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Calculators May Be the Wrong Answer As a 'Digital Divide' Widens in Schools

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LOUISVILLE, Ky. Rick Martin's fifth graders get flummoxed subtracting two-digit numbers. Hardly any know their multiplication tables.

But in his class, they don't have to.

"Go ahead and get your calculators out," the teacher tells his students at Hazelwood Elementary School one morning. Then, he assigns this problem: The Voyager 2 satellite was launched in August 1977 and reached Neptune in August 1989. How many months did the journey take?

Mr. Martin's 24 students – 11 are black and 17 live in a nearby public-housing project – start punching numbers on calculators that the school bought for them. But most flounder, not understanding that they have to subtract 1977 from 1989 and then multiply the difference by 12. Several students shout wrong answers before 11 year-old Rodney Murphy provides the correct one: 144.

Mr. Martin flicks on the overhead projector for some review work. But what he illuminates on the screen isn't a multiplication table. It's a special transparent calculator for teaching. "Let's do this one together," he says.

A digital divide has appeared in U.S. elementary schools, but it's the reverse of what you might think.

There is widespread concern about a lack of computers for poor minority students and a widening racial gap in math achievement. But low-income and minority elementary school students are actually more likely to use one form of technology than their better-off, white counterparts: the calculator.

Affordable Machines

Unlike computers, calculators are so inexpensive that any school can afford them. Elementary schools typically buy their calculators for roughly $5 each from wholesale distributors for Texas Instruments Inc. and smaller manufacturers. In states such as Kentucky, which let students use

calculators on standardized tests, some struggling schools aim to raise scores by emphasizing calculator-based instruction.

Teachers like Mr. Martin favor calculators as motivational tools. These instructors hope the machines will boost the confidence of students whose computational skills are shaky and help introduce them to concepts such as time and distance.

But more calculator use in inner-city schools generally hasn't added up to higher test scores. The majority of experts on elementary-school learning maintain that, for students who lack basic number proficiency, calculators may provide only the illusion of progress. "Kids get to use calculators as a substitute for practice, and they never really understand arithmetic," says Sandra Stotsky, deputy education commissioner in Massachusetts, a state that has taken a back-to-basics approach.

An increasing number of teachers in harried urban schools take a different view. "For at-risk children, a calculator is a valuable tool" that can boost self-esteem and stir curiosity, says Brenda Stokes, a third-grade teacher at Hazelwood Elementary.

Stirring Controversy

Regular calculator use in elementary school has stirred controversy since the 1980s. Calculator manufacturers and certain education groups have pushed the idea. Suburban parents in some areas have rallied against it.

But now, evidence of a calculator divergence based on race and wealth suggests that technology may sometimes reinforce inequities in scholastic achievement, rather than narrow them.

The Brookings Institution, a Washington, D.C., think tank, issued a study in September that found that half of black fourth graders nationwide and 44% of Hispanics use calculators every day, compared to only 27% of whites. Analyzing data from the National Assessment of Educational Progress, a federal standardized exam, Brookings found that the every-day calculator users scored lower than less-frequent users, both overall and within each racial group. Students are allowed to use calculators on the test.

"This raises a troubling new perspective on the 'digital divide' that deserves serious attention," Brookings concluded.

The think tank limited its analysis to race. But the same test data indicate that poor students and those whose parents have relatively little education also are more likely to use calculators more frequently. Among fourth graders qualifying for government-subsidized lunches, 45% reported using calculators every day in class, compared to 29% of students from better-off families. Among children who reported that their parents didn't finish high school, 42% said they use calculators every day, compared to 28% of children of college graduates. Public-school students were more than twice as likely to use calculators every day in class as those attending private school.

Roughly similar patterns exist here in Kentucky, where an elementary-school student who is black and poor is more likely than a wealthier white student to be encouraged to use a calculator, rather than figure out problems mentally or with pencil and paper. On a survey that accompanied a statewide math test in April, 43% of fifth graders in Jefferson County, which includes Louisville, reported using calculators almost every day in math class. The statewide figure was only 33%. Jefferson County schools are 30% black, compared to 10% statewide.

At Hazelwood Elementary, where nearly half of the students are black and almost all qualify for subsidized school lunches, 76% of fifth graders said on the statewide survey that they use calculators almost every day. By contrast, at Greathouse/Shryock, a suburban Louisville school with a predominantly white, upper-middle class student body, only 16% of fifth graders said they use calculators so frequently.

On the statewide math test, which allows students to use calculators, fifth graders at Greathouse scored an average of 104, exceeding the "proficiency" level of 100, on a scale of 0 to 140. The statewide average was 67. Hazelwood fifth graders scored only 40.

The Chicago Fiasco

Initially, some urban teachers were wary of calculators. When Chicago in 1988 became the first large city to buy them for all students in grades four through eight, the experiment turned into a fiasco. Teachers didn't receive adequate training on how to use the devices in class. Calculators remained in their boxes and were stolen by the hundreds.

But with a nudge from manufacturers and some major education groups, inner-city teachers have embraced calculators. Texas Instruments, which makes 80% of the calculators used in U.S. schools, has promoted its product with textbook publishers and teachers of all grades. The company this year gave nearly $500,000 to the National Council of Teachers of Mathematics for the professional group's training academy, and has occasionally paid for bringing teachers from abroad to speak at the council's conferences.

In 1989, the influential math-teachers organization had said it found "no evidence to suggest that the availability of calculators makes students dependent on them" and urged their use starting in kindergarten. This year, before it received the Texas Instruments donation, the group revised its guidelines to extend the endorsement of calculators to pre-kindergarten.

Texas Instruments, based in Dallas, gives calculators to textbook publishers and authors for testing, and the company produces its own classroom texts. Ms. Stokes, the third-grade Hazelwood teacher, supplements her Houghton-Mifflin textbook, which calls for moderate calculator use, with games and exercises provided by Texas Instruments.

Thomas Ferrio, a Texas Instruments vice president, says he doesn't know whether it sells more calculators per student to urban districts, because it doesn't track sales that way. He does assert that calculators can spur low-achieving students to acquire basic skills. "I see teachers using the technology as a motivational tool for students to keep them interested," he explains.

Hazelwood Elementary's Mr. Martin, who once dressed up as Julius Caesar for a history lesson, says calculators can "broaden [students'] horizons." But some of his fifth-graders seem overly dependent on the devices.

Asked to subtract 27 from 35 without electronic aid, 10_year_old Tarrell Holstein takes a pass. "Oh, man, I hate subtraction," he says.

Invited to multiply nine times six the old-fashioned way, Steven Coleman shakes his head. "I can't do it mentally," the 11 year-old says.

At Shelby Elementary School in Louisville, which like Hazelwood is about half black and mostly poor, students traditionally had to share calculators. Then, last year, the Kentucky state accountants' board donated calculators left over from its state licensing exam, so that every Shelby student could have one. The proportion of fifth graders using calculators almost every day in math class soared to 53% this spring, from 33% a year earlier. But fifth-grade math scores on the statewide test dropped to 48, from 49.

Is it 'Cheating'?

Kristen Spetz, a Shelby fifth-grade teacher, used to drill her students on multiplication facts for most of the year. Now she's a calculator convert. Memorization "was stressing these kids out," she says. "They couldn't get past it. Now we hit multiplication, we practice our tables, and we move on. The calculator takes away a lot of stress."

"A lot of kids think it's cheating," the teacher says. But she assures them: "It isn't [cheating] if it helps you."

Some fifth graders in Louisville seem to lack the numbers sense to employ calculators effectively. One morning, Ms. Spetz assigns the following problem: One student is paid $5 a day to clean the hallways. Another student is paid only one cent the first day, but his wages double on each succeeding day. After 21 days, which student has made more money?

The 29 fifth graders set to work with their calculators. While most of them correctly figure that the first student would earn $105, all of them understate the second student's income ($10,485.76 on the 21st day alone). Their error isn't computational but conceptual. They don't know what doubling means. Instead of continually multiplying by two, they add by twos, or ones.

Calculator-Free Classes

Engelhard Elementary in downtown Louisville has found a different solution to math woes. At the school, where half of the students are black and 80% are low-income, only 14% of fifth graders in April reported using calculators almost every day. Yet Engelhard's fifth-grade math score rose to an average of 60, from 56, an improvement that helped earn the school extra state funding.

Engelhard benefits from the involvement of volunteers from local colleges, but it also emphasizes mental math. Every Monday, these student teachers lead calculator-free math lessons for fourth and fifth graders, concentrating on strategies for memorizing multiplication tables.

Surveys in other states indicate varying degrees of racial and economic gaps in calculator use. In Pennsylvania, for example, only 5% of fifth graders taking the statewide math test in February and March reported using a calculator almost every day for math class or homework. But for black fifth graders, the figure was 9%, compared to 8.6% for Hispanics, 4.4% of white students and 4.1% of Asians.

Maine, a state whose population is 98% white, also has asked students about calculator use. Of fourth graders who reported using calculators almost every day, 47% didn't meet state math standards on a test in March, on which they were allowed to use calculators. In contrast, of students using calculators two or three times a month, only 23% fell below standards. Maine officials declined to provide data on the race and economic status of its calculator users.

Many educational authorities agree that occasional calculator use is appropriate in elementary school – to check answers, for instance, or add long columns of numbers for a science project. By high-school algebra and calculus classes, students of every race and income level depend on more-sophisticated graphing calculators, which have replaced the slide rule and are permitted on the SAT college-entrance exam.

At least one school in Louisville credits calculators for boosting test scores. When Michael Suttles took over last year as principal of inner-city Atkinson Elementary, he pushed teachers to incorporate calculators in their lessons. The proportion of fifth graders who reported using calculators almost every day nearly doubled, to 51%, by this April. And the school's average test score rose two points, to 41, although it remains among Kentucky's lowest.

Influential Endorsements

Educators have debated the proper role of calculators in elementary school for two decades, but by the early 1990s, Kentucky and some other states had taken action to encourage use of the devices in class and on standardized tests. This move was strongly supported by the 1989 endorsement of the National Council of Teachers of Mathematics and a similarly enthusiastic statement in 1990 by the National Research Council, a quasi-public organization that advises the government and scientific community on policy issues. At the same time, the National Science Foundation, a federal grant-giving agency, began pouring millions of dollars into concept-oriented, calculator-friendly curricula.

Asked about the Brookings Institution's new findings about the racial disparity in calculator use and the indication that calculator dependency may hurt test performance, Lee V. Stiff, president of the math-teachers council, questions the validity of the sort of student survey relied upon in the Brookings study.

Mr. Stiff contends that more than 100 studies __ based on testing students with and without calculators, as well as classroom observation __ show that calculators can improve student

achievement, problem-solving, and understanding of mathematical ideas. He adds that when award-winning teachers are surveyed, they overwhelmingly favor use of calculators in elementary grades. However, Tom Loveless, who wrote the Brookings report, says that most of the pro-calculator studies were poorly designed, lasted only a few weeks, and lacked adequate controls.

John S. Bradley, a program manager with the National Science Foundation, maintains that calculators generally improve student scores, although he adds that they shouldn't be allowed to become a crutch. "People worry now that kids are going to use calculators instead of learning basic number facts," Mr. Bradley says. "We used to worry they would count on their fingers and not learn basic number facts."

The move by states in the early 1990s to promote calculator use quickly provoked a backlash led by university math professors and suburban middle-class parents. In response, some states, such as California, adopted a back-to-basics approach and discouraged calculator use prior to sixth grade. Kansas recently expelled calculators from its fourth-grade math test.

The anti-calculator reaction has largely bypassed larger cities, however. Under pressure from suburban parents, the Massachusetts Department of Education now emphasizes basic math skills. It prohibits calculator use on its fourth-grade and sixth-grade math tests. But the city of Boston recently adopted a curriculum backed by the National Science Foundation that encourages fourth graders to use calculators.

Some of Mr. Martin's charges at the Hazelwood school say they even take their calculators shopping. Jamisha Thomas, 10, says she likes to buy potato chips for 50 cents and popsicles for $1.25. Asked for the sum, she enters the numbers in her calculator – but forgets a decimal point. "Fifty-one dollars and 25 cents," she says.