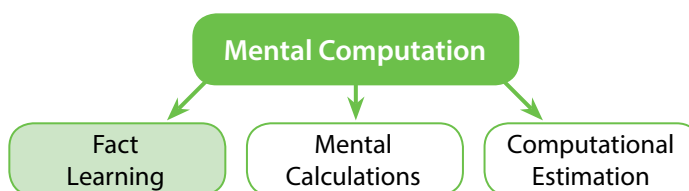


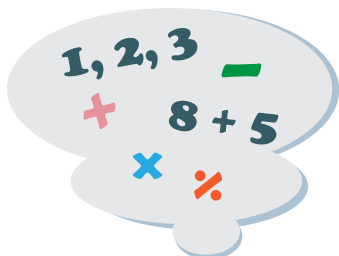
Mental Math Part 1: Fact Learning

Mental mathematics (that is, calculating mentally without the use of external memory aids) is a combination of cognitive strategies that enhances flexible thinking and number sense. It improves computational fluency by developing efficiency, accuracy, and flexibility.

Mental Computation Components



Fact Learning

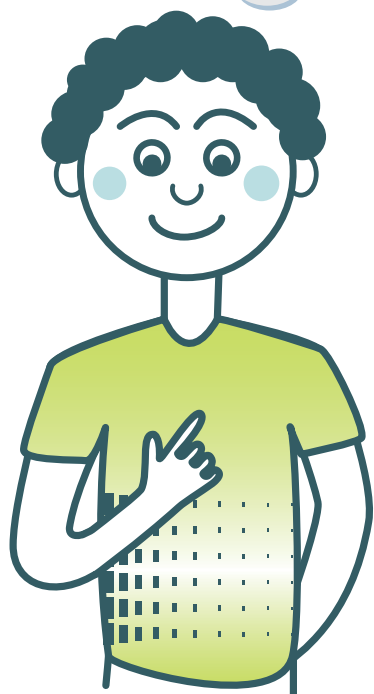


Fact learning refers to the acquisition of addition, subtraction, multiplication, and division number facts (limited to single digits 0–9).

Learning math facts is a developmental process where the focus of instruction is on thinking of and building number relationships. Recall of facts becomes automatic for students through repeated exposure and practice.

Arthur Baroody identifies three stages through which students typically progress in acquiring basic facts:

- **Counting Strategies:** using object counting (e.g., blocks, counters, fingers) or verbal counting to determine the answer
- **Reasoning Strategies:** using known information (i.e., known facts and relationships) to logically determine the answer of an unknown fact
- **Automaticity or Mastery:** efficient (fast and accurate) production of answers (Baroody, 2006, p. 22)



Teaching the Facts

The following are a few principles for teaching the facts that were provided in *A Guide to Effective Instruction in Mathematics* by the Ontario Ministry of Education:

- Most students can learn the basic facts accurately, although their speed may vary considerably. Students should have many experiences modelling facts using concrete and pictorial representations.

- Students should be encouraged to look for patterns and relationships between the operations and numbers in the facts.
- Students need strategies that help them reason their way to the solutions for the facts, rather than strategies for memorizing the facts.
- Students should not be compelled to memorize facts if they have limited strategies for solving facts. (It can be a waste of time, and it limits the opportunity for students to learn the whole range of fact strategies they will use throughout their elementary-school years.) Students who have a repertoire of strategies will be able to find an accurate answer, and over time their speed will naturally increase. (Ontario Ministry of Education, 2006, p. 13)

Assessing the Facts

“Evidence strongly suggests that timed tests cause the early onset of math anxiety for students across the achievement range.” (Boaler, 2014)

Basic facts should be assessed through observation, interviews, games, self-assessment, and strategy-focused paper/pencil practice. Although the goal is to have students recall facts in a reasonable time frame, researchers strongly caution against the use of timed tests. “Children who tended to use more sophisticated mathematical strategies experienced the most negative impact on achievement due to math anxiety. Thus, it appears that some of our best mathematical thinkers are often those most negatively affected by timed testing.” (Ramirez et al., 2013)

Reflection and Discussion

- How are basic facts currently being taught and assessed?
- Can we develop a robust set of assessment tools and strategies (beyond timed tests) in order to determine student progress toward fact recall?
- What supports do you need related to basic facts?
- What difficulties have you experienced teaching basic facts?

Resources

- Baroody, Arthur J. *Why Children Have Difficulties Mastering the Basic Number Combinations and How to Help Them*. Reston, VA: National Council of Teachers of Mathematics, 2006. Available online at <http://webmedia.jcu.edu/cmsett/files/2014/06/baroody-facts-article.pdf>
- Boaler, Jo (2014). “Research suggests timed tests cause math anxiety.” *Teaching Children Mathematics* 20.8: 469–473.
- Ramirez, Gerardo, Elizabeth A. Gunderson, Susan C. Levine, and Sian L. Beilock (2013). “Math Anxiety, Working Memory, and Math Achievement in Early Elementary School.” *Journal of Cognition and Development*, 14(2): 187–202. Available online at <http://dx.doi.org/10.1080/15248372.2012.664593>
- O’Connell, Susan, and John SanGiovanni. *Mastering the Basic Math Facts in Multiplication and Division: Strategies, Activities & Interventions to Move Students Beyond Memorization*. Portsmouth, NH: Heinemann, 2014
- . *Mastering the Basic Math Facts in Addition and Subtraction: Strategies, Activities, and Interventions to Move Students Beyond Memorization*. Portsmouth, NH: Heinemann, 2015
- Ontario Ministry of Education. *A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6, Volume Five: Teaching Basic Facts and Multidigit Computations*. Toronto, ON: Province of Ontario, 2006. Available online at http://eworkshop.on.ca/edu/resources/guides/Guide_Math_K_6_Volume_5.pdf (English) and www.atelier.on.ca/edu/resources/guides/GEE_math_M_6_fasc5.pdf (French)