Current Information Regarding Calculator Use in the Classroom Provided by the S.D. 23 District Math Committee 2008

Foreword:

Rather than be prescriptive, the K-12 Math Steering Committee would like to provide you with a short information package to help you make your own professional decisions as to how and when you will use calculators and other technologies in your classroom.

Our current IRP states:

Technology [T]

Technology contributes to the learning of a wide range of mathematical outcomes and enables students to explore and create patterns, examine relationships, test conjectures, and solve problems.

Calculators and computers can be used to:

- explore and demonstrate mathematical relationships and patterns
- organize and display data
- extrapolate and interpolate
- assist with calculation procedures as part of solving problems
- decrease the time spent on computations when other mathematical learning is the focus
- reinforce the learning of basic facts and test properties
- develop personal procedures for mathematical operations
- create geometric displays
- simulate situations
- develop number sense

Technology contributes to a learning environment in which the growing curiosity of students can lead to rich mathematical discoveries at all grade levels. While technology can be used in K to 3 to enrich learning, it is expected that students will meet all outcomes without the use of technology.

Under a Section on Number, the BC IRP states that:

Computational fluency, the ability to connect understanding of the concepts with accurate, efficient and flexible computation strategies for multiple purposes, is stressed throughout the number organizer with an emphasis on the development of personal strategies, mental mathematics and estimation strategies.

Under a Section on Teaching Through Problem Solving, the BC IRP suggests that:

Instruction should provide an emphasis on mental mathematics and estimation to check the reasonableness of paper and pencil exercises, and the solutions to problems which are determined through the use of technology, including calculators and computers. (It is assumed that all students have

regular access to appropriate technology such calculators, or computers with graphing software and standard spreadsheet programs.) Concepts should be introduced using manipulatives, and gradually developed from the concrete to the pictorial to the symbolic.

We can also refer to the National Council of Teachers of Mathematics (NCTM). Here is their foreword to the current curriculum document.

The Technology Principle

Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

Calculators and computers are reshaping the mathematical landscape, and school mathematics should reflect those changes. Students can learn more mathematics more deeply with the appropriate and responsible use of technology. They can make and test conjectures. They can work at higher levels of generalization or abstraction. In the mathematics classrooms envisioned in Principles and Standards, every student has access to technology to facilitate his or her mathematics learning.

Technology also offers options for students with special needs. Some students may benefit from the more constrained and engaging task situations possible with computers. Students with physical challenges can become much more engaged in mathematics using special technologies.

Technology cannot replace the mathematics teacher, nor can it be used as a replacement for basic understandings and intuitions. The teacher must make prudent decisions about when and how to use technology and should ensure that the technology is enhancing students' mathematical thinking.

Research

Current research cannot prove causality between calculator use and test scores. There are various research results – and opinion varies depending on the source.

One report recommends:

Drop the use of calculators at fourth grade. Restrict calculator use at eighth grade. Allowing calculators [on standardized tests] interferes with determining whether students know arithmetic and can solve challenging problems. A recent Brown Center study compared the performance of nine year olds answering NAEP computation items correctly with calculators available to nine year olds answering the same items without access to calculators. The calculator group outscored the non-calculator group across the board—by as much as forty to fifty percentage points on multiplying whole numbers, a skill that all fourth graders should master.(The Brown Center Report on American Education, Sept. 2004)

Another article contends:

Excerpts from Making Calculator Use Add Up
by Lee V. Stiff

Why calculators? And more to the point, why calculators in elementary school? First and foremost, the research shows that calculators have their place. Hembree and Dessart's (1992) analyses of research on calculator use revealed that appropriately using calculators during instruction improves paper-and-pencil skills for low-, average-, and high-ability students. They found that in the early grades, calculators are frequently used for exposure to the tool itself, for checking work, and for problem solving. From the evidence available, appropriate calculator use enhances the learning and performance of arithmetic concepts and skills, problem solving, and the attitudes of students. Research indicates that students perform better when using calculators to supplement strong programs of computation (Carnine et al. 1998).

Research has also shown that calculators can aid in "stimulating problem solving, in widening children's number sense, and in strengthening understanding of arithmetic operations" (Campbell and Stewart 1993). Calculators can help students learn basics, such as numbers, counting, and the meaning of arithmetic operations. Students show greater ease in problem solving when using calculators because they focus less on computational recall and algorithmic routines and more on the other aspects of the problem-solving process. Appropriate calculator use promotes enthusiasm and confidence while fostering greater persistence in problem solving.

Recommendations by our committee:

The use of technology in education continues to grow and change, and as professionals, we must re-examine our practices and our uses of such technologies on a regular basis. Students can learn more mathematics more deeply with the appropriate and responsible use of technology. It is also clear that teachers play a pivotal role in teaching the appropriate use of technology and calculators in the classroom.

We recommend that:

- teachers clearly discuss the proper use of calculators with their students on a regular basis – this way, students are more aware of their thinking and their learning
- students be encouraged to learn basic computational strategies in order to make sense of the operations; in order to reduce the number of students who rely on calculators to perform simple arithmetic, teachers at every grade level should help students develop strategies that will help them make sense of the basic operations
- teaching strategies is much different from drill and practice; having students practice basic skills without developing their understanding is shown to be ineffective; for examples on how to teach computational

strategies, please refer to the IRPs for elementary grades – for example – see excerpt from the Grade 4 IRP below

- teachers consider the learning outcomes of the grade and unit they are teaching, and if the purpose of the lesson is something other than basic calculations, that calculators be permitted to achieve those learning outcomes
- communication to the home about when and how calculators can be used appropriately be clear for parents

We recommend that teachers carefully consider the included information and research when using calculators and other technology in their classrooms. We hope that we have helped you with your practice, and that you feel more informed.

Excerpt from BC Grade 4 IRP:

A5 describe and apply mental mathematics strategies, such as - skip counting from a known fact - using doubling or halving - using doubling or halving and adding or subtracting one more group - using patterns in the 9s facts - using repeated doubling to determine basic multiplication facts to 9 × 9 and related division facts [C, CN, ME, PS, R]	❑ provide examples for applying mental mathematics strategies: - doubling (e.g., for 4 × 3, think 2 × 3 = 6, and 4 × 3 = 6 + 6 - doubling and adding one more group (e.g., for 3 × 7, think 2 × 7 = 14, and 14 + 7 = 21 - use ten facts when multiplying by 9 (e.g., for 9 × 6, think 10 × 6 = 60, and 60 – 6 = 54; for 7 × 9, think 7 × 10 = 70, and 70 – 7 = 63 - halving (e.g., if 4 × 6 is equal to 24, then 2 × 6 is equal to 12 - relating division to multiplication (e.g., for 64 ÷ 8, think 8 × ☐ = 64)
A6 demonstrate an understanding of multiplication (2- or 3-digit by 1-digit) to solve problems by - using personal strategies for multiplication with and without concrete materials - using arrays to represent multiplication - connecting concrete representations to symbolic representations - estimating products [C, CN, ME, PS, R, V]	❑ model a given multiplication problem using the distributive property (e.g., 8 × 365 = (8 × 300) + (8 × 60) + (8 × 5)) ❑ use concrete materials, such as base ten blocks or their pictorial representations, to represent multiplication and record the process symbolically ❑ create and solve a multiplication problem that is limited to 2- or 3-digits by 1-digit ❑ estimate a product using a personal strategy (e.g., 2 × 243 is close to or a little more than 2 × 200, or close to or a little less than 2 × 250) ❑ model and solve a given multiplication problem using an array and record the process ❑ solve a given multiplication problem and record the process