TI Takes a Bold Step for Math Education

By Franklin Demana, Ph.D.

The National Council of Teachers of Mathematics (NCTM) and other leading mathematics educators have long recommended that all students, regardless of age, use calculators to explore mathematical concepts, experiment with mathematical ideas, and discover patterns. The NCTM Curriculum and Evaluation Standards calls for all students to have access to appropriate calculators at all times. This means that even young elementary school students need calculators that let them explore and discover mathematical concepts. The new TI Math Mate™ meets this need.

Texas Instruments has a well established corporate plan that involves teachers in the planning and design of calculators for school mathematics. Teachers were directly involved in both the physical design and the pedagogical features of the new TI Math Mate. Practical and appealing, the Math Mate has a colorful design and Anylite Solar™ power. It also meets specific requests by math teachers for a simple calculator with the correct order of operations.

The built-in Algebraic Operating System (AOSTM) performs operations in the proper order; that is, it multiplies and divides before adding and subtracting. For example, if you calculate $2 + 3 \times 4$ by pressing the keys $2 \mathbf{+} 3 \mathbf{X} 4 \mathbf{=}$, the Math Mate gives the correct answer, 14. Other simple calculators perform the operations in the order entered (called chain computation). These calculators first add 2 and 3, then multiply the result by 4, giving the misleading answer of 20.

There are at least two reasons math educators should be concerned when young students use chain-computation calculators. Educational research shows that students make the common arithmetic error of performing operations in order, from left to right, on pencil-and-paper tasks. Young students (See Bold Step, page 4.)
Major Revisions in SAT Announced by College Board

In October, the College Board of Trustees approved revisions in the College Board Admission Test Program (ATP), including significant changes in the Scholastic Aptitude Test (SAT). The changes will put more emphasis on reading skills, move away from multiple-choice answers to written essays and math computations, and for the first time, allow calculators to be used.

The new ATP will have two major components:

- SAT-I: Reasoning Tests will consist of the current SAT verbal and mathematical tests with increased emphasis on critical reading and new student-generated answers in math.
- SAT-II: Subject Tests will consist of a major new test in writing, subject matter tests, and other tests designed for determining course placement and evaluating English language proficiency.

SAT-I will be introduced in the spring of 1994, with various changes in SAT-II to be phased in starting in 1991.

"These changes will make an already excellent testing program even better," said Donald M. Stewart, president of the College Board. "The new SAT will combine the high, academically demanding standards of the current tests with revisions that increase their educational relevance and quality for all college-bound students."

Mr. Stewart added that the changes came after more than three years of intense study, research, and evaluation. He noted that thousands of educators, testing experts, students, parents, public officials, and others contributed ideas, advice, and opinions to the new SAT project.

The New SAT-I

At least half of the verbal part of SAT-I will be devoted to critical reading. Vocabulary knowledge will be tested through vocabulary-in-context questions based either on the critical reading passages or independent sentences. Analogies and sentence-based questions will be continued, but antonyms will be dropped.

The math section of SAT-I will include test questions that require students to produce a response, not just select a multiple-choice answer.

"The SAT-I math section will include more data interpretation and applied mathematics questions," Mr. McCabe said. "This is similar to the kinds of math a student has to do in college."

He added that the College Board of Trustees also approved a recommendation that students be permitted (but not required) to use calculators in the SAT-I math section.

The New SAT-II

SAT-II will include a new writing test that combines multiple-choice questions and a direct writing sample. It will also include new tests in Asian languages—initially Japanese and Chinese—and a test of proficiency in English as a second language.

Mr. McCabe emphasized the importance of SAT-II as a tool for planning course work and placing college freshmen. He also noted that the impromptu essay will give students an opportunity to use a broad range of knowledge and experience to support their theses.

The New PSAT/NMSQT

As a "preliminary" SAT, the PSAT/NMSQT (Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test) will also change, incorporating more critical reading in the verbal section and more student-produced responses in the math portion. 

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[Diagram of SAT-I and SAT-II changes]

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The release of the School Edition of Super Speak & Math™ introduces a new dimension to classroom teaching tools—speech. Designed to teach and reinforce mathematical concepts and skills for students in grades 2 through 8, Super Speak & Math helps teachers concentrate on communication skills while teaching mathematics.

Developed using the NCTM Curriculum and Evaluation Standards, Super Speak & Math focuses on these concepts/skills:

- Communication and language in mathematics
- Place value
- Regrouping
- Logical reasoning
- Estimation
- Problem solving
- Basic algorithmic understanding

Super Speak & Math’s speech and sound effects, along with its three-line display, give students multi-sensory learning experiences.

Other features that reinforce learning include:

- Repeat key. Super Speak & Math repeats the verbal instructions as many times as needed.
- Immediate feedback. Students hear reinforcing praise for correct responses, and they hear the correct answer, along with encouragement, for incorrect answers.

Super Speak & Math Calculator

As students enter a problem, Super Speak & Math verbally repeats the problem, displays it in vertical format, calculates the solution, and gives the answer verbally and visually.

Super Speak & Math Activities

Six of the activities have three levels of difficulty for different abilities and grade levels.

Super Speak & Math is designed so students can work alone or in cooperative learning groups.

Place Value—A graphic representation of base-ten blocks for tens or ones appears in the display, along with the corresponding numeral, to teach the place value of one- and two-digit numbers.

Trade—Students regroup base-ten blocks to reflect one- and two-digit answers to addition and subtraction problems.

Target—Students apply logical reasoning to use one or all of three given numbers to add as many times as possible to reach a target number.

Select—Addition, subtraction, multiplication, and division skills are reinforced as students select the operation that shows the relationship between a problem and its answer.

Estimate—Students estimate the answer to a problem in as little time as possible.

Math Problems—Students are given problem-solving situations concentrating on place value, number patterns, decimals, fractions, number puzzles, and real-world story problems.

As an added value, an expansion module called Everyday Math™ comes with the Super Speak & Math School Edition. It includes consumer-related problems for comparing prices and figuring discounts and sales tax.

Super Speak & Math will be available in August with accompanying instructional materials for classroom use. For more information, visit our booth at the April NCTM meeting in New Orleans and at several regional and state conferences throughout the year. You can also call 1-800-TI-CARES (1-800-842-2737).
That Rectangular Garden: Unearthing More Fertile Ground!

By Vincent A. Daniele and Joan A. Carr

The March, 1990 (V.2, N.1) issue of It's About T.I.M.E. outlined a calculator activity designed to lead students to the discovery of the rectangular shape that would enclose the largest possible area for a given perimeter. Variations of the problem can be meaningful for students across a wide range of grade levels from middle school to college. For advanced students, use of the TI-81 Graphics Calculator makes the problem exceptionally rich.

The problem as stated in the original article is:

You have 180 meters of fence. You want to use it to enclose a rectangular-shaped garden. What is the largest area that you can enclose with the fence?

While we generally advocate that students experiment formally with different dimensions to verify that the fixed 180-meter perimeter can be maintained as the areas of successive rectangles vary, the programming capabilities of the TI-81 present a second option for such exploration.

Writing a program that would accept various lengths in order to generate the associated values for area requires that students think about the relationship between length, width, and the given perimeter; and it parallels the algebraic steps one follows when assigning x to represent the length of the rectangle in meters, solving for the width in terms of x, and expressing the area as f(x) = x * (90-x).

Both experiences, programming and the more traditional algebraic process, can create some wonderful class discussion.

Appropriate use of the graphing capabilities of the TI-81 fosters understanding of some important mathematics concepts embedded in this problem. For example, when graphing area as a function of length, students see a situation where the domain of a particular function must be described as a proper subset of the real numbers. A more complete model representing the example above is f(x) = x * (90-x); 0<x<90. The calculator visually demonstrates the need to restrict the domain since it indicates that for values of x<0 or x>90, the value of the area function would be negative, a situation students should view as meaningless.

Also, when x=0 or x=90, the function is equal to zero, which is itself an interesting concept worthy of examination. The discussion of the domain can subsequently be tied to an intuitive appreciation students may have for the physical constraints of the rectangle. The nature of length implies that it cannot be negative; but if the length is equal to zero or equal to 90 meters, the rectangle would collapse to a line segment.

The calculator allows for plenty of experimentation in graphing the areas of rectangles with other fixed perimeters. By repeating this kind of activity, generalizations can be made without tedious calculations and without drawing the graphs by hand.

All that is required is the latest in gardening implements...the TI-81.

Vincent Daniele and Joan Carr teach at the National Technical Institute for the Deaf, Rochester Institute of Technology.

Bold Step (from page 1)

who are inquisitive and explore with a chain-computation calculator may develop misunderstandings that make bridging the gap between arithmetic and algebra difficult. These misunderstandings have to be corrected by teachers. Calculators with AOS help in this bridging process because students who explore with AOS calculators actually discover the correct order of operations.

Cost is a major reason schools use chain-computation rather than AOS calculators with young students. Until now, AOS calculators have been about $15 each. The Math Mate is expected to cost only about $2 more than a low-cost simple calculator, thus removing cost as a barrier. It does not seem wise to risk student misunderstanding just to save $2.

Getting students ready to be successful in algebra is an important goal of mathematics educators. Lack of understanding or misunderstanding about order of operations is a barrier to this goal. My hat is off to Texas Instruments for taking the bold step to produce a low-cost AOS calculator. TI and the new Math Mate can be part of the solution to a pervasive problem.

Franklin Demana is a professor at The Ohio State University.
ASU Calculator Project Final Report Released

In 1988 and 1989, a calculator study involving 580 Arizona students was performed by Drs. Gary Bitter and Mary Hatfield of Arizona State University. The purpose was to integrate calculators into a middle school mathematics curriculum and evaluate the effects on students’ achievement in math and attitudes of parents, teachers, and students.

Results of the Project
The project showed that students’ mathematics performance improved significantly when they used calculators. Eighth-graders improved on all three Iowa Tests of Basic Skills (ITBS) subtests, while seventh-graders improved on the computational skills subtest.

Recommendations
While positive results were found, the results suggest that achieving NCTM goals for curricular change by improving mathematics education through the use of a calculator-based program must continue to be explored to determine:
- The most effective ways to integrate calculators into the math curriculum.
- How calculators improve mathematics performance.
- The appropriate use of calculators in math instruction.
- Whether there are prerequisite skills students should have before they begin using a calculator.

To implement the NCTM vision of integrating calculators into middle school mathematics programs, a comprehensive plan is necessary.

The plan should include:
- Long-term support and a solid commitment of resources.
- Instruction on using calculators in the math curriculum.
- Methods for improving awareness of research results among teachers.

It is also important for teachers to examine their attitudes about teaching and learning math using calculators.

Efforts to reform mathematics education will take longer if adults persist in the fear that calculators prevent students from learning basic arithmetic properly. On the contrary, research demonstrates that students who use calculators develop "better problem-solving skills and much better attitudes about mathematics" (National Research Council, 1989, p. 48).

For a copy of the final report, contact us at 1-800-TI-CARES (1-800-842-2737) or write to us at:

It’s About T.I.M.E.
P.O. Box 53
Lubbock, TX 79408-9955

Prentice-Hall Plans Materials for TI-81

Prentice-Hall School Division will publish two booklets using the TI-81 Graphics Calculator to explore Algebra I and Algebra II topics. Each booklet will contain student lessons including examples, calculator instruction, exercises, and critical-thinking activities. Also included will be teaching suggestions and an answer key. The anticipated publication date is in the spring of 1991.

If you have ideas or suggestions for other TI-81 supplemental materials, please write to:
Rosemary Calicchio
Prentice-Hall School Division
Route 9W
Englewood Cliffs, NJ 07632

TI-81 Teachers Forum Announced

The first meeting of the TI-81 Teachers Forum will be held during the NCTM meeting in New Orleans on Thursday, April 18, at 6 p.m. in the Rosedown Room at the Hilton Hotel.

The forum will provide opportunities for teachers using the TI-81 to meet and share experiences; ask questions; compare notes, classroom activities, and programs; and find out how the power of visualization is spreading across the country. Please join us!

If you will not be able to attend the meeting in New Orleans, look for news in the next issue of It’s About T.I.M.E. on where a meeting in your community will be held.

Math Explorer Video Available

A new video that helps teach the use of the calculator is available from Silver Burdett & Ginn. Using the TI Math Explorer, the video’s "amazing problems" engage students and encourage them to explore the calculator. It not only demonstrates the calculator’s functions, but it also helps students understand when it is best to use a calculator.

The calculator video is for grades 4 through 8. It is closed-captioned for the hearing impaired.

Information for Ordering

Price: $60.00
Refer to: ISBN 382-23184-8
To order, call toll-free 1-800-848-9500.
TERC Receives $6.1 Million Grant for Math Curriculum

There is hope for all those students who are tired of endless multiplication and division drills and for the teachers who are looking for ways to encourage true mathematical thinking in their classrooms. Technical Education Research Centers (TERC), a leading educational research and development organization, is creating an elementary mathematics program to change dramatically how math is taught in American schools.

Funded by the National Science Foundation, this $6.1 million, five-year project will provide a comprehensive curriculum for kindergarten through grade 6 that encompasses the NCTM Curriculum and Evaluation Standards.

The program consists of instructional modules, including print materials, selected software, and videotapes for students and teachers. Some modules in the curriculum will include significant use of computers as tools, and a number of the activities will use calculators in creative ways, not just for computation.

The new curriculum represents a departure from typical mathematics curricula. It aims to:

• Offer students meaningful math problems. The materials provide investigations that intertwine developmentally appropriate mathematics with a compelling context. These investigations both captivate students and challenge them mathematically.

• Emphasize depth rather than exposure. Students and teachers explore carefully selected, important topics in substantial depth, rather than cover numerous topics in a superficial manner.

• Communicate mathematics content and pedagogy to teachers. This curriculum does not simply provide a collection of activities for students; it is a vehicle for teacher growth and development in mathematics.

• Expand the pool of mathematically literate students. While providing interesting, challenging problems for all students, these materials address the needs of students who have been less inclined historically to continue the study of mathematics beyond minimum requirements—specifically girls, minorities, and students with special needs.

One of the central challenges is to write materials which are mathematically and pedagogically sound, more effective than textbook-based approaches, but not too difficult for teachers to implement.

Dr. Susan Jo Russell, director of the project, states that, "We are designing a curriculum which makes sense to elementary school teachers. It must clarify, rather than obscure, what mathematics is; it must make math more, rather than less, accessible; it must relate to what teachers understand. It must build upon their best intuitions about how their students learn and what their mathematics experience could be. It must challenge teachers to do mathematics teaching very differently without making overwhelming demands."

The project is planning field tests in three different school systems: Boston, Massachusetts; Arlington, Massachusetts; and Buffalo, New York. During these field tests, project staff will conduct extensive classroom observations that, combined with feedback from teachers and students, will provide the basis for the revision process. Research on students' understanding of certain mathematical concepts will be conducted concurrently with the field tests and used to inform the development process.

The new curriculum, which builds upon TERC's acclaimed materials Used Numbers: Real Data in the Classroom, is organized into three major content areas: investigations in numbers, data, and space. At each grade level, within each of these three areas, the content is presented in a series of modules that embody a set of developmentally appropriate mathematical ideas.

Number modules focus on problems to encourage flexible numerical thinking and to create an awareness of the power of numerical relationships.

Data modules focus on collecting and analyzing data, developing techniques to summarize and compare data sets, and using data to make decisions.

Space modules give students experience with a range of standard and nonstandard measures, classifying and measuring regular and irregular shapes, and describing and exploring geometric relationships.

Curriculum developers from Kent State University, State University of New York at Buffalo, and Southeastern Massachusetts University are collaborating with TERC on development of the modules, as well as the software and video components. Dale Seymour Publications of Palo Alto, California, the publisher for this project, has also published TERC's Used Numbers modules.

Brochure Offered

To request a list of TI Instructional Products, call Customer Relations toll free. Ask the representative for a 1991 Instructional Calculator brochure.

In the brochure, you will find a color photo and complete description of each TI instructional product.

The number to call for the brochure is: 1-800-TI-CARES (1-800-842-2737).
Tech Conference Goes West

The Annual International Conference on Technology in Collegiate Mathematics (known as "the Tech Conference") was first held in 1988 at The Ohio State University. The conference is a response to a growing need among college and university mathematics faculty to understand the new ways technology is being used in teaching and testing today's college math students. The conference has become an important forum for reviewing research, discussing pedagogy, and previewing new technologies.

At the third Annual Tech Conference, held in November, 1990, at Ohio State, more than 800 participants attended presentations, workshops, mini-courses, and contributed-paper sessions. Representatives of the National Science Foundation spoke on funding opportunities. Panel discussions were held on the impact of technology on calculus reform. Everyone had an opportunity to see how to use graphing calculators and graphing software effectively in the classroom.

For 1991, the Tech Conference is moving to Portland, Oregon, and will be hosted by Portland State University on November 14-17. Program Chairpersons Bert Waits and Frank Demana of The Ohio State University see the move as a way to make the conference more accessible to people in different parts of the country. Future sites are still to be determined.

For more information about the 1991 program, contact Bert Waits or Frank Demana at 614-292-1934. For registration information, write to the conference sponsor:

Addison-Wesley Publishing Company
Attn: Conventions Dept.
1 Jacob Way
Reading, MA 01867-9984

TI-81 Workshop Planned

Dr. Tommy Eads of the North Lamar Independent School District in Paris, Texas, has developed an outline for a six-hour workshop for mathematics teachers on the use of the TI-81 Graphics Calculator in grades 9 through 12.

Tommy Eads is a popular and experienced teacher and workshop presenter. He has been teaching with graphing calculators since 1988, and currently uses the TI-81 with four precalculus classes and one advanced-placement calculus class. Enthusiastic about the use of technology in math education, Dr. Eads notes that "many teachers will not use technology because they have not had the time set aside for experiences in the use of new technology."

To counter this problem, Dr. Eads developed the workshop outline as a guide for teachers wanting to train other teachers.

Dr. Eads begins the workshop with an introduction and overview that includes an assessment of the background and experience of the attendees, including the subject areas and grade levels they teach, as well as their previous experience with technology.

Next he reviews the NCTM's standards for using technology in the classroom.

Planning a Calculator Workshop?

To support teacher training efforts, TI offers several services. We can refer you to an instructor and loan you a set of 30 calculators for your calculator workshop.

Please call us for instructor referrals. Then make the arrangements for your workshop with the instructor and

contact us again if you need a loaner set of calculators.

For complete information, call or write:

Alva Farmer
Texas Instruments
M/S 3946
P.O. Box 650311
Dallas, TX 75265
214-917-1550
Help Us Update the Mailing List

It's About T.I.M.E. is published several times a year and distributed free to anyone interested in math education. To help us keep our mailing list current, fill out and mail the form below if your address changes.

Please make copies of the form for friends and associates who would like to receive future issues of our newsletter.

Share Your Ideas

We can publish all the latest news about projects that concern technology in math education, but our best source of information about how to apply technology in the classroom comes from you. If you have an idea for an article for It's About T.I.M.E., please let us know.

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