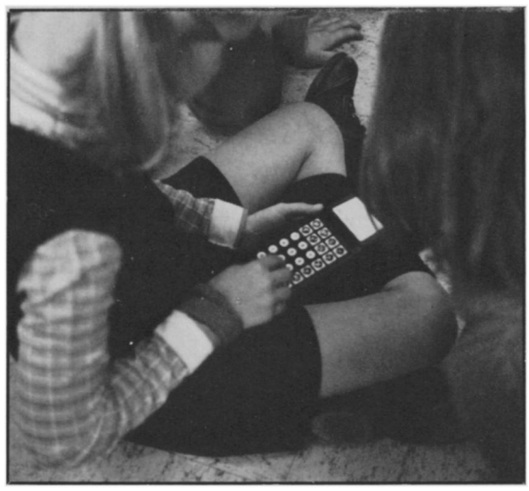
Calculators in the Classroom

Pro: Calculators make tedious math fun, fast and accurate, educators and students agree. When used for creative problem solving, motivation in students seems spontaneous.



Con: Mechanization of fundamental classroom skills may leave kids unable to do simple math on paper. The cost for electricity or batteries may make operating the device daily too expensive.

by Deedee Pendleton

Conrad, a Washington, D.C., second grader, is 1 billion, 296 million seconds old right . . . now. Or, if you prefer, seven years, three months and five days. If you ask him how he knows, he'll tell you he figured it out on his calculator. If that sounds a little unsettling, relax. Conrad is getting a first-hand lesson in using his father's $40 electronic hand calculator at school. And although some parents are complaining the basics of education are being undermined by machines, the kids seem to love it.

Pocket math, as it's called, has been assaulted on all sides, but both the manufacturers of electronic hand calculators and progressive educators are anxious to see one in every classroom, if not one at every desk. Some first graders are already doing basic addition with calculators the minute their teachers feel they understand the principles, and high-school and college students are buying calculators as if they were radios.

Some calculators cost as little as $20, or about the same as some textbooks, and instructors say they could become required equipment in advanced math classes. The pocket-sized units are already replacing textbooks in elementary schools, and teachers are hoping that what once seemed to children a tedious labor may, through the calculator, become fun.

Opponents of calculators say that kids won't know how to count if their calculator batteries ever go dead, just as TV-oriented students no longer seem to know the basics of grammar and spelling. The device, critics contend, will make pencil-and-paper math obsolete.

But instructors who are using them take the opposite stand. They say that calculators stretch the student's interest, allow for more relevant kinds of problems (how far is it to the moon?) and increase motivation. Because of their speed and accuracy, calculators lend themselves to complicated problems previously avoided by grade-school teachers.

"One of the important uses of hand calculators is to enable children to solve more interesting problems, and to work out large divisions which would otherwise discourage them," says George Springer, an Indiana University mathematics instructor. Thus, oversimplified problem solving becomes unnecessary.

Teaching the basics before letting the child experiment with the calculator, many arithmetic teachers say, is essential for the machine's best use. "The hand-held calculator can be a very valuable tool, but only to an operator who understands the basic ideas, concepts and meanings behind the instantaneously generated answers it provides," says Frank S. Hawthorne of the New York State Education Department. Unlike the abacus, a calculator provides little or no help in learning computational skills.

Calculators will help children adjust more readily to a technological world, Springer says, and will make it easier for them to understand decimals, on which the metric system is based.

There is some opposition to the calculator in the classroom, admits Douglas Lapp, a Fairfax County (Va.) science curriculum specialist, but he says it isn't always valid. "Americans are particularly prone to think technology will offer easy solutions to everything, when in fact it simply solves existing problems, but does nothing automatically.

"The fundamental problem in math education still is that kids too often don't know the meaning of mathematical education and won't learn any more than they did by rote memorization," Lapp says. "We need to first give them concrete specific solutions as physical models for multiplication, which they can later transfer to concepts." Jill Horlick, an elementary-school math specialist, agrees. "The calculator doesn't think for you; it doesn't have a brain." She says that once her students can understand the theory of multiplication, they can adapt their knowledge to their imaginations. "Kids *normally* think about the universe; they love to manipulate large numbers because it makes them feel important. Why stop [the child] from thinking beyond those numbers just because he doesn't have the tools yet?"

New mathematical principles adapted for the calculator classroom are inevitable, Horlick maintains. More emphasis is placed on estimation, or on learning to judge which of the answers the calculator gives is reasonable. In addition, decimal placement becomes much more understandable, she says, because the calculator is able to provide answers of 6 to 12 digits, far beyond a young child's ability to calculate on paper. Children too often become bogged down in the complexity of a problem on paper, "and lose sight of the problem they are trying to solve," while the calculator eliminates the long rows of numbers usually associated with four-digit multiplication problems.

Douglas Grouws, a University of Missouri mathematics education instructor, holds that educators "must pay careful attention with regard to how we use [calculators] in the class-

Continued on page 181

. . . Women

scientists in the slide program, all attractive and successful, were photographed at home, in their offices and laboratories, and taped on subjects ranging from the excitement and frustration of their jobs to their personal lives. If Moché's packet proves effective, thousands of potential high-school and college science majors will see the series as a recruiting device.

Purdue has hired two women engineering students to act as advisers for incoming freshmen, and part-time scholarships are being offered to married women, who receive funds for tuition for one course per semester, and additional child care costs for the hours they are in class.

High schools, particularly specialized ones, are slowly falling into line. One New York City vocational school requires students to take 10 of 12 basic courses, including those previously separated by sex. While girls repair typewriters and light fixtures, boys learn stenography, cosmetology and trade dressmaking. Films about career decisions and the effects of sex roles are available to high schools, and some coeducational intramural programs are being initiated.

Getting in on the ground floor is essential to changing attitudes, scientists think. A series of polls taken in the early 1960's by Arline C. Erlick, editor of Purdue's OPINION PANEL, indicated an upswing in high-school students' interest in science. The trend hasn't changed since then, Erlick says, but women students still aren't interested in pursuing science careers. "In school after school we find no girls who want to go into science." Females in general show less interest than males in science and mathematics, and more interest in English and business courses. From other studies, generalizations about those few high-school girls interested in science have emerged: They tend to make better grades in school than other students, participate in extracurricular activities, and are often from families in which at least one parent is employed in a science-related field. They express aspirations for a college education and future high earnings, and a present need for career counseling.

But once the female scientist enters college, her chances of accomplishing her goal quickly diminish. Obstacles such as an absence of adequate model students, failure to question socialization forces which define and limit her aspirations, a dependency on the opinions of men and a desire to be socially accepted quickly get in the way of success in school. "Excellence in competitive achievement," Dora Helen Skypeck, associate professor of math education at Emory University, says, "is either consciously or unconsciously associated with a loss of femininity and the possibility of social rejection. . . ." Skypeck and her associate, Eugene C. Lee, discovered through a decade of research that while more than half of all male science majors decided to become scientists while still in high school, 70 percent of those women who became scientists did not decide on a career until after graduation from high school. Since science majors are usually required to have at least two years of pre-science training before acceptance into specialized programs, many sophomore college students find themselves inadequately prepared to enter science departments with their male peers.

The number of freshmen women expecting to major in science hasn't changed much in the last decade, data collected by the American Council on Education indicates. In 1967 about 9 percent of the women entering college said they intended to major in the physical sciences, engineering, mathematics or life sciences; in 1973, 10 percent showed an interest in those science careers. About 30.7 percent of the freshmen males intended to major in those fields in 1973.

About four times as many freshmen women said they were interested in health professions than did males. Fewer than one in 100 women expressed interest in engineering, but 12 percent of the male freshmen polled said they plan to major in it. About one percent of both men and women students are interested in mathematics and statistics, but three times as many women study computer science as do men.

If a woman is dissatisfied with her initial major selection in science, Brown says, the source of the dissatisfaction will rarely be academic difficulty, and she is more likely to resolve the dissatisfaction by switching majors or schools than by leaving the university.

Some college administrators say scholarships specifically designed for women are the only answer to attracting equal numbers of women into the field, but Brown contends that bribes aren't the answer. "What we have to do is increase the pool of girls who have legitimate interests and are intent on hanging in there." □

. . . Calculators

room. I don't think availability will necessarily eliminate the need to be able to calculate by hand. However, the calculator may shift the emphasis away from proficiency in hand calculations to a greater emphasis on the meanings of the operations and when they can be appropriately applied." Grouws recommends using calculators in combination with basic arithmetic skills by, for example, providing them to students to check handworked problems.

But Horlick maintains that using the calculator for a combination of processes is essential. "You're defeating the purpose if you only used the calculator to check answers. The child wouldn't be learning to use the principles of the calculator."

The primary question, in her view, is, "Does the student know what he's doing?" Much more emphasis must be placed on, "What does it all mean?" than on "How fast can you get the right answer?" Those most opposed to calculators have gone so far as to ban them from the classroom, fearing that the device could become a crutch and keep students from learning the basic mathematical skills. Another argument for calculators, though, is that they make complex and realistic teaching exercises possible (how many cubic centimeters would it take to fill this room?). First graders, Horlick says, love to plan a family vacation, calculating costs of gas, motels and food.

A survey of teachers, mathematicians and laymen by MATHEMATICS TEACHER magazine has revealed that 72 percent of those polled opposed giving every seventh-grade student a calculator to use during his secondary education, but 96 percent agreed that "availability of calculators will permit treatment of more realistic application of mathematics, thus increasing student motivation."

In Virginia's Fairfax County, math teachers voluntarily agreed to permit high-school students to use calculators for homework and for some class assignments, but to forbid their use on tests unless every student in the class has one.

"With prices so low for calculators, it's no more a flight of the imagination to buy a calculator than it would be to buy a textbook," Springer says. When industry uses metrics and decimals exclusively, he adds, students taught to use calculators in school will be able to adapt quickly. There is one calculator for every nine Americans, and students who can't afford their own often borrow calculators from their parents. The device has become an essential part of training in statistics and computer science.

By 1976, the price of some calculators is expected to drop to as little as $10. If it does, the possibility of supplying public schools with them, and consequently incorporating them into elementary- and high-school math programs, may become very real. □