Straight Talk

about Issues in Mathematics Education

Calculators—One of many tools to enhance students' learning

The National Council of Teachers of Mathematics believes that calculators are important tools to support the learning of mathematics and that knowing how to use calculators intelligently is part of being prepared for an increasingly technological world.

Calculators are important learning tools.

Let's be honest. Calculator use affects school mathematics. Ready and affordable access to calculators can increase the kind and amount of mathematics in the school curriculum. Students use calculators to work with numbers that are difficult to manipulate, to organize data, and to display graphs. They can experiment with different ways of attacking a problem, examine mathematical models, study trends in data, and check the accuracy and reasonableness of their thinking. Through these activities, students connect what they are learning in school to real-world situations.

The appropriate use of calculators as learning tools seems to have overall positive results. Many research studies indicate an increase in the amount and level of mathematics that students learn when calculators are used in instruction (Hembree and Dessart 1992). In the Third International Mathematics and Science Study, students with the highest scores used calculators more frequently in mathematics instruction than students with the lowest scores (Beaton et al. 1996). Further, calculators can motivate and support students who have negative attitudes toward mathematics (Bitter and Hatfield 1994).

Calculators don't do mathematics, students do.

Calculators don't replace the need to learn basic facts, computational procedures, and algebraic-manipulation skills. Rather, students use calculators in school to solve challenging and complex problems not only in arithmetic but also in algebra, geometry, and other areas of mathematics (Demana, Schoen, and Waits 1993). A variety of calculators are being used in schools, ranging from simple four-function calculators that add, subtract, multiply, and divide to calculators that display tables and graphs and do algebra.

Calculators don't think, students do.

And students need to know more than what buttons to push and in what order. They need to understand the mathematics of the problem they are trying to solve. They need to be able to decide what information to enter and what operations to use, and then they need to interpret the results the calculator gives them in return.

Calculators are commonly used at home and work.

The world has changed because of technology, and calculators are an important part of that change. In the world outside school, calculators are used frequently. Society expects that students will know how to use calculators to complete tasks. Evidence of this expectation is the required use of calculators on the SAT, Advanced Placement exams, and some state tests. If students are to be prepared for their future, calculators need to be a part of their mathematics instruction.

References

Beaton, Albert E., Ina V. S. Mullis, Michael O. Martin, Eugenio J. Gonzalez, Dana L. Kelly, and Teresa A. Smith. Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS). Chestnut Hill, Mass.: Center for the Study of Testing, Evaluation, and Educational Policy, Boston College, 1996.

Bitter, Gary G., and Mary M. Hatfield. "The Calculator Project: Assessing School-wide Impact of Calculator Integration." In Impact of Calculators on Mathematics Instruction, edited by George W. Bright, Hersholt C. Waxman, and Susan E. Williams, pp. 49-65. Lanham, Md.: University Press of America, 1994.

Demana, Frank, Harold L. Schoen, and Bert Waits. (1993). Graphing in the K-12 Curriculum: The Impact of the Graphing Calculator. In Thomas A. Romberg, Elizabeth Fennema, & Thomas P. Carpenter (editors), Integrating Research on the Graphical Representation of Functions (pp. 11-39). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hembree, Ray, and Donald J. Dessart. "Research on Calculators in Mathematics Education." Calculators in Mathematics Education, edited by James T. Fey, pp. 23-32. Reston, V.a.: National Council of Teachers of Mathematics, 1992.

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Resources

Heid, M. Kathleen, "The technological revolution and the reform of school mathematics." American Journal of Education, Nov 97, v. 106, n. 1, pp. 5-61.

This article presents a study which looks at technology in relation to the reform of mathematics education for schools. how students can understand mathematics; analysis of technology in mathematics classrooms; findings of the study.

Usiskin, Z. (1998). Pencil-and-paper algorithms in a calculator- and computer age. In L.J. Morrow, The teaching and learning of algorithms in school mathematics. 1998 Yearbook. Reston, VA: NCTM (p. 7-20)

This chapter describes the various aspects of algorithms and where there is appropriate use of calculator algorithms. Different scenarios of a balance between paper-and-pencil and calculator algorithms are discussed. Usiskin concludes: "And so we can expect that although calculator and computer algorithms will overtake virtually all paper-and-pencil algorithms, a few of these old algorithms will remain. Those that remain will be in our curriculum not because they are curiosities and not because they train the mind but because they have qualities of good algorithms." (p.19)

Demana, Frank, Harold L. Schoen, and Bert Waits. (1993). Graphing in the K-12 Curriculum: The Impact of the Graphing Calculator. In Thomas A. Romberg, Elizabeth Fennema, & Thomas P. Carpenter (editors), Integrating Research on the Graphical Representation of Functions (pp. 11-39). Hillsdale, NJ: Lawrence Erlbaum Associates.

This chapter presents an analysis of graphing in the grades 1-8 curriculum and discusses how graphing utilities have begun to change the role of graphing across the K-12 curriculum. Pitfalls in using graphing calculators are discussed in the context of specific problems and instructional activities.

Ray Hembree & Donald J. Dessart. (1992). Research on Calculators in Mathematics Education. In James T. Fey & Christian R. Hirsch (Editors), Calculators in Mathematics Education: 1992 Yearbook (pp. 23-32). Reston, VA: National Council of Teachers of Mathematics.

This chapter updates an earlier review of research on calculator use that appeared in JRME in 1986. Calculator use seems to enhance learning in many areas of mathematics concepts, skills, problem solving, and attitudes. There appear to be few if any risks resulting from calculator use.

James T. Fey and Christian R. Hirsch (Editors), Calculators in Mathematics Education: 1992 Yearbook. Reston, VA: National Council of Teachers of Mathematics.

This book contains 25 chapters on calculators across the K-12 mathematics curriculum. There are also 11 specific, classroom activities that illustrate ways that calculators can be used.

Williams, S. E., and Bright, G. W. (1998). Investigating Mathematics with Calculators in the Middle Grades: Activities with the Math Explorer and Explorer Plus. Dallas, TX: Texas Instruments.

Bright, G. W. & Williams, S. E. (1998). Investigating Mathematics with Calculators in the Middle Grades: Activities for the TI-30Xa SE and TI-34. Dallas, TX: Texas Instruments.

The two books listed (above) provide activities for use of different calculators in middle grades mathematics instruction. The activities grew out of a project funded by the U.S. Department of Education. That project involved teachers of the Alief Independent School District in a three-year effort to design and test calculator activities.