Solving the Mystery of Poor Math Performance

An instructional and structured format
to solve the chronic ills of
elementary and middle school student math outcomes.

Eliminating the Achievement Gap via
eradicating the numeracy skill gap!

Blaine A. Helwig

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Executive Summary

America's elementary students fail arithmetic in staggering numbers each school year as they have for the last 70 years. Our children are failing ARITHMETIC! Arithmetic has been around for millenniums, and apparently, we are unable to teach our children skill mastery in adding, subtracting, multiplication, dividing, place value, rounding, even and odd numbers, fractions, decimals and the like. However, there are viable alternatives in our elementary classrooms to the failure of the past and present.

A commercially purchased core curriculum is specifically intended *for grade level instruction*, and it assumes that students do not possess prior grade level numeracy or academic skill gaps. However, this is simply not the case in our public schools. A significant percentage of second through sixth grade students possess prior grade level arithmetic/numeracy skill gaps. These math fact and math processing skill deficiencies impair students' ability to readily engage in their current grade level instruction. Consequently, regardless of the commercially adopted core curriculum and the problem-solving instructional resource stated effectiveness, the majority of classroom teachers - regardless of experience levels - possess difficulty using the adopted curriculum with fidelity in a typical elementary classroom. The end result of these academic numeracy skill gaps is consistent substandard student achievement outcomes each school year as measured by the infamous and ubiquitous Achievement Gap. Thus, ***eradicate the numeracy skill gap, and the Achievement Gap vanishes as well!***

In this paper, the educator can learn where and why the academic gaps are forming as well as the means to stop them from fomenting or a method to eradicate them in the intermediate grade levels (3rd through 5th grades). In only one school year – regardless of student socioeconomics, it is possible to achieve stellar academic student outcomes in any elementary school.

The four (4) components of the standard 90-minute math block discussed in the main writing of this document are effective in all classroom and socioeconomic settings. However, with any pedagogy and instructional resource methodology, there exists an ever-present caveat of efficacy in every classroom – effective classroom management. It is imperative that teachers and administrators develop positive relationships with their students as well as maintain both effective student management and daily routines in the classrooms to preserve daily instructional minutes. If these classroom relational dynamics are not nurtured and consistently maintained, the overall efficacy of any successful pedagogical resource and instructional system will be significantly impaired. It is also imperative that the campus administration assist and support classroom teachers with student discipline, as the situation warrants.

This document is a relatively long read, but worth reading if an educator or parent wants truthful answers to poor and chronic math performance. This white paper specifically isolates the reason for public school past and present math woes and provides a proven, replicable, viable and inexpensive solution.

Finally, proven outcomes are important in any assertion or proposition in any professional field. The process and pedagogy presented in this document produced two (2) urban Title 1 National Blue Ribbon Schools, and both schools are featured for academic excellence by the United States Department of Education as National Blue Ribbon Profile Schools. Graham Elementary and Blackshear Elementary Fine Arts Academy in the Austin Independent School District (Austin, Texas) have also earned multiple-year Gold Ribbon School (Children At Risk – Houston) awards and a myriad of Texas Education Agency (TEA) high academic performance recognitions.

About the Author

Blaine Helwig is a locally, state and nationally recognized campus administrator and was the J. Walter Graham Elementary Principal in Austin ISD for over 9 years. In that time period, J. Walter Graham Elementary (an urban Title 1 school) experienced dramatic and sustained academic success with typical inner city challenging student demographics. From 2009 to 2016, Graham Elementary School's academic performance earned exemplary accountability ratings and every possible academic distinction by the Texas Education Agency. The school was honored as a 2012 National Blue Ribbon School recipient, and the campus was featured as a National Blue Ribbon Profile School for academic excellence on the United States Department of Education's website - one of only four schools in the country to receive this prestigious honor. The Graham campus has also been recognized annually by Education Non-Profit Organizations for high and sustained academic performance. Finally, the language arts, mathematics and science stop-gap resources implemented at Graham that produced heightened student success are currently used in many other Title 1 campuses and districts with similar high percentages of English Language Learners, minority and low socioeconomic student populations.

In 1985, after completing a Bachelor of Science degree in Architectural Engineering from the University of Texas at Austin, Mr. Helwig worked for seven years as a senior design engineer, analyzing and designing state and federal highway bridges. He was also employed as a civil engineer in California and Utah with the United States Department of Defense as a lead project engineer overseeing earthen and hydraulic dam construction. At present, Mr. Helwig retains his license as a registered professional engineer in Texas with a structural engineering specialization.

Mr. Helwig was conferred a Bachelor of Business Administration in Accounting in 1992. During this period of business study, he pursued additional and concentrated coursework in both economics and finance. After working as an accounting director for a large library system in central Texas, he was alternatively certified to work as an elementary teacher by the University of Texas. He taught fourth and fifth grade self-contained classrooms in the Round Rock Independent School District for six years. It was during those professional years that extensive language arts, science, social studies and mathematics curriculum were developed. The initial design work on the numeracy and literacy stop-gap resources was completed, implemented and beta-tested in intermediate classrooms. Those stop-gap intervention programs significantly evolved during his Title 1 school experience and are currently used by tens of thousands of elementary students in both traditional public schools as well as charter schools across the State of Texas.

In 2004, he was awarded a Master's degree in Educational Administration from Texas State University and worked for two years as the assistant principal at Charlotte Cox Elementary in the Leander Independent School District, a suburban school district near Austin. He began work in the Austin Independent School District in 2006 as an Elementary Program Supervisor under the direction of the Associate Superintendent's Office. A year later, he started his principal assignment at J. Walter Graham Elementary and maintained that capacity until his retirement in the fall of 2016. In 2012, Mr. Helwig was recognized by the United States Department of Education as one of seven recipients in the country with the prestigious Terrel H. Bell award for school transformation for producing outstanding student achievement for all students regardless of race, language proficiency and socioeconomic status. He was also the 2012 recipient of the Central Texas HEB Principal Excellence in Education Award and a five-time nominee and a two-time finalist for Austin ISD Principal of the Year.

Currently, Blaine Helwig is a curriculum writer and a Title 1 education consultant in rural and urban school transformation. He is a cofounder of Celestial Numeracy, a daily numeracy program that presently serves over 90,000 elementary and middle students each day as well as a cofounder of The New 3Rs Academic Transformation.

Solving the Mystery of Poor Math Performance

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Solving the Mystery of Poor Student Math Performance

By Blaine Helwig

NOPE! The usual suspects of endless blame are not the reason poor academic math results in American public schools. In fact, a viable, replicable and inexpensive solution exists to achieving heightened and sustainable student math outcomes in Title 1 public elementary schools with the *most challenging* demographics.

When I was a fourth and fifth grade teacher, I never had a student fail a State standardized mathematics test. Ever! Furthermore, as an urban Title 1 elementary principal with 90 plus percent low income (approximately 65% LEP/emergent bilingual) student demographics, our school always had standardized math results between 90 and 100 percent passing rates (including students receiving special education services) and up to 60 percent student mastery for 15 consecutive years – including the first year I became the campus' lead administrator. My wife copied our processes as a Title 1 principal at two different urban Title 1 elementary schools, and she equaled and bested our results in various school years – again, beginning in her first year at both schools. Therefore, her school's instant and continued performance proved my Title 1 elementary school was not an outlier of academic success.

Mathematic performance in the United States has been an incessant problem for as long as I can remember, and I turned sixty last June. What is also an issue with student math outcomes is that IT CONTINUES TO BE AN ISSUE TO THIS DAY!

Therefore, the question at hand is, ***"How is it possible that some of America's Non-Title 1 and a vast majority of Title 1 elementary schools continue to score so chronically low in comparison to other industrialized countries year after year?"***

I am pleased to inform the reader that the primary reason for incessantly poor performance in arithmetic mathematics is NOT due to incompetent teachers or administrators, incapable students, high poverty, lack of money, desperately desiring higher student outcomes, or the kids' parents.

Let us examine the culprit of poor math performance in American public schools – Title 1 and non-Title 1.

Warning: This document is a relatively long read, but worth reading if an educator or parent wants truthful answers to poor and chronic math performance. This passage specifically isolates the reason for public school past and present math woes and provides a replicable, viable and inexpensive solution.

The Root Cause of the Academic Numeracy Gap – Inequitable Skill Ability

Typically, low academic performance is a consistent characteristic of most Title 1 public schools; however, low math performance is also prevalent in a significant number of non-Title 1 schools as well. ***Why?*** Because a significant number of middle-income and high-income children develop the same academic numeracy gap as their less affluent peers enrolled in Title 1 elementary campuses. When academic numeracy gaps rear their ugly head, for all practical purposes, the math performance issues are the same regardless of income status. Now, it is important to note that a parent with financial resources can more readily solve their child's math issues with home support or money – since they can afford to pay for outside afterschool or nightly tutorial services from commercial vendors. A good commercial vendor understands the students' underlying

innumeracy issues occurring in the elementary schools as does the author, and they directly address them. Conversely, low-income students – generally – have much lower levels of home academic support as well as their parents' ability to afford expensive commercial afterschool tutoring.

Part 1 – Origins of the Academic Numeracy Gap Versus Literacy Gap

The 'literacy gap' between low income and more affluent children occurs before either student arrives for their first day of public school. In short, extensive sociological research conducted over the last 60 years indicates that middle-income and high-income students' parents read and speak more to their children (e.g. ages 1 to 4) in comparison to lower income familial environments. Thus, low-income children arrive at school with a significant literacy and a word recognition gap than their more affluent counterparts. It is highly likely that low-income children in comparison to their more affluent peer's *numeracy* ability is not that appreciably different. Why? Prior to school age, most young children ages 1 to 4 are not consistently engaged in extensive arithmetic operations that produce a long-term impact on a child's math ability. It is the author's experience that significant and repeated levels of pattern recognition, logical thinking, analytical activities and arithmetic operations predominately occur and are developed much more readily in structured school classrooms. Thus, if a numeracy gap foments it will occur in the primary grades (i.e., kindergarten through 2nd grades) and if uncorrected, widens during and after third grade as more intermediate grade level (i.e., 3rd through 5th grade) math skills are introduced. Intermediate students are unable to master many intermediate grade level math skills that have *dependent and unmastered* prior grade level math skills. After a typical review of standardized test data each school year, it is empirically fair and justified to conclude that Title 1 elementary schools in comparison to non-Title 1 campuses produce greater levels of numeracy disparities that lead to poor student math performance over time. However, it is also fair to state that there are significant numbers of middle- and high-income students that exhibit similar poor math ability as low-income students for the exact same reasons.

As stated above, the numeracy gap leading to poor student math performance may occur in either socioeconomic school setting. Clearly, it is not a teacher's intention to provide poor daily mathematics lesson or instruction. It is a lack of knowing what and how to teach so the vast majority of students learn and master grade level mathematical content.

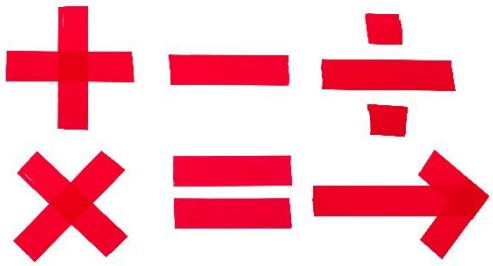
In a sentence, it is not the classroom teachers that are to blame for poor math performance, for they are instructing students to the best of their ability – as they were trained at university or emulating their colleagues' math instruction. However, the education community – teacher colleges and universities failed to provide teachers with an instructional methodology and thinking that ensures mastery by all in arithmetic skill areas. *In short, classroom teachers have not been shown a simple strategy to address prior grade level numeracy gaps, or shown a methodology to prevent them from forming in the primary grades.* This confusion results in pedagogical and instructional mediocrity with too many elementary classroom teachers following what the author coins as the 'Modern Teaching Failure Philosophy': *"If a student gets it, they get it. If they do not, they do not! Teacher moves on to next lesson."*

Modern Teaching Failure Philosophy:
If students get it, they get it.
If they do not, they do not!
Teacher moves on to next lesson.

The consequences of ignoring academic numeracy gaps are more than evident of this type of teaching philosophy over the last 60 years. In fact, the outcome is chronic ***grade-level*** standardized testing results beginning in third grade since significant numbers of students have been passed on with arithmetic skills or academic numeracy gaps. Unless the skill gaps are corrected, they widen, and poor student performance continues unabated.

Part 2 – The Importance of Math Facts and Processing Skill Mastery IN Problem Solving Applications

Arithmetic math facts (i.e., addition, subtraction, multiplication and division) and grade level math process skills (e.g., place value, even/odd numbers, whole number lines, comparing and ordering numbers, decimals, fractions, perimeter, area, volume, etc.) play an essential role in elementary students' ability to problem solve. Standardized testing in most States does not focus on discrete skills, but by application of many numeracy skills in a word or story math problem – as in the example shown below. It is also important to emphasize that mastery of both two math arithmetic skill areas (i.e., math facts and math processing skills) also dictate students' level of success during their secondary school years in algebra, geometry and trigonometry. If a student has not been provided successful intervention by middle and high school, secondary teachers are placed in a challenging and often untenable position. They must parallel their instruction on daily lesson design on both dependent, unmastered arithmetic skill gaps as well as teach students the content in their area of pedagogical algebraic or geometric responsibility. Consequently, it is critical to rectify these numeracy skill gaps in elementary school, or better yet, prevent them from forming in the first place.



Let us analyze a typical third grade mathematics word problem – an ***application*** of embedded math fact and math processing skills.

> *On Saturday, July 20, Susan and Jessica went to the store. Susan purchased a chair for 25 dollars and a rug for 49 dollars. Jessica bought a pair of shoes for 61 dollars. Estimate the difference the two girls spent at the store to the nearest ten dollars.*

Solution:

Susan:	Round to nearest 10:	\$25 to **\$30** and \$49 to **\$50**
	Sum purchases:	\$30 and \$50 equals **\$80** ✓
Jessica:	Round to nearest 10:	\$61 to **\$60** ✓
Estimated Difference between Susan and Jessica's purchases:		\$80 - \$60 = **\$20** ✓✓

In the math word problem as shown above, the solution indicates that Susan spent *about* 20 more dollars than Jessica. However, let's drill further down and examine the problem-solving process ***by listing the main arithmetic math (numeracy) skills that were required to correctly solve*** the 'Susan/Jessica' application work or story problem – again, a typical problem occurring on standardized assessments.

1.) **Place Value –** Basic understanding of ones and tens place for two-digit number was required.

2.) **Whole Number Lines/Rounding Two-Digit Whole Numbers –** The student needed to know the 'fixed' number line locations of 25, 49 and 61 to successful round numbers to the nearest 10.
3.) **Addition and Subtraction Math Facts –** Mastery of basic math facts was required.
4.) **Addition and Subtraction of two (2) Digit Numbers –** The student was required to functionally add and subtract multi-digit numbers without regrouping or carrying.
5.) **Math Vocabulary –** The student needed to know the following specific math vocabulary words and their meaning in mathematics: estimate, difference, and nearest ten.
6.) **Estimate means 'round' the whole numbers, first –** If the student sums Susan's purchases without rounding, he/she would obtain the following: 25 + 49 = $74. Subtracting $61 (Jessica's purchase) from $74 is $13. The student would round $13 to $10, and obtain the *incorrect estimate*. Students must understand in estimation, round the numbers first, and then and only then, find the estimate. If not, the concept of finding a quick estimate of situation is entirely lost.

Part 3 – Implications of Non-Mastery of Numeracy/Math Skills – the Academic Numeracy Gap

The lack of accountable math skill instruction is the root cause of student outcomes for three reasons. First, an application (e.g., a typical Susan/Jessica word problem) in arithmetic mathematics or algebra, for that matter, is nothing more than words connecting an embedded string of discrete math skills – math facts and math processing skills. Second, if a student(s) possesses a lack of mastery of any of the six (6) required math skills listed above for the Susan/Jessica word problem, then a student(s) will be unable to successfully solve the grade level arithmetic application. Third and most important, ***students' academic literacy and numeracy gaps are the direct cause of the infamous reading and math achievement gaps!*** Thus, ***eradicate the numeracy and literacy skill gaps, and the Achievement Gap vanishes as well!***

In reality, the infamous '*Achievement Gap*' is nothing more than *academic math and reading skill gaps* between low-income students and their more affluent peers.

Each school year when standardized mathematics test results are released to the public and there is a notable discrepancy between low-income students and their more affluent peers. This discrepancy is due to many more low-income students attending schools that allowed numeracy gaps to form in the primary grades and then, failed to rectify those skill deficiencies in their intermediate grades. As indicated earlier, this same chain of events can and does affect to varying degrees students enrolled in non-Title 1 elementary schools; however, their parents may be able to correct the issues at home or afford outside commercial vendor services that rectify their children's academic numeracy gaps. Commercial math tutoring services are effective because they cannot continue to collect fees without demonstrating immediate or relatively quick results. Therefore, the more competent vendors are adept at isolating and addressing children's prior grade level numeracy skill gaps.

There is no entry-level work in teaching. A first-year teacher has the same duties as a veteran on the same grade level.

Fortunately, numeracy gaps can also be resolved in the Title 1 elementary schools without parents paying the fees of expensive afterschool math tutors or commercial mathematics vendors. The remedy focuses on effective instructional methodology and simple but real time intervention resources. It is important to press that there are no entry-level jobs in public education teaching; accordingly, a first-year (entry-level) teacher has the exact same classroom duties and responsibilities as a 15

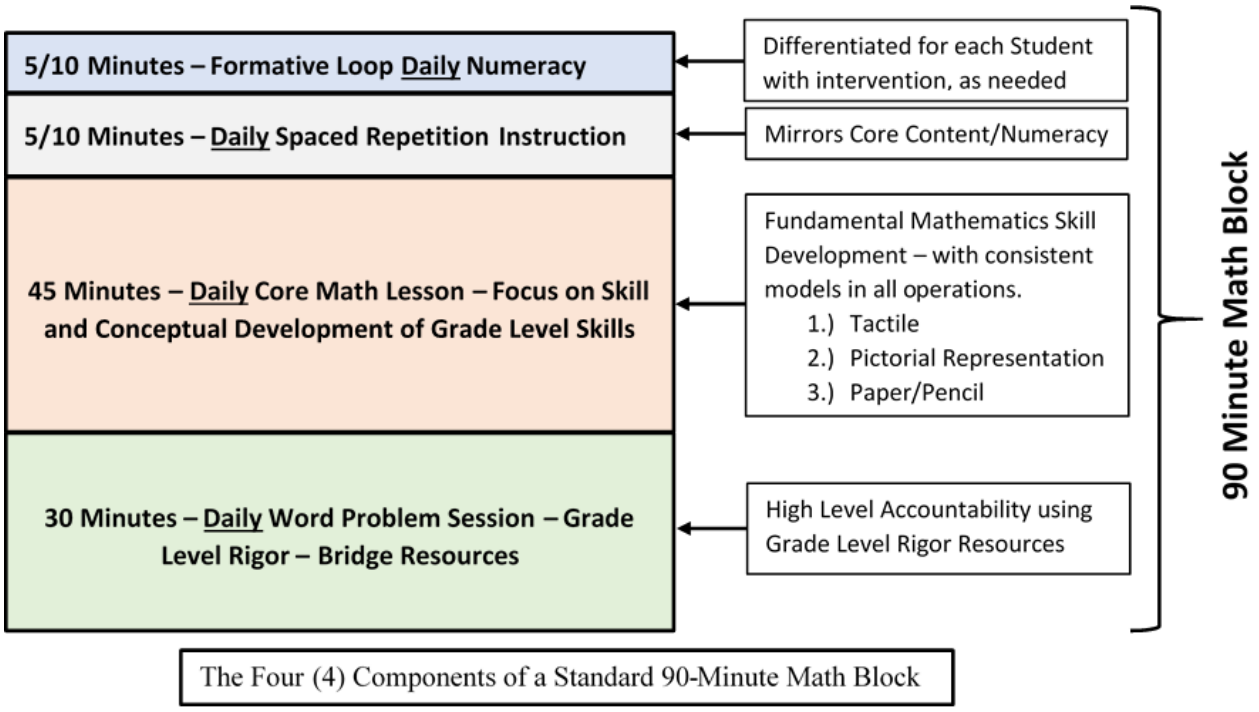
or 25-year veteran teacher on the same grade level. Thus, the 90-minute math block and math system must be a simple design so that a novice teacher is as efficacious in closing the numeracy gaps as a similarly trained seasoned teacher.

Let's examine a 90-minute math block that is capable of closing gaps and/or preventing numeracy gaps from forming, and in the end, produce heightened and sustained mathematic outcomes despite challenging demographics in this country's public elementary schools.

The 4 Components of a Typical 90-Minute Elementary Math Block

A well-structured and typical math block should have FOUR main components: Daily Numeracy, Spaced Repetition, Core Daily Lesson and Problem Solving (Bridge Resource). As with all core daily learning subjects, the math block design should maximize efficiency of both student engagement and learning as well as producing equitable student performance in all socioeconomic settings.

The figure below shows a typical 90-minute math block and a recommended time for each of the four components.



The Four (4) Components of a Standard 90-Minute Math Block

First Component: Daily Numeracy – Formative Loop (5 - 10 minutes)

(Systematically Closing Prior Grade Level Numeracy Gaps while Ensuring Grade Level Skill Mastery)

Daily numeracy is one of the KEY ELEMENTS in dramatic increases in math performance, and conversely true, when omitted entirely or not implemented properly. It is one of the primary reasons for chronically low student outcomes of most elementary math programs. In short, stellar school mathematics performance requires a numeracy program like Formative Loop to quickly turnaround a school and prevent high failure rates on standardized math assessments.

Formative Loop is a digital tracking/monitoring and student paper-pencil daily assessment numeracy program that covers numeracy skills from first through eighth grades. Its systematic and granular approach guarantees segmented student success in both math facts and processing skills. It also affords real time monitoring and

has many explicit and implicit advantages. These specific attributes of the numeracy program are annotated in detail below.

***Explicit Advantages** of the Formative Loop Program Design*

1.) The program includes grade level skill assessments; **AND** most importantly, it *systematically* addresses any and all students' unmastered arithmetic skill gaps from prior school years. Thus, innumerate and academically struggling intermediate students (i.e., 3rd – 5th grades) are rapidly pressed to grade level in one school year, and students already on grade level maintain their rate of skill development.

2.) Formative Loop is a schoolwide digital on-line tracking and monitoring system affording individualized differentiation for each student in real time – pinpointing students' needs that affords ease in identifying and correcting.

3.) Students' daily 5-minute (or two 5-minute) assessment(s) is a **written** exercise, so the teacher has flexibility in the daily operations – students do NOT need to be sitting in front of a computer, providing tremendous time efficiency. *Additionally, there is a psychomotor and empirical aspect of long-term memory learning that is directly tied to the physical act of writing.*

4.) A singular 5-minute daily run that sequences both math facts and math processing skills is always used for first and second grades; however, a separate 5-minute daily exercise for math facts, and a 5-minute daily exercise for math processing skills is recommended for intermediate grade levels. In doing so, students gain math facts operation (e.g., addition, subtraction, multiplication or division) while simultaneously mastering math processing skills (e.g., place value, rounding, even/odd, etc.).

Prior grade level academic skill gaps are not vanishing on their own. Their must be a systematic and accountable process to eradicate them.

5.) The numeracy program contains an extensive on-line numeracy resource library that affords classroom teachers the ability to efficiently download applicable homework, guided or independent practice, as needed.

6.) The program is not only efficient and effective, but it is inexpensive – at the time of writing this document it is priced at $7 per student for the school year.

***Implicit Advantages** of Formative Loop Program Design*

1.) In a typical Title 1 elementary school, it is common that a significant number of enrolled children are academically behind. However, the numeracy program rapidly accelerates students back to grade level. Thus, the small percentage of students with learning disabilities potentially needing 504 services or special education services are more easily identified; whereas, academic struggling students are rapidly accelerated to grade level.

2.) The campus administrator or math coach or teacher team leader can view all teachers and all students in real time and directly compare each classrooms' numeracy skill progression.

3.) Student data may be used for fall and spring semester parent meetings and Admission, Review and Dismissal (ARD) meetings, as needed or warranted. As students are accelerated back to grade level, struggling students are more readily identified and cannot blend in with students that possess only numeracy skill gaps. The daily work of struggling academic students can be used as evidence to justify further investigation for a potential learning disability.

4.) At the beginning of the math block, the teacher administers the one or two 5-minute daily student (written) assessments; whereas, the grading and inputting of the results can be quickly completed by the classroom teacher, math coach or volunteer. Thus, the assessment(s) are completed by the students, the

grading and inputting depends upon the level of quality controls the principal chooses. Another implementation option is for students to complete the 5-minute daily numeracy assessment(s) first thing in the morning as students arrive in the classroom freeing up more time for the 90-minute math block. This process also provides a highly structured and predictable beginning to the instructional day.

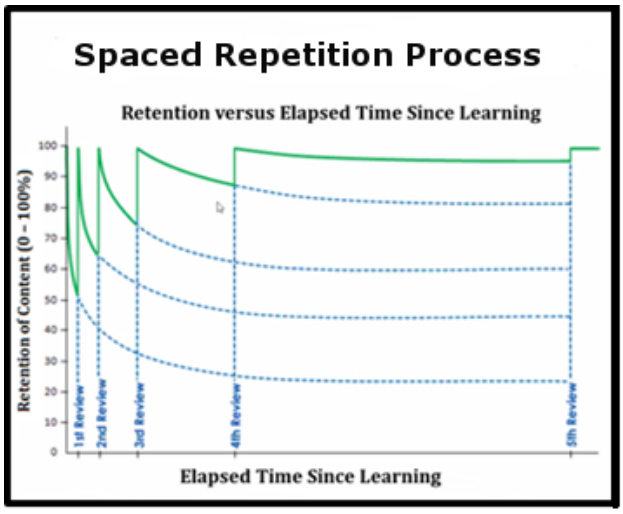
5.) Diagnostic Evaluation – the use of students' daily work clearly indicates patterns and weaknesses. Hence, a teacher or grader can pinpoint the specific arithmetic operation that a student should practice to produce overall mastery of the skill. The math fact assessment clearly and quickly indicates the precise arithmetic facts requiring practice. Thus, only the few math facts that the student has NOT mastered are identified and the child only studies those specific facts for nightly homework.

6.) The teacher can implement a spaced repetition instructional process that symbiotically interacts with Formative Loop creating rapid student skill development in both math facts and math processing skills.

When pressed, Formative Loop affords an educator (teacher or math coach) to monitor and target EVERY student in a classroom or school regardless of its enrollment size. Students are rapidly accelerated to grade level numeracy skills by filling prior academic grade level skill gaps. An efficient and effective daily numeracy program is an indispensable part of a student's math development. It is IMPOSSIBLE to academically turnaround urban and rural Title 1 elementary campuses to equitable levels of scholastic performance without the use of the Formative Loop numeracy program. ***Why?*** It is not possible to close the prior grade level numeracy gaps with large numbers of children that are academically behind without a systematic system that can target each student in real time – especially with a staff that has 15 to 25 percent of teachers with less than three to four years of experience.

Second Component: Spaced Repetition Instruction - (5 to 10 minutes - daily)

Spaced Repetition is a dynamic, instructional methodology that permits a teacher to solve the approximate number of repetitions for SKILL student mastery for EACH child in the classroom. Students possess varying needs of repetition to master or ingrain learning into long-term memory. Students classified as gifted and talented in math require 1 to 3 repetitions to achieve skill mastery, and general education students need between 8 to 16 repetitions to ingrain a skill into long-term memory. Skill mastery for students receiving special education services depend upon each student's disability; thus, the child's Individual Education Plan (IEP) should be consulted and followed to the legal letter of the document. It is important to note that classrooms will all start with the same skill during spaced repetition each morning; however, they will progress at different speeds. ***Why?*** Each classroom has 20 to 35 students sitting in them, and they all have different skill needs. Thus, one teacher may need to expend a little more time on this math/numeracy skill versus an adjacent classroom. However, the teachers should all finish the skills by year end, with expected adjustments along the way.



Spaced Repetition is a highly effective and efficient instructional tool; however, when it is used in conjunction with the Formative Loop program, it is a game changing process for children struggling academic as well as students already on-grade level. In general, ALL students in the classroom are provided a threshold level of repetitions to ensure mastery of both math fact and math processing skills. It affords each classroom teacher to differentiate math processing skills with regard to the academic skill needs of their students.

The symbiotic nature of daily spaced repetition (instruction) in conjunction with Formative Loop can be readily seen in math fact mastery as published in the following download paper: *Accelerated Math Fact Student Mastery*. This short white paper is available as a free download on the New 3Rs Academic Transformation, under the 'Expertise' tab. Again, as previously stated, spaced repetition is also a valuable instructional tool for ensuring that all students ingrain their math processing skills to long-term memory as well. In fact, it is the most efficient and effective classroom instruction of ***guided math*** ever invented where all students are actively engaged in simultaneous and concurrent learning. It is a systematic and dynamic instructional process that any teacher of any level of experience is as effective as a seasoned veteran – which is key in stellar math performance from every classroom teacher on the grade level.

Formative Loop and Spaced Repetition symbiotically eradicate students' *numeracy skill gaps* – independent of a teacher's experience level.

The author has written blogs and white papers (and soon to be released videos) expatiating the merits and technique of spaced repetition instructional. The author has created numeracy skill mastery guidelines for grade 1 through 5 and posted on the website address provided in the footer of this document. All white papers, resources, blogs, and videos are free downloads.

Third Component: Daily Core Lesson - (Approximately 45 minutes - daily)

The daily core lessons predominately address grade level math processing skill development. These lessons would follow the standard scope and sequence curriculum guides for the given grade level. When a new mathematics concept (e.g., multiplication in third grade) is introduced at a grade level, core lessons utilize pedagogy in student learning from tactile/manipulative work to a pictorial model, and then and only then, paper and pencil. The daily core lessons will follow this type of sequencing throughout the school year for all grade level mathematics concepts. As expected, classroom teachers plan individually or as a grade level to design highly accountable and engaging daily lessons that befit their own individual teaching style.

However, two major obstacles often hinder student learning with intermediate (i.e., 3rd through 5th) grade level core lessons. First, the *dependent* academic skill numeracy gaps from prior grades or school years adversely affect daily grade level student learning. Grade level math processing skills are frequently predicated upon prior student mastery of dependent skill(s). *Commercially purchased grade level math resources **are designed and assume** that students do not possess prior grade level skill deficiencies, but unfortunately, they do!* Both Quantile Theory and Bloom's Taxonomy more than adequately depict these dependent math situations, and any Title 1 classroom teacher with more than one (1) year of teaching experience can provide empirical evidence of academic skill numeracy gaps when working with their students.

Second, as previously discussed, first year and the vast majority of seasoned elementary teachers do not know how to systematically handle academic gaps when the skill gaps are across years of math skills. These skill gaps may range from even and odd numbers to place value to whole number lines to math facts – the skill list is long and the most challenging aspect is that students have different areas of skill deficiencies. Hence, the teacher is under duress and time constraints to teach the current grade level standards let alone rectify the lack of prior grade level mastery. Thus, teachers move on to the next lesson, and the students are left further behind.

In some Title 1 elementary schools, the percentage of 'forgotten' students can be as high as 80 to 90 percent. It is important and apparent to most educators that the numeracy skill gaps can be more readily addressed in elementary school than in middle school. Each grade level adds on more and more math processing skills each school year and eventually, by the end of fifth grade, it is much more challenging for middle school teachers to rectify the elementary arithmetic skill gaps for a large number of students in their allotted 90-minute (middle school) math block.

In short, the prior grade level numeracy gaps must be addressed or chronic student math performance will continue in both the core lesson and the application segment of the standard 90-minute math block. Note: This is the efficiency and effectiveness of Formative Loop in conjunction with Spaced Repetition (SR) instruction. The numeracy resource and SR instruction address and rectify the prior grade level skill gaps in any classroom at any school efficiently and effectively.

Let's summarize the two (2) possible means to eliminate or eradicate numeracy gaps – again, using Formative Loop and the Spaced Repetition portions of the math block.

1.) **Prevent the numeracy gap from forming in the primary grades.** Use high levels of accountability in the classroom (Spaced Repetition) and maintain sound numeracy programs (Formative Loop) to ensure that students master their math facts (e.g., addition and subtraction) in addition to first and second grade level math processing skills. Spaced Repetition session will parallel the core daily lessons and any diagnostic areas indicated by the daily Formative Loop numeracy work shown in real time for EACH student.
2.) **Rectify the numeracy gap in the elementary grades – beginning in third grade**. This task is more onerous and occurs when students arrive from the primary grades with numeracy skill gaps. However, it can be accomplished using Formative Loop and SR instruction with a parallel skill accountability as provided in the free downloadable guides provided on the website address provided in the footer of this document.

Of course, the first option (above) relies on the primary grade teachers to not allow the numeracy gap to form with their students in the first place. Pragmatically, even in the best run math system, it is reasonable to assume that a few students will still have numeracy gaps from first and second grades – but that number of children should be much, much smaller, and a reasonable group of children more easily managed by intermediate grade level teachers – the second option (above). Thus, the third through fifth grade teachers can close and/or eradicate those few students' numeracy gaps with a structured system described above.

Another issue that typically surfaces in the intermediate grades is when new students enroll at the campus, and it is highly probable that those new students will have small to significant numeracy gaps. However, those new enrollees can easily be handled – even with 25% to 30% student mobility – again, using the second option (above) while the remainder of the students without gaps experience only a quick review of the material.

Fourth Component: Application - (Approximately 30 minutes - daily)

These grade level resources are frequently printed and implemented in spiral bound book for EACH student by a school district's printing service or a local commercial printing vendor. The author calls this type of grade level curriculum – Bridge Resources – since they act as a 'bridge' of embedded discrete skills that students are expected to successfully solve on standardized State assessments at the end of the school year. Bridge Resource example types may be located in free downloads from white papers or their implementation in related blogs at the website address provided in the footer of this document.

A major benefit to a classroom teacher in using this type of resource is that they eliminate daily or weekly copying as well as planning and preparation by providing a daily student work. Again, this resource provides a State's standard requirements for student learning expectations and the daily rigor of the summative assessment expectation at the end of the school year. An administrative benefit from the classroom use of these resources is a historical running record of student work and teacher monitoring and corrections. Principals can quickly review the quality of student work from one student to all students in the classroom from any previous day or week or month, regardless if the administrator was physically in the classroom when students completed the work.

A recent trend is that standardized State assessments are an on-line or a digital format, and many State agencies no longer offer a pencil-paper assessment option. However, students should employ pencil-paper resource formats for the fall semester and into the early spring since those types of resources are more easily controlled and monitored by the classroom teachers. The paper-pencil resource ensures that students are clearly demonstrating a consistent work flow and logical thought processes using identifiable problem-solving strategies. Conversely, a digital format is more arduous to control and monitor and correct student work and their strategies in real time for teachers of any experience level. Additionally, there is no physical running record for campus administration to review students' problem-solving work, and the entire process is usually unmonitored. The administrator would physically need to be in the classroom much more frequently to ensure that students are showing their thinking via their written work. As expected, once students are fundamentally sound in skill development and consistently showing their work and thinking in problem solving applications, it is not difficult to transition to a digital assessment format. Student expectations have been firmly established and practiced, and the mechanics and accountability when transitioning are easier in a digital environment for both a classroom teacher and administrator.

Our Elementary Children are Failing Arithmetic – ARITHMETIC!

Our elementary students are failing to do well in arithmetic. ARITHMETIC! That is adding, subtracting, multiplying, even and odd numbers, place value, rounding, fractions and decimals and the like. It is NOT as if American students were bombing standardized assessments in differential equations, vector calculus, and discrete mathematics. Nope! We are failing our children in basic arithmetic. Arithmetic calculations that have been in every human's life for millenniums and millenniums, and we have not concluded the means to teach that content to mastery? If nothing else, educators at all levels from the elementary campus to the Colleges of Education should be embarrassed that we have not figured out the pedagogy for students to master arithmetic concepts and operations in the year 2022. *However, the brunt of the blame and accountability must be placed on the Colleges of Education for they are the ones training the teachers to continue to produce woefully unprepared teachers.*

Okay, the ranting is over! Now, what do we do about our chronically poor mathematics performance in this country?

It is NOT that students are NOT good at math. Educators have not been properly trained to allow students to be good at mathematics!

If primary teachers understand instructional techniques and consistently use foundational and accountable resources to prevent the numeracy gaps from forming, the mathematics performance will dramatically rise. Furthermore, if children slip by in the primary grades and/or students continue to arrive to third grade with significant numeracy skill gaps, intermediate teachers must be trained in a systematic means to eradicate them. Then and only then will math performance dramatically improve in all socioeconomic settings in the United States.

If we do not do this – directly address the numeracy skill gaps that we have NOT faced for the last 70 years, then, the numeracy gaps that begin in the elementary primary grades will continue to widen school year after school year. In middle school, the arithmetic and numeracy skill gaps will continue to adversely affect student learning and understanding in algebra beginning in seventh grade and continuing to geometry and trigonometry in high school. The same problems we are incessantly discussing yesterday and today will be the exact same ones we are talking about next year and the year after and after, etc.

Closing Thoughts

As discussed in this paper, the 90-minute math block must be a ***simple and replicable instructional block***, or entry-level teachers and seasoned teachers will not be effective with their students. If the vast majority of students are on-grade level without prior grade level numeracy gaps, teachers of all experience levels are immediately successful with their core lessons – since the adopted grade level core curriculum (at any age) assumes the students do not have prior gaps. As noted, this work is possible using a daily diet of Formative Loop and Spaced Repetition instruction – so ALL children are given an equitable academic education.

The root basis for chronic low math performance is the resource methodologies and instructional system or lack thereof that American public schools implement in their classrooms. In a word, low student math outcomes are a self-inflicted systematic wound of misguided instruction, methodology and resource implementation. Again, students' numeracy gaps originate in the primary grades, and if they are not corrected by third grade, they widen each school year. We measure this inequity by the infamous 'Achievement Gap.' However, ***the Achievement Gap is actually a skill gap***. Teachers are NOT being trained to prevent the academic gap from forming or how to rectify it once it exists.

Although all children are subjected to potential numeracy skill gaps in the primary grades, higher income children's parents are more prepared and have the financial resources to more readily address them. For low-income children, this same effect can be accomplished WITHIN the schools with the correct math resources and instruction. Thus, addressing students' numeracy gaps is the key step in academic equity and transformation. Until that becomes a priority in our elementary schools and school districts, expect a continuation of poor student math performance.