Fluency in Mathematics

Kindergarten – Algebra 2

Aligned to the Arizona Mathematics Standards, Adopted 2016

Fluency in Mathematics

Wherever the word *fluently* appears in a content standard, the word includes efficiently, *accurately, flexibly, and appropriately*. Being fluent means that students are able to choose flexibly among methods and strategies to solve contextual and mathematical problems, they understand and are able to explain their approaches, and they are able to produce accurate answers efficiently.[1]

- **Efficiency**—carries out easily, keeps track of sub-problems, and makes use of intermediate results to solve the problem.
- **Accuracy**—reliably produces the correct answer.
- **Flexibility**—knows more than one approach, chooses a viable strategy, and uses one method to solve and another method to double-check.
- **Appropriately**—knows when to apply a particular procedure.

Please see standards 2.OA.B.2 and 3.OA.C.7 for standards related to addition and subtraction of within 20 and multiplication within 100. Both of these standards show mastery involves "from memory" as an outcome. By the end of 2nd and 3rd grade, these procedural fluency standards should be automatic recall by students.

Fluency Expectations, K-8

Specific mathematics standards in K-6 state fluency as the intended end of grade level outcome. Some standards in grades 7-8 do not explicitly state ***fluently*** within the standard but based on the definition of fluency, we want students to *efficiently, accurately, flexibly, and appropriately* problem solve.

Fluency Expectations, High School

The high school standards do not always set explicit expectations for fluency but fluency is important in high school mathematics. For example, fluency in algebra can help students get past the need to manage computational details so that they can observe structure and patterns in problems. Therefore, this section makes recommendations about fluencies that can serve students well as they learn and apply mathematics.

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[1] National Council of Teachers of Mathematics, Inc. (2014). *Principles to Actions: Ensuring Mathematical Success for All*. Reston, VA. Diane Briars (2016) NCTM. djbmath@comcast.net. Russell, S. J. (2000). Developing computational fluency with whole numbers. *Teaching Children Mathematics, 7*(3), 154–158.

Table 3. Fluency Expectations Across All Grade Levels.

Grade	Coding	Fluency Expectations
K	**K.OA.A.5**	Fluently add and subtract within 5.
1	**1.OA.C.6**	Fluently add and subtract within 10.
2	**2.OA.B.2**	Fluently add and subtract within 20. By the end of 2nd grade, know from memory all sums of two one-digit numbers.
	2.NBT.B.5	Fluently add and subtract within 100.
3	**3.NBT.A.2**	Fluently add and subtract within 1000.
	3.OA.C.7	Fluently multiply and divide within 100. By the end of 3rd grade, know from memory all multiplication products through 10 x 10 and division quotients when both the quotient and divisor are less than or equal to 10.
4	**4.NBT.B.4**	Fluently add and subtract multi-digit whole numbers using a standard algorithm.
5	**5.NBT.B.5**	Fluently multiply multi-digit whole numbers using a standard algorithm.
6	**6.NS.B.2**	Fluently divide multi-digit numbers using a standard algorithm.
	6.NS.B.3	Fluently add, subtract, multiply, and divide multi-digit decimals using a standard algorithm for each operation.
	6.EE.A.2	Write, read, and evaluate algebraic expressions.
7	**7.NS.A.1.d**	Apply properties of operations as strategies to add and subtract rational numbers.
	7.NS.A.2.c	Apply properties of operations as strategies to multiply and divide rational numbers.
	7.EE.B.4.a	Fluently solve one-variable equations of the form $px + q = r$ and $p(x + q) = r$
8	**8.EE.C.7**	Fluently solve linear equations and inequalities in one variable.
Algebra 1	**A1.F-IF.C.7**	Graph functions expressed symbolically and show key features of the graph.
	A1.A-SSE.A.2	Use structure to identify ways to rewrite numerical and polynomial expressions.
Geometry	**G.G-SRT.B.5**	Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing a real-world context.
	G.G-GPE.B.4	Use coordinates to algebraically prove or disprove geometric relationships.
	G.SRT.C.8	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.
Algebra 2	**A2.A-SSE.A.2**	Use the structure of an expression to identify ways to rewrite it.
	A2.F-BF.B.3	Identify the effect on a graph when changing $f(x)$.
	A2.A-REI.B.4	Fluently solve quadratic equations in one variable.