the graph opens up or down. The lab reinforces these ideas graphically.

Results

A pretest was given shortly before the topics were presented to determine if the two groups of students were comparable in their preknowledge of the topics in this study. Following the completion of the instruction on these topics a parallel version of the pretest was given as a posttest. An unpaired two group t-test (2-tail) was used to compare the means on both tests. There was no significant difference in the means on either the pretest or the posttest.

Figure 1 below shows that on the pretest in the pilot study the two groups were comparable in preknowledge of the topics under study (t = -.597 and p = .5539).

Unpaired t-Test X 1:class Y 1:Pretest

DF:	Unpaired t Value:	Prob. (2-tail):
42	-.597	.5539

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Group 1	22	37.186	12.297	2.622
Group 2	22	39.527	13.69	2.919

Figure 1 Pretest in Pilot Study (Fall 1993)

Figure 2 below shows that there was no significant difference in the scores on the posttest in the pilot study (t = .89 and p = .3786).

Unpaired t-Test X 1:class Y 1:Pretest

DF:	Unpaired t Value:	Prob. (2-tail):
42	.89	.3786

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Group 1	22	65.995	18.466	3.937
Group 2	22	61.259	16.802	3.582

Figure 2 Posttest in Pilot Study (Fall 1993)

Similar results were obtained in the Spring 1994 study. Figure 3 shows that the two groups were comparable in preknowledge of the topics (t = 1.434 and p = .1574).

Unpaired t-Test X 1:class Y 1:Pretest

DF:	Unpaired t Value:	Prob. (2-tail):
53	1.434	.1574

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Group 1	30	50.677	14.466	2.641
Group 2	25	45.408	12.392	2.478

Figure 3 Pretest in Spring 1994

Figure 4 shows that there was not a significant difference in the scores on the posttest (t= -.969 and p = .3369).

Unpaired t-Test X 1:class Y 1:Pretest

DF:	Unpaired t Value:	Prob. (2-tail):
53	-.969	.3369

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Group 1	30	73.667	14.106	2.575
Group 2	25	76.96	10.358	2.072

Figure 4 Posttest in Spring 1994

Implications for practice

The results indicate that the use of lab assignments to provide a major portion of the instruction on certain elementary concepts in Precalculus is just as effective as ordinary classroom instruction. It appears that the use of such labs may be an effective way to provide time for more thorough coverage of the more difficult topics.