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Fact Fluency: How does *Everyday Mathematics 4* ensure students will master math facts?

What is the research behind how children best learn math facts?

Research supports a basic facts trajectory that begins with early, informal, and highly conceptual encounters with the operations through story problems (as early as preschool) and develops toward memorization and mastery of facts. In phase 1, children model and count to produce an answer. In phase 2, children work from a known fact and derive an answer to an unknown fact. In phase 3, children have mastered their facts and can efficiently produce an answer (Baroody, 2006). Progression through all 3 of these phases in the trajectory is promoted by meaningful practice of facts, making fact strategies explicit in the classroom and discussing and analyzing them, and focusing on key groups of facts for strategy development. Conventional approaches to learning facts often omit phase 2, where efficient reasoning strategies to solve facts are developed, which can result in children who are unable to call upon strategies to figure out answers to facts they don't know or have forgotten (Bay-Williams and Kling, 2014). Other research suggests that when children move to memorization of basic facts without a solid foundation of conceptual understanding and a toolkit of efficient strategies, they are less likely to think about numbers and their relationships and more likely to make errors (Boaler, 2015).

How does Everyday Mathematics 4 *support the development of fact fluency?*

A major focus in kindergarten through second-grade mathematics is the development of fact fluency with basic addition and subtraction facts, and a major focus in third-grade mathematics is the development of fluency with basic multiplication and division facts. Fluency can be described as "the efficient, appropriate, and flexible application of single-digit calculation skills and is an essential aspect of mathematical proficiency" (Baroody, 2006). Moving through the 3 phases of the basic facts trajectory as described above can help children develop fact fluency. This approach to fluency is evident in *Everyday Mathematics 4.* Children first encounter the four operations within the context of number stories that they solve using models such as drawings and counters. In Kindergarten through Grade 3, numerous activities use *Quick Looks* images including dot patterns, five frames, ten-frames, double ten-frames, and equal groups. Through *Quick Looks* activities, children develop the ability to subitize**,** to recognize a quantity without counting, and to compose and *decompose* numbers in various ways. Research suggests developing the ability to subitize facilitates the development of fact fluency (Clements, 1999). Showing numbers in different ways and asking children to describe how they see them elicits flexible thinking about numbers. As children encounter various combinations of numbers, they also develop strategies for basic facts. Children learn to use known facts, called "helper facts," to derive answers to unknown facts. Explicit instruction of fact strategies such as near doubles, near squares, making tens, adding a group, subtracting a group, and decomposing, or breaking apart, are explored, discussed, and analyzed in lessons and practiced throughout the program. This targeted instruction promotes children's ability to select and use efficient strategies (Bay-Williams and Kling, 2014).

Where is the fact practice in Everyday Mathematics 4?

In *Everyday Mathematics 4,* children engage in meaningful fact practice throughout the year. This includes targeted fact practice that focuses on specific strategies so that children develop the ability to select an efficient strategy to solve any unknown fact. Frequent practice is provided in Mental Math and Fluency

exercises, games, Math Boxes, and in the context of solving number stories and other program routines such as "What's My Rule?", Frames and Arrows, and Fact Triangles. Fact Triangles are the *Everyday Mathematics* version of flash cards. Fact Triangles are more effective than traditional flash cards because they emphasize fact families and are frequently used to practice random facts. This practice is distributed throughout the year so that students have numerous opportunities to revisit concepts and skills.

Why does the fact practice in Everyday Mathematics 4 appear as it does*?*

In traditional curricula, basic facts practice generally involves worksheet drills and timed tests. These can be tedious and can lead children to dislike mathematics. "Mathematics facts are important but the memorization of math facts through times table repetition, practice, and timed testing is unnecessary and damaging" (Boaler, 2015). However, frequent practice is necessary in order for children to build and maintain strong mental-arithmetic skills. In *Everyday Mathematics 4,* fact practice is "spaced" or "distributed" throughout the curriculum. Research shows that spaced learning and practice rather than "massed" or "blocked" approaches leads to better performance (Son and Simon, 2012). Much of the fact practice in *Everyday Mathematics* is in the form of games. Games can be especially useful for building fact fluency (Bay-Williams and Kling, 2014; Wolpert, 1996). Practicing facts through games provide opportunities to develop fact fluency in meaningful and motivating contexts. Games also improve children's attitudes about mathematics as well as improve achievement among low achievers (Seckinger, Mitchell and Lemire, 1989). Because the numbers in games are generated randomly, games make fact practice more fun than arithmetic worksheets. Also, the game format eliminates the tedium typical of most drills. Many of the *Everyday Mathematics* games come with variations that allow players to progress from easy to more challenging versions. Games, therefore, offer an almost unlimited source of practice material.

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