

## Appendix A4-1: Instructional Practices to Avoid

### Inappropriate drill

Children need substantial practice in many mathematical competencies. However, the *nature* and timing of this practice can mean the difference between appropriate and inappropriate instruction. For example, even preschools can play games such as “Snapshots” in which the teacher holds up 2 fingers on one hand and 3 on other (held apart) for only two seconds and children “think, pair, and share”—whispering “five” to each other. This visually-based “number composition” builds a firm foundation for arithmetic. However, “bare bones” drill on worksheets filled with “facts” such as  $2 + 3 = \underline{\quad}$  do not build the same foundation and are neither motivating nor appropriate for the way preschoolers’ learn.

Fluency in single-digit addition and subtraction combinations is an appropriate goal for the primary grades, but again, there are appropriate and inappropriate ways to practice. For example, “Snapshots” can be played with all combinations. Children should also use *thinking strategies* to figure out basic combinations. Inappropriate practice may be useless or even potentially harmful. For example, in one large study, the more first grade teachers used timed tests of additional and subtract facts in first grades, the *fewer* facts children knew (198). Also negatively related to children’s mastery of facts was the use of textbooks with a specific goal of memorization. Not necessarily harmful, but not helpful either, was the use of flash cards and extensive work on small sums to the exclusion of larger sums.

Fluency with arithmetic combinations is important. Fluency “frees the mind” to solve more difficult problems (251). To achieve true fluency—automaticity *and* able to think flexibly, children need to learn to solve simple addition and subtraction strategies several different ways (even if they are slow, such as “counting all”), then learning thinking strategies (such as “counting on” or “break-apart-to-make tens”— $9 + 6 = 9 + (1 + 5) = 10 + 5 = 15$ , all done mentally and quickly), then internalize all these until they are automatic. Once they reach that last stage, distributed, spaced practice—often game-like and involving a variety of contexts—is appropriate (303).

### Inappropriate use of calendar activities

Our National Research Council report stated, “Generalized teaching strategies and activities are defined as those that can apply to a variety of the NCTM mathematics standards. The most prominent generalized strategy was calendar-related activities, which occurred on a daily basis in over 90 percent of the classrooms surveyed, this despite the fact that mathematics educators do not consider most calendar activities to be useful early childhood mathematics instruction and have serious questions about the efficacy of “doing the calendar” every day (5, p. 241). The report goes on to say that despite the calendar’s potential usefulness in teaching simple time concepts such as “yesterday” and “today,” these are not core mathematical concepts. The calendar groups days into rows of 7 rather than 10, the basis of our number system. “Time spent on the calendar would be better used on more effective mathematics teaching and learning experiences.”

Worse, many teachers spend long times on the calendar, and engage only one child (or one child

at a time) in “doing” the calendar. Because most children are not involved, this is one example of the type of activity that harms, rather than builds, self-regulation.

### **Math mistakes**

Although it seems obvious that errors in mathematics must be avoided, many teachers and curricula propagate just such mistakes. For example, it is not true that “multiplication always makes numbers bigger.”

### **Teaching practices that harm the development of executive function (self-regulation) competencies**

Also important is eliminating the dull routines and overly authoritarian environments that do not develop and can harm children's developmental of executive function competencies (304-306). For example, too many mathematics classes include unfortunate features such as calling on one student at a time while the rest passively listen (and often do not attend) or having long “dead times” with no instructional or other activities (e.g., waiting for children to line up or pass out materials).

Instead, children learn more as they “think, pair, and share,” talking to their neighbor to give an answer or discuss a solution strategy, or as they answer chorally. Movement games might be used in which children follow more complex rules or to switch from one set of rules to another. For example, in “Shape Step,” a variety of shapes are outline on the floor (with painters’ tape) and the teacher or a child challenges children to step on “only the shapes with four sides” and then “all the shapes with at least one right angle” (and so on).