Beyond "Getting the Answer": Calculators Help Learning Disabled Students Get the Concepts

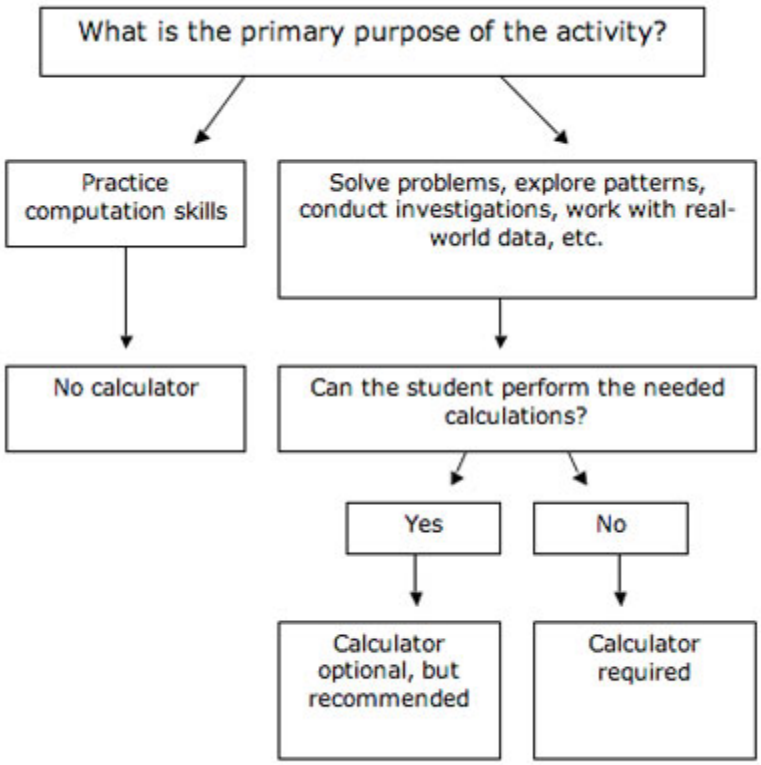
By: Center for Implementing Technology in Education (CITEd) (2007)

Research has much to tell us about using calculators for instruction. In a review of studies that examined the use of calculators in K-12 classrooms, Ellington (2003) found that calculator use was associated with better operational and problem-solving skills. In addition, students who had access to calculators had better attitudes toward math. But when exactly should calculators be used and for what purpose? This Info Brief summarizes Thompson and Sproule's (2000) "Calculator Decision-Making Flow Chart" and uses the principles of Universal Design for Learning (UDL) to clarify how calculator usage helps students with learning disabilities understand math concepts.

Calculators: To use or not to use...

Don't calculators just give students the answer? Unfortunately, this stance on calculators prompts many teachers, even those in early grades, to opt out of using calculators in the classroom. When the goal of instruction is to help students practice computation skills, then this decision to not use a calculator makes sense. When teachers want students to engage in higher-order thinking such as solving problems, exploring patterns, conducting investigations, and working with real-world data, the use of calculators can benefit all students, especially those with learning disabilities who might otherwise be unable to participate in these engaging activities. This decision making process is illustrated in Thompson and Sproule's (2000) flow chart (see Figure 1*).

Figure 1. Calculator Decision-Making Flow Chart*



While the performance of students with disabilities or math difficulties is rarely explicitly discussed in the studies on calculator use, CITEd has extrapolated from research to provide the following ways in which calculators can support learning math for students who struggle. (See more research at **www.cited.org**.) These skills are presented through the lens of UDL to clarify how this approach can help students with learning disabilities understand math concepts.

Universal Design for Learning (UDL)

Universal Design for Learning is an educational framework that optimizes opportunities for all individuals to gain knowledge, skills, and enthusiasm for learning (Meyer & Rose, 2002; Rose & Meyer, 2006; Rose, Meyer, & Hitchcock, 2005). The "universal" in Universal Design for Learning (UDL) does not imply one optimal solution for everyone, but instead underscores the need for inherently flexible, customizable content, assignments and activities, and assessments characterized by:

- Multiple representations of information — as there is no single method for the presentation of information that will provide equal access for all learners (Recognition Principle);
- Multiple methods of action and expression — as there is no single method of expression that will provide equal opportunity for all students (Strategic Principle); and
- Multiple means of engagement — as there is no single way to ensure that all children are engaged and motivated in a learning environment (Affective Principle).

The term "universal design" is borrowed from the architectural concept of the same name, which called for curb cuts, automatic doors and other architectural features to be built into the design to avoid costly after-the-fact adaptations for individuals with disabilities. UDL applies the same concept to learning — creating a curriculum with numerous built-in features to meet the learning needs of a wide range of students, including those with disabilities and special talents.

Recognition Learning

As a way of providing multiple means of representation, calculators can be an alternative to traditional paper and

pencil computations for students with learning disabilities to explore principles and procedures in mathematics.

Exploration

Calculators can help students with disabilities explore math concepts. In the early grades, students can use them to test number concepts such as counting (using the automatic constant to add 1 repeatedly), number relationships (more than, less than), and magnitudes (100 is much larger than 10). For many students these basic concepts are difficult to grasp, and the visual nature of the calculator display, along with the speed and accuracy with which they work, can help students develop their own mental "pictures" of number concepts. Similarly, graphing calculators can support older students with disabilities to confirm hypotheses, understand geometric principles, and connect visual, numeric, and symbolic representations of algebraic equations.

Procedures

Remembering the steps in a math procedure is another common problem for students with disabilities. Multiple line displays, such as those on graphing calculators or two-line calculators used with younger children, appear to be particularly beneficial in understanding math concepts and procedures because students can see the steps of the solution, rather than just the answer (St. John & Lapp 2000).

Strategic Learning

Calculators provide students an alternative to paper and pencil methods for building calculations and fluency strategies.

Calculations

The typical special education curriculum in mathematics focuses on basic computation skills, not the problem-solving skills that are essential for success in the general education math curriculum. Yet many students who struggle to learn basic facts have the potential to learn higher-level skills and concepts. By learning to use calculators effectively, these students can focus their efforts on the math concepts, rather than struggling to perform computations. Calculators can give students with disabilities access to exploring higher-level math concepts.

Fluency

Recall of math facts is difficult for many students with disabilities; the errors they make in recalling math facts can result in inaccuracies at all levels of computation. Calculators can help students become more fluent and accurate with math facts by providing feedback (Graham & Thomas, 2000).

Affective Learning

Underlying the scaffolds calculators provide for students' recognition and strategic learning is the support they provide for affective learning. Calculators can help learning disabled students participate in rigorous problem-solving activities that might otherwise be too frustrating for these learners. Learners who function best when doing something physical often enjoy the tactile aspect of working with calculators.

The use of calculators in the classroom should be limited to the teacher's professional judgment, but when used, their potential is infinite. When teaching or assessing computation skills, calculators might not be an appropriate support for students to use. But when teachers balance this curriculum with real-world problem-solving activities, calculators can provide an appropriate tool to balance the challenge of these endeavors with the support students with learning disabilities need.

Additional Resources

- **National Council of Teachers of Mathematics (NCTM)**

NCTM is a professional organization devoted to K-12 mathematics education. This website provides links to various tools that support the teaching of mathematics.

- **K-8 Calculator Lessons**

  This site provides links to various calculator activities.

- **High School Graphing Calculator Lessons**

  This site includes links to self-guided and self-paced lessons to be used with graphing calculators.

References

Ellington, A. J. (2003). A meta-analysis of the effects of calculators on students' achievement and attitude levels in precollege mathematics classes. *Journal for Research in Mathematics Education, 34*(5), 433-463.

Graham, A.T. & Thomas, M.O.J. (2000). Building a versatile understanding of algebraic variables with a graphic calculator. Educational Studies in Mathematics, 41(3), 265-282.

Rose, D. H., & Meyer, A. (2006). *A practical reader in Universal Design for Learning.* Cambridge, MA: Harvard Education Press.

St. John, D. & Lapp D.A. (2000). Developing numbers and operations with affordable handheld technology. Teaching Children Mathematics, 7(3)November 162-164.

Thompson, A., & Sproule, S. (2000). Deciding when to use calculators. *Mathematics Teaching in the Middle School*, 6, 126-29.

A "Tech Works" brief from the **National Center for Technology Innovation** (NCTI) and the **Center for Implementing Technology in Education** (CITEd). * Figure 1: Thompson, T., & Sproule, S. (2005). Calculators for students with special needs. Teaching Children Mathematics, 11(7), 391-395.

---

http://www.ldonline.org/article/Beyond_%22Getting_the_Answer%22%3A_Calculators_Help_Learning_Disabled_Students_Get_the_Concepts?theme=print

©2008 WETA. All Rights Reserved.