Calculator Study Yields Encouraging Results

Nationwide, more than one in ten school age children have been identified as handicapped. With the growing emphasis on providing these students a greater variety of service delivery models (e.g., special education within the content of the regular mathematics class), educators are faced with the problem of how to effectively address special students' academic needs. This article describes a project in which children with mental retardation and learning disabilities used technology to address computation math deficits through the use of a readily available and inexpensive educational tool, the handheld calculator.

The project assessed the following:
• Whether students with learning disabilities or mental retardation could be taught to master the use of the handheld calculator.
• How long the teaching of calculator skills would take for each population.
• What effect the calculator would have on the students' accuracy on computation tests as compared to accuracy with paper-and-pencil algorithms.

Sample Population

All the participants were students in one of two mixed-category (learning disabled and mildly mentally retarded), self-contained special education classes in a large, urban school district in western New York. The students ranged in age from 10 to 13. The 11 students in class 1 had mathematics grade equivalents between third and mid-third grade level. The 8 students in class 2 had mathematics grade equivalents between the mid-first and late-second grade level.

None of the students exhibited severe acting-out behaviors that would inhibit their instruction, nor were they currently using a calculator in their math classes.

(See Calculator Study, page 4.)

1991 Conferences (Through December)

Texas Instruments will be exhibiting at the following conferences. We hope to see you there!

<table>
<thead>
<tr>
<th>Conference</th>
<th>Location</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional NCTM</td>
<td>Louisville, KY</td>
<td>10/10-12</td>
</tr>
<tr>
<td>NW Math Conf.</td>
<td>Vancouver, BC</td>
<td>10/17-19</td>
</tr>
<tr>
<td>Regional NCTM</td>
<td>Baltimore, MD</td>
<td>10/31-11/2</td>
</tr>
<tr>
<td>AMATYC</td>
<td>Seattle, WA</td>
<td>11/7-11</td>
</tr>
<tr>
<td>Regional NCTM</td>
<td>Albuquerque, NM</td>
<td>11/7-9</td>
</tr>
<tr>
<td>OSU Tech</td>
<td>Columbus, OH</td>
<td>11/9-11</td>
</tr>
<tr>
<td>Regional NCTM</td>
<td>San Juan, PR</td>
<td>11/18-20</td>
</tr>
<tr>
<td>Regional NCTM</td>
<td>Nashua, NH</td>
<td>11/21-23</td>
</tr>
<tr>
<td>Regional NCTM</td>
<td>Long Island, NY</td>
<td>12/4-6</td>
</tr>
</tbody>
</table>
Book Review: Using the TI-81 Graphics Calculator to Explore Functions

This compact and highly readable book by Dr. Brendan Kelly contains everything a teacher needs to integrate graphics calculators into the senior high curriculum. With liberal doses of history, humor, and real-world problems, the author leads the reader (student or teacher) through the use of these devices to find roots, explore shapes, and optimize functions.

There are eleven two-page "explorations" or lessons in this monograph, each one containing some historical figure or fact, worked examples, theory exercises, calculator exercises, open-ended (and pleasantly difficult) investigations, and a "challenge" exercise. Teachers could use this as a lesson plan or as a structure for group problem solving and investigation. Each of these explorations has enough work for several class hours if all the open-ended material is completed by every student.

The book assumes that students and teachers understand the operation of a TI-81 (or at least that they will use the manual) and concentrates on the next level—the mathematics and the problems that can be cracked with appropriate use of this technology. When required, keystrokes are indicated. Most of the graphs use the default x and y ranges, or they are obtained from this range by zooming out a couple of times. No calculator programming knowledge is required to follow the investigations.

The answer key contains the most likely answers for the questions (and some hints for the investigations), with clear diagrams and appropriate key sequences. The worked examples are equally clear, showing keystrokes, diagrams, and axis labels.

The book could use a more detailed teacher answer key for the challenge sections and for the open-ended activities. In addition, the inclusion of at least one polar or spiral non-function inquiry would have extended the set of investigations.

However, the entire book contains a liberal dose of the Irish humor of Brendan Kelly and well-thought-out historical vignettes on important problems and mathematicians. Teachers wanting to use the TI-81 or TI-81 ViewScreen will find this book a most valuable addition to their classroom resources.

This review of Dr. Kelly's book was written by Dr. David Kennedy, Math Coordinator, Langley School District #35, British Columbia. Dr. Kennedy has used programmable and graphics calculators in his algebra and calculus classes for eleven years.

For more information about Dr. Kelly's book, write to:
Brendan Kelly Publishing Company Inc.
2122 Highview Drive
Burlington, Ontario L7R 3X4

C²PC Update

Teachers all over the United States participated in "Calculators and Computers in PreCalculus" workshops this summer. Professors Bert Waits and Frank Demana of The Ohio State University traveled to California, Texas, Oregon, Indiana, Alaska, and Montana to present ten weeks of this intensive program that trains teachers, showing them how to use technology to lead a more lively, interactive precalculus course. Professors Waits and Demana also went home to Columbus for two weeks to bring another 35 teachers into the C²PC fold and to train 10 trios of teachers to present C²PC workshops. These newly trained workshop leaders are now available to bring C²PC to your district or state.

All graduates of C²PC and related projects are invited to the Fourth Annual C²PC/First Annual CalcNet and TRANSIT Teacher's Conference at Ohio State on the weekend of December 13-14, 1991. This will be a great opportunity to share your successes and frustrations with other C²PC teachers and offer your ideas for improving the program. Activities will include a graphing calculator program exchange (bring your favorite!), presentations by Professors Chuck Vonder Embse of Central Michigan University and Greg Foley of Sam Houston State University, and updates on technology and testing, the success of C²PC students in calculus, and new textbooks and products.

For more information on C²PC, new C²PC workshop leaders, or the Teacher's Conference, contact Renee Hartshorn or Sherrie Kauffman at The Ohio State University, (614) 292-1934.

Dealer Announced for Puerto Rico

Texas Instruments Instructional Calculators are now available through our new Puerto Rican distributor, Caltex Distributors, Inc.

For details, contact:
Ruben Rivera
554 Ave. de Diege
Puerto Nuevo, Puerto Rico 00920
Telephone: (809) 782-5110
GIFT Recognizes Innovative Mathematics and Science Teachers

GTE recognizes the important connections between pre-college education, higher education, and the health of American industry. Through the Growth Initiatives For Teachers (GIFT) program, GTE supports and sustains excellence in the teaching of secondary mathematics and science.

Through GIFT, outstanding mathematics and science teachers from grades 6 through 12 receive funds for school enrichment and professional development activities. These funds provide the teachers with opportunities to update their subject knowledge and undertake innovative classroom projects. GIFT is designed to broaden horizons, offer new opportunities, and foster creativity.

A key feature of GIFT is the integration of mathematics and science in a school's curriculum. For this reason, one mathematics and one science teacher from the same school form a "team" and submit a School Enrichment proposal that links the two disciplines in an innovative way. Each team member submits an individual Professional Development proposal to suit his or her needs. This collaboration promotes shared learning experiences for the teachers and demonstrates to the students the value of integrating related subject areas.

GIFT was established by GTE in 1983 with a pilot effort in North Carolina. In 1988, the program was offered in seven states. For the 1992-93 school year, GIFT will be available in 30 states and the District of Columbia.

For more information regarding the GIFT program, contact your local GTE office or write or call the program's national manager:

Ms. Martha Kramer
GTE Service Corporation
One Stamford Forum
Stamford, CT 06904
(203) 965-2000

Bilingual Materials for Classroom Calculators Available by Year’s End

To meet educators' growing needs for bilingual instructional materials, Texas Instruments will begin including teaching materials in both English and Spanish in the classroom kits for their Instructional Calculators.

The new bilingual materials will have teaching notes, transparency masters, and activity sheets in English on the front and in Spanish on the back of each page of the materials.

Classroom calculator kits with the bilingual materials will be available before the end of 1991.

Math Mate September, 1991
TI-30 Challenger September, 1991
TI-108 October, 1991
Math Explorer December, 1991

Kits purchased after these dates will automatically include the bilingual materials.

For more information about the bilingual materials or any calculator in the TI line of Instructional Calculators, call toll-free 1-800-TI-CARES (1-800-842-2737).

TI-81 Forums Planned for NCTM Conferences

Look for TI-81 Graphics Calculator Forums to be held at each of the conferences listed below. Don't miss your opportunity to share programs and articles and to hear what other educators have to say about teaching with the TI-81.

Louisville, KY 10/10-12
Baltimore, MD 10/31-11/2
Albuquerque, NM 11/7-9
San Juan, PR 11/18-20
Nashua, NH 11/21-23
Long Island, NY 12/4-6

If you are unable to attend a regional meeting and would be interested in organizing a TI-81 Forum at your state or local NCTM conference, please call Richard Howell at (214) 917-1570.

TI-81 Information Library To Be Established

Texas Instruments is preparing a TI-81 Graphics Calculator Library—a compilation of articles, workshop materials, and programs written by teachers and professors for and about the TI-81.

Articles dealing with any field of math are welcome, as well as programs, games, or workshop materials.

Before submitting articles for consideration, call Alva Farmer at (214) 917-1550 to request a TI-81 Library permission form for article/abstract inclusion. Return it with your submission to:

Alva Farmer
Texas Instruments
M/S 3946
P.O. Box 650311
Dallas, TX 75265

Look for details on how to request information from the library in the next issue of It's About T.I.M.E.
Middle school students were chosen to test the effects of calculator training at both the upper-elementary and middle school levels. Fractions were selected as a content area because they are included in the mathematics curriculum of middle school students.

**Materials and Instrumentation**

The materials used included 11 lessons developed by the researcher for this project. Calculator use was taught in each lesson, and every lesson contained a mastery test. Students were required to achieve a minimum of 90% on the mastery test in order to progress to the next lesson.

Students in class 1 were given 11 lessons covering the basic operation of the calculator and the addition, subtraction, multiplication, and division of whole numbers and fractions. Students in class 2 were given 5 lessons covering the basic operation of the calculator and the addition, subtraction, multiplication, and division of whole numbers.

The Texas Instruments Math Explorer Calculator was used in this study. The Math Explorer was chosen because it has the basic functions common to the typical handheld calculator and has the unique ability to:

- Perform functions with fractions.
- Divide whole numbers with an integer as a remainder.
- Convert improper fractions to mixed numbers.
- Convert between decimals and fractions.
- Perform functions with negative integers.

At the completion of each lesson, each student in class 1 was given a computation test using paper-and-pencil one day and the same test using the calculator the next day. Test items included addition, subtraction, multiplication, and division of whole numbers and fractions. Students in class 2 followed the same procedure, taking computation tests including addition, subtraction, multiplication, and division of whole numbers.

**Method**

Students were taught the calculator lessons in groups of two or three during twenty minute periods every Wednesday, Thursday, and Friday. Students continued learning each lesson until mastery was reached. For example, if a student mastered lesson 1 (90% correct responses using the calculator) after session 1, s/he then started lesson 2.

**Data Collection**

Data on student progress consisted of:

A) Tabulation of the number of sessions necessary to reach mastery for each student.
B) Performance on the end-of-lesson tests during each phase.

Data on calculator proficiency consisted of performance on a computation test using paper-and-pencil algorithms one day compared to performance on the same test using the calculator the next day.

**Results**

Students in class 1 took an average of 7.25 sessions to complete their 5 lessons to mastery. The first 4 lessons were mastered by every student after one session for each lesson. Once again, division of whole numbers was the most difficult calculator algorithm to master, with students averaging over 3 sessions to reach mastery. On the computation test, students in class 2 answered an average of 4.4 out of 8 problems correctly using paper-and-pencil algorithms. When using the calculator, these students answered an average of 7.85 out of 8 correctly.

**Conclusion**

All of the students in this study were able to master the use of the calculator with relative efficiency and ease. On average, students doubled the number of computation problems completed correctly when using the calculator as compared to using paper-and-pencil algorithms.

The use of the Texas Instruments Math Explorer seems to successfully address the computation deficit areas most commonly affecting secondary students with learning disabilities. Students with mild handicapping conditions mastered the calculator’s functions in a timely manner. Furthermore, students expressed that they enjoyed using the calculator and found it "fun."

This study was done by Michael Glover, Assistant Superintendent for Instruction at the Albion Central School District in Albion, New York.

The study was conducted under the supervision of Dr. John F. Cawley of S.U.N.Y. at Buffalo.
PC-81 Emulation Software Now Available

Educators, now you can print out your TI-81 programs and screen displays!

With the PC-81 Emulation Software, all the powerful, easy-to-use functions of the TI-81 Graphics Calculator are now available on an IBM-compatible personal computer. The new software not only emulates all the TI-81 Graphics Calculator functions, but also lets you print, save, export (save to a disk), and import (retrieve from a disk) the TI-81 displays and programs you create using the emulation software.

Programs created with the PC-81 Emulation Software can be saved to disk for future use and for exchange with other people. For starters, five programs are included. And the PC-81 software can be used with an LCD panel and an overhead projector for demonstrations and lectures.

To use the PC-81 software, you need a CGA, EGA, or VGA video adaptor, 300k bytes of available RAM, and the 2.0 or later version of MS-DOS. The print utilities require an Epson-compatible printer. The software also supports a Microsoft-compatible mouse.

For more information about the PC-81 Emulation Software, please contact your nearest instructional dealer or call 1-800-TI-CARES.

Student Packs: Single Instructional Calculators Offered

In response to requests from teachers and parents for a single-unit classroom calculator kit, TI is making the Math Mate, Math Explorer, and TI-30 Challenger available in Student Packs.

Each Student Pack consists of a calculator and a Quick Reference Guide. The Challenger and Math Explorer also include Quick Reference Cards.

The Student Packs are now available from TI Consumer Relations. To order, call toll-free 1-800-TI-CARES.

K-12 Calculator Research Summarized

Texas Instruments frequently receives requests from teachers for data regarding the use of calculators in the classroom. This information is often needed to support requests for funds to purchase calculators and to address the concerns of parents about the role of calculators in mathematics instruction.

To fulfill this need, a review of the current research on calculator use in grades K through 12 was completed. A summary of that review is available to teachers free of charge. To order a copy of the summary report, contact Consumer Relations by calling toll-free 1-800-TI-CARES (1-800-842-2737) or writing to this address:

It’s About T.I.M.E.
K-12 Research Summary
P.O. Box 53
Lubbock, TX 79408-0053

TI Supports Calculator Training

TI wants to support your calculator training efforts. 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 call 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
Telephone: (214) 917-1550

The Math Mate, TI-30 Challenger, and Math Explorer are now available for purchase by individual students, parents, and teachers.
Share Your Technology Successes

We can publish all the latest news about technology in math education, but our best source of information about how to apply technology in the classroom comes from you.

If you would like to share your ideas, write an article for It’s About T.I.M.E.. Send your articles and any other correspondence concerning the newsletter to:

It’s About T.I.M.E.
P.O. Box 53
Lubbock, TX 79408-0053

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City: ____________________________ State: ____________ Zip: ____________________________

Position:  
___ Teacher  ___ PTA  ___ Math Supervisor  ___ Math Professor  ___ Math Ed. Professor  ___ State Math Dept.  ___ Publishing Company
___ Other: ____________________________

Grade Level:  
___ PK-2  ___ 3-6  ___ 6-8  ___ 9-12  ___ College  ___ Teacher Training
___ Other: ____________________________

Calculator:  
___ TI-108  ___ TI-30 Challenger  ___ TI-30 SLR+  ___ TI-34  ___ TI-81 Graphics
___ TI Math Explorer  ___ Other: ____________________________

Workshops:  
___ I'm interested in giving workshops.  ___ Teacher Training
___ Other: ____________________________

School District: ____________________________

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