EFFICACY OF FORMATIVE LOOP NUMERACY PROGRAM

INTRODUCTION

Currently, the Formative Loop Numeracy program is in daily use by over 100,000 elementary and middle school students across the United States. Since 2014, the program's use in the schools has doubled every school year. The efficiency and effectiveness of the program's unique design impacts not only students' mathematical skill and numeracy ability but also heightens problem solving prowess.

Two independent school implementations and a myriad of anecdotal accounts from parents, classroom teachers and campus administrators demonstrate the effectiveness of the Formative Loop program. The numeracy program not only positively affects students' mathematics prowess for those performing on grade level, but its differentiated sequencing design significantly impacts student achievement for struggling learners and affords these students to rectify skill deficiencies and return to grade level mathematics. Another powerful attribute is the numeracy program's flexible design that provides seamless integration and implementation with any school or district adopted mathematics core curriculum. In this analysis paper, the following two urban Title 1 schools in the Austin Independent School District (Austin ISD – Austin, Texas) and their academic transformation will be presented in detail:

J. WALTER GRAHAM ELEMENTARY SCHOOL

BLACKSHEAR ELEMENTARY FINE ARTS ACADEMY

These two urban elementary schools' sustained standardized test performance have been recognized with multiple State and National awards. Both schools' academic performance has yielded student outcomes equal to their high socioeconomic elementary school counterparts. The mathematics results from these schools validate and confirm the effectiveness of the Formative Loop Numeracy program.

FORMATIVE LOOP NUMERACY PROGRAM

Formative Loop Numeracy is a web-based numeracy platform that works in any school socioeconomic setting with any district curriculum adoption. It possesses granular horizontal layering and a vertically differentiated sequencing for **both** math fact *and* processing skills so an elementary student is successful at all grade levels. A daily five (5) minute paper and pencil differentiated skill assessment is required, and the papers are collected and quickly reviewed for mastery. The teacher chooses a 'Pass' or 'Retry' on each student's exercise using the Formative Loop website. Based on the teacher review of the daily assessment, students' progress to the next numeracy skill if successful or remain on their current skill depending on the outcome of their daily assessment. Interventions are provided during transition times, if needed, guaranteeing a verification of mastery of every math skill from basic operational facts to a myriad of arithmetic numeracy skills. In short, students progress through the Formative Loop program – learning and mastering both on-grade and lower grade level math skills, simultaneously. After the student daily data is entered into a computer, the next day's sheets are automatically printed to a nearby copier in alphabetical order. Neither a computer lab or transition time to a computer lab is ever needed. Students can complete their five-minute differentiated daily assessment at any time of the day whenever it is convenient in the teacher's daily schedule.

To achieve math fact fluency, several opportunities to practice each fact are required (Burns, Ysseldyke, Nelson, & Kanive, 2015; Hawkins, Collins, Hernan, & Flowers, 2017). Using the Formative Loop program, the four operational math facts (addition, subtraction, multiplication and division) are designed to promote successful daily learning. If a student is unsuccessful with the mixed assessment of one of the operations, the student is placed in a stepped series of the same operation beginning with only the 1's, until mastered, then the 2's, etc. In a short time period, the student has steadily built a knowledge base in that operational math fact area and is demonstrating mastery of the same mixed assessment where they were unsuccessful only two weeks prior. By definition, students who are fluent in basic math facts are capable of quickly and automatically recalling the solutions to single-digit mathematical operations (Musti-Rao, Lynch, & Plati, 2015).

Formative Loop's unique sequencing (standards based and quantile correlated) affords students a successful path to math fact automaticity and is founded in university research work. Automaticity with math facts is important, because it is a part of so many other aspects of math performance and is a major factor in students' future successes and achievements in mathematics (Isaacs & Carroll, 1999; Woodward, 2006). Developing automaticity with multiplication and division facts in the elementary grades provides a significant foundation for future understanding of many mathematical applications and problem solving and advancement in mathematics (Steel & Funnell, 2001; Wong & Evans, 2007). Prior research has demonstrated that achieving fluency in basic math facts is imperative for later mathematics achievement (Geary, 2011). The mastering of math facts is also an established priority and requirement of State and National Mathematics Standards, influential mathematics organizations, and advisory panels. The importance of students demonstrating mastery of basic math facts is numerated below.

A student's mathematics ability is highly dependent upon a student's ability to fluidly work with basic number operations. A highly numerate student demonstrates problem solving prowess which is directly related to the basic skill level. Furthermore, students who achieve math fact fluency in early grades are more likely to succeed in later math topics such as algebra and geometry (Nelson, Parker, & Zaslofsky, 2016; Steel & Funnell, 2001). The Hence, many state standards such as the Texas Essential Knowledge and Skills (TEKS) and the Common Core (CC) standards both require mastery of all four-math fact operations in elementary school years. As an example, the Common Core standards from 2010 state:

> CC Standard 2.OA.2. Fluently add and subtract within 20 using mental math strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.
>
> CC Standard 3.OA.7. Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division. By the end of Grade 3, know from memory all products of two one-digit numbers.

In the final report on the National Mathematics Advisory Panel in 2008, principal messages cited the following quotation on the importance of fact base mastery,

> "Use should be made of what is clearly known from rigorous research about how children learn, especially recognizing…the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic…quick and effortless…recall of basic math facts."
>
> "Computational proficiency with whole number operations is dependent upon sufficient and appropriate practice to develop automatic recall of

> addition and related subtraction facts, and of multiplication and related division facts."

The National Council of Teachers of Mathematics (NCTM) for Grade cited the following principle illustrating the importance of math fact mastery for elementary students (a similar statement for grade 2 addition and subtraction is also cited):

> Number and Operations and Algebra: Developing quick recall of multiplication facts and related division facts and fluency with whole number multiplication.

Students use understanding of multiplication to develop quick recall of the basic multiplication facts and related division facts. They apply their understanding of models for multiplication (i.e. equal-sized groups, arrays, area models, equal intervals on the number line), place value and properties of operations (in particular, the distributive property) as they develop, discuss, and use efficient, accurate, and generalized methods to multiply multi-digit whole numbers.

The Formative Loop program not only includes math fact operational mastery, but it includes a comprehensive arithmetic skill base program in all areas of arithmetic numeracy: place value, extensive mental math exercises, rounding and estimation work, a complete range of arithmetic computational proficiency, multiple mastery, geometric mastery of polygons and circles, fractions, decimals, and whole number line proficiency. Every math topic is not only broken down into manageable discrete skills for each conceptual area, but the numeracy program also includes pictorial model exercises to ensure students equally develop both a foundational understanding and computational competency. As students adapt to more complex problems and problem solving activities, their level of success in those areas is highly dependent upon their numeracy foundation. University researchers have established this connection between rudimentary mathematics skills and application. Mastery of foundational concepts of numbers allows for a deeper understanding of more complex mathematical problems and flexible problem-solving techniques (Baroody, 2003; Ferrari & Sternberg, 1998, Hiebert & Wearne, 1996). Without a strong numeracy based skill foundation, (Issacs and Carrol, 1999) research also concluded,

> "Lack of ability to solve basic computation problems can negatively affect students' ability to develop higher-level math reasoning."

At the classroom level, Formative Loop provides teachers with the capability to understand each child's math skill strengths and weaknesses in real time. Teachers are given a manageable tool to afford each student daily differentiated mathematics skill instruction without lesson preparation or planning. The program's diagnostic and accountability tracking of each student and classroom's performance offers teacher and administrator alike to quickly assess and determine if any student is struggling academically. Without using diagnostic feedback, students may incorrectly assume that their answers are correct and unintentionally build fluency on false information (Hawkins, et al. 2017).

Students are excited as they earn achievement awards as they successfully progress building math confidence each and every school day. As their child progresses through the Formative Loop program, parents are amazed at their children's success in math skills and heightened problem solving ability. Finally, teachers are given access to an extensive resource and pedagogy library available for immediate download of specific curriculum areas. Educators are no longer required to search the internet or create curricula to supplement core lessons, provide additional student practice/homework, and needed resources for small group guided math lessons.

J. WALTER GRAHAM ELEMENTARY

J. Walter Graham Elementary is a typical east Austin urban Title 1 School with challenging student demographics. The school has approximately 700 students, with 60% of the students classified as ELL (English language learners) and approximately 90% classified as economically disadvantaged. The student mobility rate is around 20%. What is atypical about Graham Elementary with its 86% minority student population is the school's dramatic rise and sustained academic performance.

In the 2006-07 school year, Graham's standardized mathematics passing rates were averaging in the mid 60's with commended rates at 15%. These test scores produced an 'Acceptable' Texas Education Agency (TEA) school rating, and the campus was ranked in the bottom ten percent academically in comparison to all Texas elementary schools.

At the onset of the 2007 school year, a global numeracy program was implemented to provide a differentiated math skill system to ensure structured skill development to every student attending Graham. The Formative Loop program afforded the school to track each first through fifth grade student with digital accountability on both math facts and comprehensive arithmetic numeracy skills. In the first school year, standardized math scores dramatically increased to above 90% minimum passing and commended rates nearly tripled. Over the next ten years, mathematics passing rates climbed to nearly 100% and student commended rates soared to nearly 60%. The Graham math instructional specialist concluded,

> "the numeracy skills aptly prepared students for the problem-solving rigor of state's assessment, and the Formative Loop Numeracy Program was so efficient and effective that math was taken 'off the table' and allowed a heightened focus on literacy on the campus."

Over the last decade, Graham Elementary is the only elementary school in Texas to be recognized by the Texas Education Agency (TEA) as an Exemplary Rated School and earn 36 out of a possible 37 Academic Distinctions from 2008 to 2019. In 2012, Graham was further honored as one of only 25 schools selected in the State of Texas to be named a National Blue Ribbon School. It was further recognized by the United States Department of Education in the same year to be recognized as a National Blue Ribbon Profile School for Academic Excellence - one of only four schools in the country. In 2015, Graham was recognized as the highest performing academic Title 1 School in Texas by the Houston based non-profit organization, Children at Risk.

Since the Formative Loop program provides a user friendly differentiated skill-base program, all students at a school can be academically successful. As can be seen in the table below on Graham's longitudinal math performance, the consistency of the numeracy program affords a sustained student performance despite the high mobility rates, personnel changes and standardized testing changes in Texas over the last decade. Both of the Graham principals since 2007 have publicly stated in multiple professional development presentations and at large conferences, '*The Formative Loop Numeracy Program's daily implementation stands as a testament to the importance of student numeracy mastery with regard to problem solving efficacy for all enrolled primary and intermediate students at the campus. Formative Loop must be pressed and all students' progress must be monitored, so* ***all*** *students are ensured an equitable math foundation and problem solving success.*'

In summary, since the 2007-08 school year despite all the common challenges endemic in urban Title 1 schools, Graham Elementary School's academic performance has consistently sustained and demonstrated heightened student outcomes. The school continues as a top performing elementary school in comparison to both Texas Title 1 and non-Title 1 schools. In fact, the east-side campus has emerged as the most successful and consistent academic performing Title 1 elementary campus in the one-hundred year plus history of the Austin Independent School District.

J. Walter Graham Elementary Ratings - Math Performance - Awards and Recognitions			
School Year	**Texas Education Agency Rating**	**TEA Math Performance**	**Awards and Recognitions**
2006-07	Acceptable	67	
2007-08	Acceptable	91 ^^	
2008-09	Exemplary	98 ^^	
2009-10	Exemplary	98 ^^	
2010-11	Exemplary	99 ^^	
2011-12	Exemplary	92 ^^	National Blue Ribbon School National Blue Ribbon Profile School
2012-13	Met Standard**	97 ^^	3 of 3 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2013-14	Met Standard**	97 ^^	6 of 6 TEA Academic Distinctions TEA Title 1 Rewards School
2014-15	Met Standard**	90 ^^	5 of 5 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2015-16	Met Standard**	93 ^^	6 of 6 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2016-17	Met Standard**	91 ^^	4 of 5 TEA Academic Distinctions
2017-18	Met Standard**	93 ^^	6 of 6 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2018-19	A-Rating++	95 ^^	6 of 6 TEA Academic Distinctions Gold Ribbon Award School ##

*** TEA changed State Accountability Rating System to Distinction/Rewards School*

++ TEA changed State Accountability Rating System to Distinction/School Grading System

Children At-Risk Non-Profit Organization

^^ Implementation of Formative Loop Numeracy Program

BLACKSHEAR ELEMENTARY - FINE ARTS ACADEMY

Blackshear Elementary is another Austin school with 81% of the total student enrollment classified as economically disadvantaged and a 21% mobility rate. Additionally, of the nearly 350 enrolled students, 65% are classified as "at-risk".

Despite these challenging factors, a new principal was hired in 2012 determined to change the academic and social environment of Blackshear. She mirrored the school's academic climate based on the recent Title 1 success of J. Walter Graham Elementary implementing the same academic methodology at the Blackshear campus, including the Formative Loop Numeracy program.

Blackshear Elementary Fine Arts Academy
Ratings - Math Performance - Awards and Recognitions

School Year	Texas Education Agency Rating	TEA Math Performance	Awards and Recognitions
2011-12	Acceptable	81	
2012-13	Met Standard**	96 ^^	3 of 3 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2013-14	Met Standard**	96 ^^	6 of 6 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2014-15	Met Standard**	96 ^^	National Blue Ribbon School National Blue Ribbon Profile School 4 of 5 TEA Academic Distinctions TEA Title 1 Rewards School Gold Ribbon Award School ##
2015-16	Met Standard**	92 ^^	5 of 6 TEA Academic Distinctions

*** TEA changed State Accountability Rating System to Distinction/Rewards School*

Children At-Risk Non-Profit Organization

^^ Implementation of Formative Loop Numeracy Program

When the Formative Loop program was implemented in 2012 at Blackshear, the mathematics academic performance significantly increased. There were major gains in the passing rates on the State's standardized assessment in comparison with previous school years, and the mathematic commended rates increased from 10% in 2011-12 to 50%. The significant increases and sustained academic performance at Blackshear produced state recognition in TEA Academic Distinctions as well as annual Gold Ribbon Awards. In 2015, Blackshear was honored as the United States Department of Education selected the school as a National Blue Ribbon School and a National Blue Ribbon Profile School for Academic Excellence – one of only five schools in the country.

CONCLUSIONS

Thousands of students and classrooms begin their morning with Formative Loop. The two schools' empirical data presented in this report demonstrate the positive impact on student achievement in mathematics with representative student demographics endemic in urban Title 1 schools. The Formative Loop program provides a differentiated daily skill exercise that affords classroom teachers to serve all their students efficiently and effectively. The digital monitoring of students' formative and summative progress in real time is a valuable

diagnostic tool for both teachers and campus administrators to ensure that all students are successful throughout the school year.

School and district personnel are contacting Formative Loop with their own turnaround stories and the mathematical successes of their students.

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