



White Paper
BlueStreak Math: Math Fact Fluency

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White Paper

BlueStreak Math: Math Fact Fluency

“You figure the check, I can’t do math.” Imagine lunch at a restaurant and saying, “You scan the menu, I can’t do reading.” And that’s the story of mental math and math fact fluency.

What is Mental Math?

Learning math facts is a math hallmark of schooling that stretches back to the 1800s. Yet, it can be an elusive cognitive skill for students, who will slip by without mastering the math fact fluency in mental math performances. It’s all in your head! Mental math is simply the ability to do math facts in your mind, without the aid of paper and pencil or calculators. It’s a process that offers in immediate and accurate recognition of the combinations of numbers used in all kinds of math computations from simple addition and subtraction problems to more complex tasks that involve multiplication, division and application scenarios.

What is Math Fact Fluency?

A more precise focus on mental math, is termed, *fact fluency*. *Fact fluency* means knowing the math facts *mentally* and with *automaticity* and *accuracy in order to do math problems instantly*. Math fluency is about having the *ability to do a simple math performance in your head*. In fact, according to experts, students must know their math facts with *fluency and accuracy within a specified time that ranges in the literature from 2-3 seconds to 8 seconds (Berg, 2016) or 10 seconds* noted in respected documents from the CCSS (2009) to NCSM (2012) to PARCC 2010) among others.

In any case, the mental quickness and automatic response is what is most important regardless of how the development of faster pacing advances with individual practice. Similar to knowing sight words in reading fluency, where the students know a set of basic, high frequency words by sight recognition, math fluency provides the same kind of familiarity and instant recognition for students’ skillfulness with math facts. Fluent readers are not halting, stumbling, or reversing themselves and the same is characteristic of students performing fluent mental calculations with math fact fluency.

The benefit can be striking. Students can free up their working memory with fact fluency permitting time and attention to more difficult steps and tasks in their calculations and computations. If they have to recreate simple math facts every time, math becomes tedious and taxing. If they know their facts in their mind, with BlueStreak speed, they can “streak” by these simple facts and proceed to the more complex parts of conceptual problem solving and logical reasoning required in math performances. The math facts have to become reflexive and flow with ease when doing math. It’s smooth and quick, streaking through the mind with lightning speed, with math fact fluency flashing through in milliseconds. Math fact fluency is the gold standard of math proficiency.

Why is Math Fact Fluency Critical?

This simple skill of memorizing math facts that can be accessed instantly and with cognitive automaticity, is a vital foundation for the study of the complex, higher-level mathematics, such as algebra, geometry and calculus (Loveless & Coughlan, 2004; NMAP, 2008; Resnick, 1983; Reys, Lindquist, Lambdin, & Smith, 2010). In fact, many experts agree that critical elements for proficient math performance include this skill of fluent recall of basic math facts. It is seminal to understanding and to the ability to perform more abstract mathematics (Baroody, Bajwa, & Eiland, 2009; Kilpatrick, Swafford, & Findell, 2001; NMAP 2008; Resnick, 1983).

In short, math deficit with math fact fluency impacts students' entire k-12 math experience. Failing to truly conquer math facts in addition, subtraction, multiplication and division in the early years, pre-k-5, causes students to struggle with math, in general, throughout their schooling. Many develop an attitude of "I hate math" and more importantly, they are shut out of higher math classes. In his book, *Why Don't Students Like School?* cognitive scientist Daniel Willingham (2009) stated "It is virtually impossible to become proficient at a mental task without extended practice" (p.81).

Algebra II is regularly considered a "gateway course" for continued success in mathematics. With math fact fluency, students are prepared to continue their math journey into higher levels needed for success. A report by the Institute of Education Sciences emphasized the import of basic, foundational math skills: "Quick retrieval of basic arithmetic facts is critical for success in mathematics. Yet, research has found that many students with difficulties in mathematics are not fluent in such facts" (Gersten et al., 2009, p. 37). The goal then is to provide the practice, repetition and rehearsal with math facts until they become natural reflexive actions during mental math performances.

Advocates for Math Fact Fluency

While the Common Core State Standards advocates and advances the skill of math fact fluency stressing its critical role of more abstract mathematics, they are not alone. The National Council of Teachers of Mathematics, National Mathematics Advisory Panel, What Works Clearing House, and Texas, state mandated TEKS (Texas Educational Knowledge and Skills, agree.

- The NCTM's Curriculum Focal Points make fact recall one of the three focal points in grades 2 and 4
- Automaticity with mathematical facts is one of the National Mathematics Advisory Panel's Core Principles of Mathematics Instruction
- The What Works Clearinghouse's research-based recommendations for Response To Intervention (RTI) programs for struggling students in mathematics include 10 minutes per session for developing fluent retrieval
- Texas recently approved new elementary mathematics standards (TEKS) specifically requiring automaticity.

What Exactly is BlueStreak?

BlueStreak is an invigorating software solution that assists students utilizing the key aspect of *math fact fluency*. It's important to note that *math fact fluency* is not something that happens all at once in a single grade. Along the way, across the grades, active attention for continuous, repetitive practice is required for students to know and be able to perform these skills with proficiency. As stated earlier, it is similar to the expansion of sight words as students develop greater abilities in reading fluency.

This web-based solution ensures that sufficient practice and extra support are provided at each grade to allow all students to meet the standards that call explicitly for fluency in this particular math area. In fact, BlueStreak is not only a highly effective digital tool, it is also amazingly engaging for students motivated by the design. BlueStreak is a just released, cutting edge digital tool that invites, excites and ignites student practice, learning and mastery of *math fact fluency*.

The name, itself, BlueStreak symbolizes the speed, accuracy and automaticity that *math fact fluency* entails for functional mastery and it evokes an image of lightning-like speed and illumination that motivates and inspires. It has that allure to youngsters that movies of fast cars, traveling at lightning speeds has.

What Does It Look Like When Doing BlueStreak Math?

BlueStreak is a Prek-8, standards-based content that encompasses addition, subtraction, multiplication, division and application facts from 0-12. It is designed with specific content for Prek-3, early literacy students, as well as for regular and second chance readers in grades 4-8. Students are on a one-to-one application working on their own, at their own pace, with adaptive progressions to match and /or provide an adaptive challenge for their ability level. BlueStreak elements include:

- Pre and Post Test for 0-6 and 7-12 addition, subtraction, multiplication, division and application
- Mood Chart for interactive space theme video to practice facts
- Learning Cards presented to learn new facts
- 3 Game Themes: The Explorer, Defender and Racing Games
- Extended Practice Application
- Chart of Detailed Report for Administrators, Teachers, Parents, Students
- Certificates for Mastered Facts

Students begin with a **Pre-test**, one designed for facts, 0-6, the other for facts, 7-12. These determine their level and **adapt to the area of weakness** - from not knowing the facts to knowing the facts, but demonstrating a certain deficiency area in fluency. Students then are placed in a **game-based setting**, given a **learning card for 2 facts** they don't know and begin their **2 minute rounds**. Each round consists of new learning cards along with mastered facts for game-based practice. Students earn BlueStreaks for their longest Streak, getting facts accurate and fluent, while practicing.

How is Student Progress Assessed?

Assessment is key when working on fact fluency. BlueStreak Math provides an initial assessment to determine which facts the students know with automaticity and accuracy. This provides actionable feedback that is used to adjust the ongoing facts presented to each student. Students are provided an individualized learning path based upon their areas of strength and weakness. This provides the basis for a systematic method of assessing and addressing each student's fact fluency. Mastered facts are interspersed while new facts are introduced and practiced providing confidence to the student as they are learning their new facts through engaging game-based formats. A post-test will assess the students' growth in each of the fact fluency areas, addition, subtraction, multiplication, division and application.

Scoring is based on the Pre-test of 24 questions, accommodated with an adaptive assignment on learning cards for the hierarchy of skills. On the Post-test performance, using a new set of 24 questions, students are expected to answer accurately with 100% fluency within 4 minutes. If they can't perform at the level of proficiency, they are presented the learning cards that they did not master and get an opportunity to practice again until mastery.

Why BlueSteak is a Superior Product?

- BlueStreak is a web-based online product for math fluency
- BlueStreak has 24/7 Anytime, Anywhere student accessibility
- BlueStreak provides a Systematic Process of Mastering Facts
- BlueStreak demonstrates a *Hierarchy of Skills for Developmental Growth*
- BlueStreak is based on *One-to-One Math Fact Fluency Progressions*
- BlueStreak addresses *Required Skills* with engaging strategies
- BlueStreak features *Multiple Games* that allow students to practice their facts
- BlueStreak provides *Immediate Feedback* to the student about mastery of facts
- BlueStreak gives *Feedback progress to Parents, Administrators, Students*
- BlueStreak provides *Pre/Post Tests Data to Assess Students* and Differentiate
- BlueStreak issues actionable feedback to all in *Easy to Read Charts and Graphs*
- BlueStreak teaches fact fluency to facilitate time for more complex thinking

Why Start with BlueStreak Math?

The pedagogical sequence for learning math fact fluency is sound, practical, tried and true. It is a robust, multi-sensory approach that *differentiates, engages* and *reinforces learning* by stimulating a number of senses. It is similar, in that way to a process in reading fluency called, the Neurological Impress Method (Heckelman, 1966) that impress the auditory and visual lobes of the brain as well as the motor cortex in the parietal lobe where the integration of the senses occur. with speaking aloud. It is a remedial reading method used in reading fluency.

Multimodal Sensory Learning

See It:	Visual component stimulates the Occipital Lobes of the brain that provide vital imagery to the brain
Hear It:	Auditory component stimulates the Temporal Lobes for the Auditory senses as it hears the sound of the language
Say It:	Voice component activates the Motor Cortex of the brain and the Temporal Lobes that are simulated by the sound of the student's voice as s/he says the words aloud
Type It:	The Bodily/Kinesthetic senses activate the Motor Cortex creating muscle memory
Solve It:	Thinking and Reflecting awaken the critical Frontal Lobes of the brain that perform Executive Functions of cognition including skills of analyzing, evaluating, perceiving, comprehending, connecting

Why Stay with BlueStreak Math?

BlueStreak is an elastic program. It has the plasticity or the ability to change the brain's chemistry and its structure and BlueStreak stretches beyond the immediacy of drill and skill exercises. In addition, BlueStreak offers challenges to students that stretch across the nation. The contests determine the fastest and most accurate in challenge rounds that invigorate and motivate students to persevere and stick with it until mastery and beyond.

Why Revisit, Review, Refresh, Renew with BlueStreak Math?

- The same enticements that got them to start and stay with BlueStreak
- Web-based online product, for math fluency
- 24/7, anytime, anywhere student accessibility
- Multiple games that allow students to practice their facts
- Proficiency challenges and competitions across states
- Familiarity and comfort with the BlueStreak games
- Step by Step Success that build confidence and self-esteem

How is BlueStreak Math Aligned with Common Core State Standards?

As students progress through the Common Core State Standards in Mathematics, they pursue three key developmental components of learning: conceptual understanding, procedural skill and fluency and application of skills in problem solving situations.

BlueStreak, with an engaging game format, develops these three key CCSS-M learning components with fidelity.

BlueStreak begins by providing students practice in single-digit calculations in all four operations. This increases conceptual understanding by learning basic facts with speed and accuracy. Computational practice is done in stages, which allows for the continuing development of basic fact fluency. Drill alone does not always lead to mastery. In order to further develop mastery, Blue Streak adds a “Challenge Level” to emphasize “thinking strategies” of single-digit combinations, which improves student achievement and mastery of basic skills.

The BlueStreak Challenge Level also enables students to apply their learned math facts in different situations that require conceptual understanding and mathematical knowledge. Correctly applying their newly acquired basic skills and math knowledge provides students with a solid foundation for future procedural skills in all four operations.

BlueStreak provides all students with engaging foundational activities that develops quick and accurate computational skills and extends application opportunities that provide students with insights into the future structure of mathematics.

Supporting Common Core State Standards by addressing the following fluency expectations are as follows:

Grade	Standard	Required Fluency
K	K.OA.A.5	Add and subtract within five
1	1.OA.C.6	Add and subtract within 20, demonstrating fluency for addition and subtraction within 10.
2	2.OA.B.2	Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.
3	3.NBT.2 3.OA.7	Students fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. Students fluently multiply and divide within 100. By the end of grade 3, they know all products of two one-digit numbers from memory. Note: Students must begin work with multiplication and division (3.OA) at or near the very start of the year to allow time for understanding and fluency to develop.
4	4.NBT.B.4	Students fluently add and subtract multi-digit whole numbers
5	5.NBT.B.5	Students fluently multiply multi-digit whole numbers

2016 Common Core State Standards Initiative Web Site, More information is also available in the *K-8 Publishers’ Criteria*, developed by the CCSSM authors, available at www.corestandards.org.

How is BlueStreak Math Aligned with PARCC?

Model Content Frameworks, Mathematics Grade 3-11, Version 4.0 December 2014
<https://parcc.pearson.com>

How is BlueStreak Math Aligned with Smarter Balance?

Throughout the K-6 standards in CCSSM there are also individual content standards that set expectations for fluency in computation (e.g., fluent multiplication and division within the times tables in Grade 3). Such standards are culminations of progressions of learning, often spanning several grades, involving conceptual understanding, thoughtful practice, and extra support where necessary. Technology may offer the promise of assessing fluency more thoughtfully than has been done in the past. This, too, is part of ‘measuring the full range of the standards.’ Computer Adaptive environment to adjust the level of scaffolding that is provided depending on the student’s performance level. Computer administration of the assessment affords the possibility of assessing student fluency with mathematical operations by means of monitoring the response time. <http://www.smarterbalanced.org>

How Does BlueStreak Extend Student Skills into Life Skills?

Sharing the metacognitive “why”, with students is a necessary component of math understanding and reasoning abilities. Explaining that mental math will not only serve students well in school but, more importantly, that students will use these skills outside of the classroom in real world situations. Students need to know that those who master the technique of mental math will find that the strategy helps them when they visit the store and need to tally how much the bag of potato chips or candy bar they grabbed from the shelves will cost before they walk up to the register.

As they mature, mental math will help students calculate the price of sale items, know how big of a tip to leave or how to split a bill when a large party dines out. They will be able to estimate the amount of paint needed for their bedroom walls, the yardage of fabric needed for the puppet theater and even how to guestimate the cost of the family vacation.

Again, telling students the practical ways mental math can help them specific examples of why they need to master these simple combinations and how to use them readily in their everyday transactions will likely motivate them to become more skillful at the practice. Studies have shown that students are more interested in learning techniques that they can apply to real-world situation, and thus, more motivated to want to learn them. Here is a brief listing of BlueStreak benefits for life skills:

- Gain a level of awareness *above and beyond the immediate subject matter*.
- Connect the subject matter to a bigger contextual frameworks
- Think about the tasks and contexts for different learning situations
- Understand themselves as learners in these different contexts
- Increase their abilities to transfer learning to new related and unrelated tasks
- Adapt their learning to new contexts that may be remote from the original
- Know about the different kinds of strategies for learning
- Will be more likely to use strategies for analyzing and problem solving
- Develop a full awareness of why and how of the learning target
- Assume more self-control and management over their own thinking and learning

Resources

Baroody, A. J., Bajwa, N. P., & Eiland, M. (2009). Why can't Johnny remember the basic facts? *Developmental Disabilities Research Review*, 15, 69-79 (Special issue on "Pathways to Mathematical Learning Disabilities" guest edited by M. Mazzocco). doi:10.1002/ddrr.45

Berg, B., 8.15.16 <https://sites.google.com/site/bestnextcommoncoremath/xtra-math>
related:<https://sites.google.com/site/bestnextcommoncoremath/xtra-math> Berg, B. <https://sites.google.com/site/bestnextcommoncoremath/xtra-math>

Common Core State Standards Initiative Web Site. (2016). More information is also available in the *K-8 Publishers' Criteria*, developed by the CCSSM authors, available at www.corestandards.org.

Kami, C. (1985). Too Many Don't Know Facts: Young Children Reinvent Arithmetic. New York: Teachers College Press.

Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools NCEE 2009-4060). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/practice_guides/rti_math_pg_042109.pdf

Heckleman, R.G. (1966). Neurological Impress Method (NIM).isc.sagepub.com/content/1/4/235.full.pdf

"It's All in Your Head": Mental Math: Math Facts Fluency
<https://www.verywell.com/what-is-mental-math-620915>

Kilpatrick, J, J.Swafford & Findell, B. Eds. (2001). (Front Matter) Adding It Up: Helping Children Learn Mathematics | The ...The National Academies Press. www.nap.edu/read/9822/chapter/1

Loveless & Coughlan. (2004). "The Arithmetic Gap," *Educational Leadership*, 61, 5 (February) pp. 55-59. The Brookings Institution, Washington, DC.

Morin. A. 3.16.2016. What is the Definition of Mental Math: How This Kind of Math Benefits School-Aged Children. www.k-5mathteachingresources.com/mental-math.html

NCSM Fall Newsletter. (2012) p21. mathedleadership.org

NMAP, 2008; Resnick, 1983 Resnick, L.B.(1983) . A development theory of number understanding . In Herbert P . Ginsburg (Ed .), *The development of mathematical thinking* (pp . 109–151) . New York: Academic Press.

Partnership for the Readiness for College and Career (PARCC). (2010). PARCC application for the Race to the Top Comprehensive Assessment Systems Competition. Retrieved February 2, 2013, from <http://www.fl DOE.org/parcc/pdf/apprtcasc.pdf>.

Reys/ Lindquist/ Lambdin/ Smith/ Colgan. (2010). Helping Children Learn Math, Canadian Edition.

Rivera, Reiss, Eckert and Menon, (2005). K5 Learning Blog. Reading and Math Enrichment.
<http://www.k5learning.com/blog/why-do-kids-need-learn-math-facts>

Van de Walle, John, A. (2007). Helping Children Master Basic Facts-Elementary and Middle school Mathematics. Pearson Education.

Willingham, D. (2009). Why Don't Students Like School? A Cognitive Scientist Answers Questions About How the Mind Works and What It Means for the Classroom 1st Edition.
Boston: Jossey Bass.

