

## Math Facts: An Online Discussion

I recently heard the three terms describing the progression of knowing math facts: rote, automaticity and fluency. I am looking for clarification of the three terms as well as a way to determine the difference in knowing when assessing children. Another way of asking this is if a student can correctly fill in a mad minute sheet in one minute, are they rote, fluent or automatic with their knowledge?

Thank you for any help you can give me to gain clarification on this issue.

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Rote is just memorization. Automaticity and fluency mean the same thing in my mind--generating a correct answer in a short period of time such as 2-3 seconds per fact. If there's a better explanation, I'd be interested in hearing someone else's take on it.

The question is, do the children have number sense? Can they compose and decompose numbers? For instance a child can just memorize  $8 + 6$ , but can they think of that problem as  $8 + 2 + 4$ ...make the 10 and add the 4. If kids can do this, they are in charge of the numbers.

I don't know if there is a way to assess this with students other than doing a quick one on one interview with them and asking how they solved or having them show with manipulatives and ten frames. Maybe someone else will have a suggestion about how to assess for facts *and* number sense.

I just heard a speaker at the national math conference say research shows a *negative correlation* between timed tests and learning math facts long term. I've worked with teachers over the years tell me how well their students do on timed tests, but then turn right around and complain about students not knowing their facts. Go figure. Pun intended. ;)

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In my district, we see rote as a way of learning - as in practicing with flash cards. There is no meaning attached. No strategies are used to get to the answer. The kids just memorize the facts.

We say that fluency is where the children are accurate, flexible and efficient with their thinking to arrive at answers.

Automatic is where the child can generate the answer within 2-3 seconds.

Some children can be really fast at using strategies on a timed test. They could even be counting by ones to work things out. You usually can't know from looking at a timed test how the child is getting their answers.

We try to minimize the use of timed tests here as we don't see that they help kids develop fact knowledge that sticks. We see that timed tests are extremely stressful for many children and encourage a distaste for math.

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Please feel free to search for automaticity or computational fluency in NCTM "journals" to find relevant journal articles from Teaching Children Mathematics that address your question. This is from the Common Core:

## Whole-number computational fluency expectations across grade levels

**PROFICIENCY includes both CONCEPTUAL  
UNDERSTANDING and PROCEDURAL FLUENCY.**

<b>Level</b>	<b>Concept that is INTRODUCED</b>	<b>Culminating Fluency Expectation</b>
<b>K</b>	Add/Subtract to 10	Add/Subtract to 5
<b>1</b>	Add/Subtract to 100	Add/Subtract to 10
<b>2</b>	Add/Subtract to 1000	Add/Subtract to 20 (use mental strategies) Add/Subtract to 100
<b>3</b>	Multiply/divide to 100 Multiply 1-digit numbers by multiples of 10 up to 90	Add/Subtract to 1000 Multiply/Divide to 100
<b>4</b>	Multiply up to a 4-digit number by a 1-digit number Multiply up to a 2-digit number by a 2-digit number Divide up to a 4-digit number by a 1-digit divisor	Add/Subtract multi-digit numbers
<b>5</b>	Divide up to a 4-digit number by a 2-digit divisor	Multiply multi-digit numbers
<b>6</b>		Divide multi-digit numbers

I agree with the responses you've received so far - great explanations!

I believe that your own district needs to make that determination - how many problems, in how many minutes. I have heard 3 seconds per problem depending on the age of the student and writing ability. But, that's if you believe timed tests are best practice. :)

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Rote generally means from memory, and automaticity and fluency mean knowing the facts by using quick, and accurate strategies.

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The Common Core in the second grade progressions explains fluency like this:

*The word fluent is used in the Standards to mean “fast and accurate.”*

*Fluency in each grade involves a mixture of just knowing some answers, knowing some answers from patterns (e.g., “adding 0 yields the same number”), and knowing some answers from the use of strategies. It is important to push sensitively and encouragingly toward fluency of the designated numbers at each grade level, recognizing that fluency will be a mixture of these kinds of thinking which may differ across students. The extensive work relating addition and subtraction means that subtraction can frequently be solved by thinking of the related addition, especially for smaller numbers. It is also important that these patterns, strategies and decompositions still be available in Grade 3 for use in multiplying and dividing and in distinguishing adding and subtracting from multiplying and dividing. So the important press toward fluency should also allow students to fall back on earlier strategies when needed. By the end of the K–2 grade span, students have sufficient experience with addition and subtraction to know single-digit sums from memory; as should be clear from the foregoing, this is not a matter of instilling facts divorced from their meanings, but rather as an outcome of a multi-year process that heavily involves the interplay of practice and reasoning.*

We need to consider fact fluency along a learning trajectory, using the levels of thinking defined in the CCSSM and *Cognitively Guided Instruction*-- **Direct Modeling, Counting Strategies,** and **Number Facts** ("derived" and "known.") This framework allows us to notice students' strategies, thoughtfully plan classroom discussions to share and connect those strategies, as well as plan future experiences to progress all students along that trajectory.

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I think everyone agrees that fluency and strategies are both appropriate and necessary targets. For most kids, those two targets seem to develop together. The abiding questing is what to do when they don't develop together. EDM has so many good games for developing fluency, but what is the best response when 4th and 5th grade students are still bogged down with playing games because they are counting on their fingers? What is the best response when an Algebra student has a conceptual understanding, but they are unable to complete a problem because they are so bogged down with using strategies that, at that grade level, are no longer efficient?