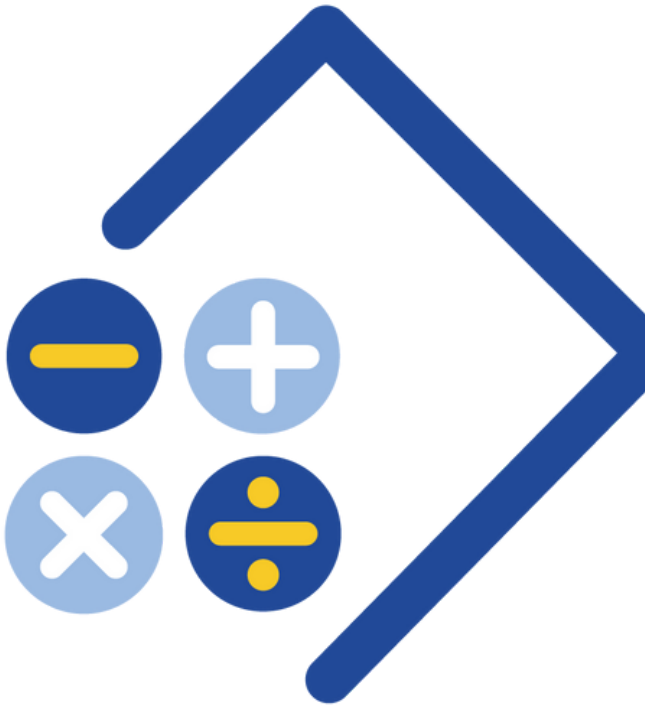
Problem Solving Math Education in the District

Strategies for a Brighter Math Future 2024



DC Math Hub

CONTENTS

About the DC Math Hub

The DC Math Hub is a new and evolving cross-sector initiative intended to draw attention to evidence-based instructional strategies in math that move the needle forward for all students. One of the Hub's goals is to be a centralized resource for information on data-driven innovative and promising practices as well as professional development opportunities offered by Hub members. On April 5, 2024, the DC Math Hub will host a math summit at the Urban Institute that includes national thought leaders, researchers, and DC mathematics Bright Spot school leaders and teachers to discuss the challenges and evidence-based practices in math education. The Hub and Summit also serve to lift up educators' voices, creating space for them to share and learn from each other.

About this Report

This report, the first of what we hope will become an annual compendium, explores the latest trends in math achievement in DC and nationally, as well as valuable insights from instructional leadership teams and leading educators at public schools in the District of Columbia who have shown success in math growth for students. Researchers at the DC Education Research Collaborative at the Urban Institute spoke to eight award-winning math educators, asking them to share their experiences, successes, and challenges so that others can celebrate, support, and expand on their work. They represent DC Public Schools (DCPS) and DC public charter schools, teaching pre-kindergarten through 12th grade, and were referred by DCPS, the Office of the State Superintendent of Education (OSSE) and their school districts' leadership teams. This report also includes parent and family perspectives on math education from a survey of 325 DC public and public charter school parents sponsored by Education Reform Now Advocacy and fielded by SurveyUSA.

Acknowledgements

This report was prepared by EmpowerK12 with generous support from Education Forward DC. Content for the report benefited from research and feedback provided by staff from Center City PCS, the DC ERC, DCPS, Deputy Mayor for Education (DME), Friendship PCS, and OSSE. Each organization's participation in this project in no way indicates an endorsement of this report, and all errors are the responsibility of the EmpowerK12 authors. A comprehensive list of contributing individuals can be found at the end of this report.

EXECUTIVE SUMMARY

Strategies for a Brighter Math Future 2024

Prior to the March 2020 closure of schools around the country due to the COVID-19 pandemic, the District of Columbia was hailed as "improving faster than any other major city school system in the country."[1] However, the pandemic was a stark interruption of DC's steady upward progress in mathematics, reflecting broader trends across the nation. The most recent National Assessment of Educational Progress (NAEP) results, which report fourth and eighth grade math and reading scores for every state and a sample of urban districts, including the District of Columbia's public schools, showed the largest drop in U.S. math scores since 1990 and a statistically significant decline in reading since 2019.

Knowledge of math is non-negotiable for a thriving, flourishing life as an adult in the 21st century. Yet, post-pandemic, most DC students are not reaching grade-level standards: of those students who took the 2023 math PARCC assessment, just over 1 in 5 students (21.8%) met or exceeded expectations. While progress has been made, at the current rate of improvement, math recovery to 2019 levels could take 4-6 years for some priority groups of students, including economically disadvantaged students and students with disabilities.

Learning from bright spots

Some schools in DC are bucking this trend, achieving math results for students that are on par or ahead of 2019 levels. These schools share a collection of research-based strategies that contribute to strong growth and achievement in math for priority populations of students:

- **Develop students' mathematical mindset and confidence**
- **Utilize scheduling and data to maximize effective instructional time**
- **Use high-quality instructional materials with a systemwide, coherent strategy**
- **Blend conceptual understanding, procedural knowledge, and math fact fluency in instruction**
- **Support teacher preparation and ongoing development**

We spoke with school leaders and teachers at DC schools getting results in math to understand what lessons we can take away to spread stronger math instruction across all our public schools. This report shares more about the current state of mathematics teaching and learning in public schools in the District and nationally. It also covers promising strategies for math instruction, both drawn from research into what works, and how highlighted schools are implementing those best practices.

This body of work is the start of understanding and building on excellence in math where we see it, showing that DC can become a beacon for outstanding math instructional practices. We hope this report will inspire serious attention to the state of math, a better understanding of research-based practices, and collaborative creativity that leads to historic gains in math achievement for all students.

NATIONAL AND LOCAL MATH ACHIEVEMENT TRENDS

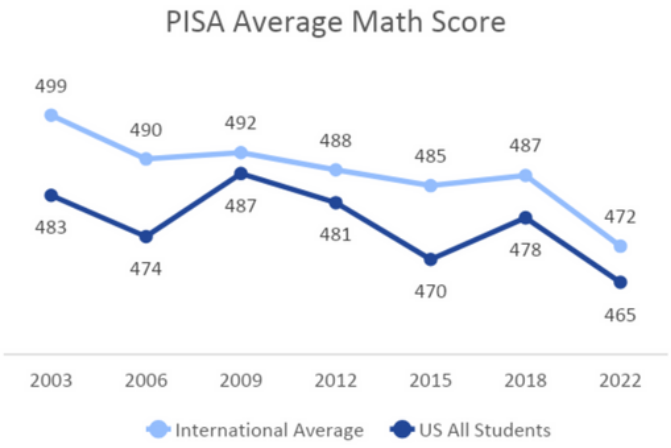
> "Our country's math performance has been mediocre for 40 years — a failure to mathematically thrive across much of the U.S. The nation will, if the past is a predicate for the future, continue to lag behind the rest of the world in the understanding and application of math, skills that are critical for citizens and employees."
>
> **Bob Hughes, director of U.S. K-12 Education Program at the Bill & Melinda Gates Foundation**[2]

Globally, the United States has trailed behind as top performing countries in math outcomes for students for many years – and unfortunately, the COVID-19 pandemic and resulting lost instructional time sharpened this trend. In the District of Columbia, the pandemic interrupted the progress made in math, as shown by both state-specific and nationally normed assessments.

U.S. continues downward math performance trend on the PISA international test

The PISA, Programme for International Student Assessment, is an international test that measures the knowledge and skills of 15-year-old students in reading, mathematics, and science. PISA provides a benchmark for education systems around the world by assessing students' ability to apply their knowledge to real-world problems and challenges. According to the 2022 PISA results, released in December 2023, the U.S. mathematics performance was the lowest recorded since testing began in 2003 and trailed the international average by 7 points.[3]

The U.S. also showed large achievement gaps by student group. Students from low-income backgrounds, students of color, English learners, and students with disabilities scored significantly lower than their peers on the math test. For example, the average score for White students was 505, while the average score for Black students was 398. Similarly, the average score for students eligible for free or reduced-price lunch was 434, while the average score for students not eligible was 507.

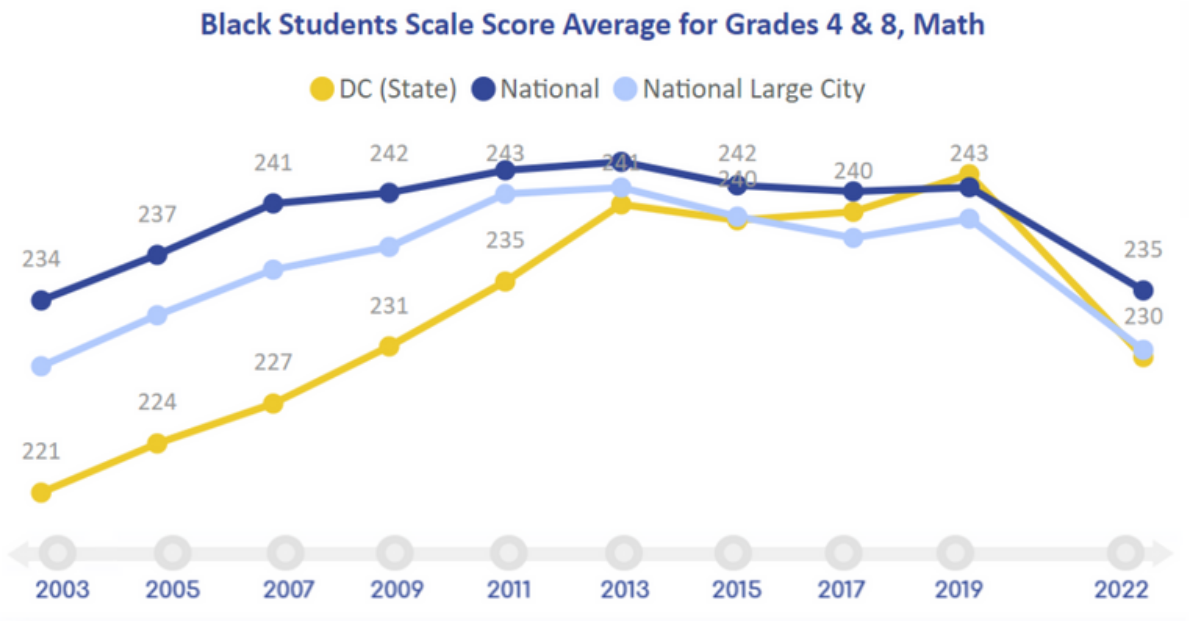


COVID-19 impacted DC and national math performance on the Nation's Report Card (NAEP)

The NAEP, sometimes called the Nation's Report Card, is a large-scale assessment that measures the academic achievement of students in grades 4 and 8 in math and reading every two years. It is considered the gold standard of educational assessment, as it provides a common measure of student performance across states, select urban districts, and demographic groups. NAEP results serve as a source of information for policymakers, educators, researchers, and the public to identify strengths and weaknesses of the U.S. education system and to monitor progress over time.

The COVID-19 pandemic had a negative impact on the U.S. NAEP average scores in math, as schools across the country faced closures, disruptions, and learning loss. The 2022 NAEP results showed that the U.S. math score dropped by 6 points from 2019, the largest decline in NAEP history. Prior to the pandemic, U.S. average math scores had been flat for more than a decade. The pandemic also widened the existing achievement gaps, as students from disadvantaged backgrounds were more likely to face challenges such as lack of access to devices, internet, and high-quality instruction.

The District of Columbia experienced a significant drop in math achievement on the NAEP, following the national trend. The average DC math score in Grades 4 and 8 decreased by 11 points from 2019 to 2022, reaching the lowest level since 2011. The math performance gap between Black and White students grew by 6 points to a gap of 61 points on a 500-point scale. Prior to the pandemic, DC as a state had made substantial progress in math compared to the national average for most student groups. For example, DC's economically disadvantaged students trailed the national average for students from low-income families by 6 points, which had been 18 points a decade prior in 2019. The average math score for Black students across the District was one point higher than the national average for Black students in 2019, after trailing the nation by 11 points in 2009. Due to pandemic school closures, our Black students' math score declined and now trails the U.S. average by 5 points.



Special Feature

Center City PCS

Center City Public Charter Schools, a network of six PK-8 education campuses in five different wards, has extended the power of its rigorous math curriculum – Great Minds' Eureka Math2 (EM2) grades K-8 – with continuous teacher support and professional development; using student data to shape instruction; and balancing instruction between concepts, procedural knowledge, and fact fluency to create math problem solvers.

The EM2 curriculum pushes students to delve into complex problem-solving, reason with abstract concepts, and reflect critically on their learning processes. Leaders at Center City have further empowered educators with deep content knowledge and the pedagogical tools to illuminate mathematical concepts for their students in two critical ways: by leveraging student data to tailor instruction and providing ongoing coaching and professional development for teachers to internalize the mathematical standards and concepts for themselves.

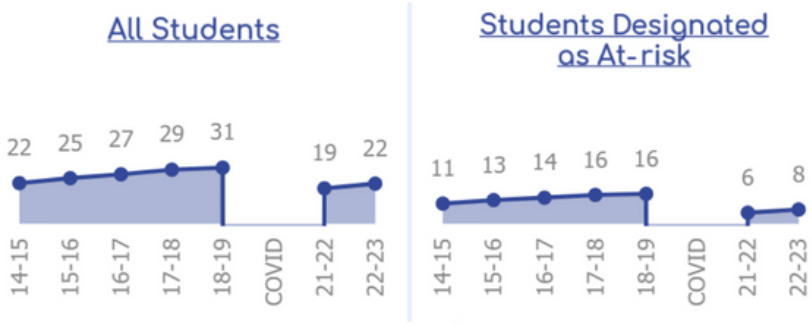
First, Center City uses Great Minds' Affirm, a platform that complements EM2 by assessing students' existing skills before each module, helping teachers to pinpoint and address learning gaps with precision. The Center City curriculum team has also worked to foster an environment of continuous learning and growth, weaving in practices like the Four-Square Do Now, a strategy that helps students solve math word problems, and other strategies that reinforce foundational skills daily.

Through observation and classroom assessment data, district leaders found that some classrooms across the network sometimes revert to procedural teaching at the expense of conceptual understanding. To address this ongoing challenge, Center City increased coaching touchpoints with both teachers and leaders, and the network's math instructional lead is working more closely this year with school-based interventionists to identify and respond to significant mathematics foundational, conceptual understanding gaps among students.

Teachers also receive ongoing support, professional development, and coaching to reinforce the curriculum, including monthly virtual gatherings of educators from across the network and participate in OSSE's DC Math Teacher Bootcamp to build the belief that everyone can be a math person.

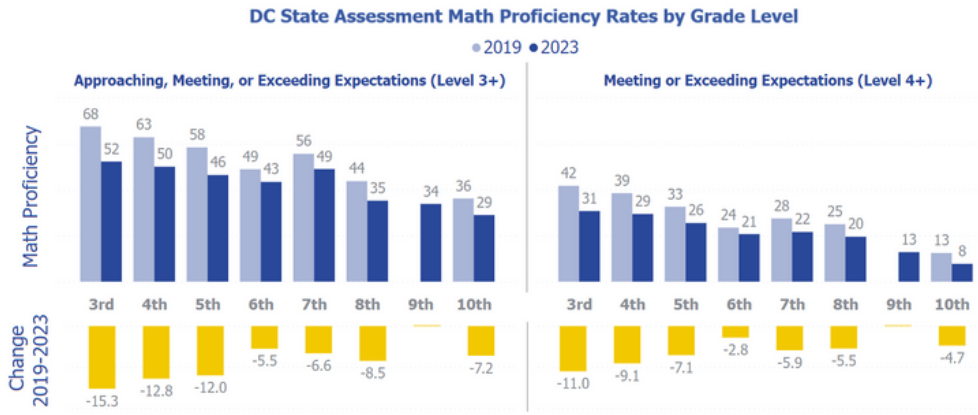
DC state assessment results improve every year the test has been consecutively administered, but COVID wiped out pre-pandemic gains

According to the DC state assessment (CAPE, which was previously called PARCC), math proficiency in the District of Columbia had increased steadily from 2015 to 2019, reaching a record high of 31% of students meeting or exceeding expectations in 2019. However, the COVID-19 pandemic disrupted this positive trend and caused a significant decline in math achievement from 2020 to 2022. The percentage of students meeting or exceeding expectations in math dropped to 19% in 2022, a decrease of 12 percentage points from pre-pandemic. This decline was pronounced for economically disadvantaged students, whose math proficiency rate fell to 6% after COVID.



In 2023, math proficiency increased by three percentage points for all DC students and by two percentage points for economically disadvantaged students.

Math proficiency rates tend to decline by grade level with the largest drops from pre-pandemic rates in the youngest grades.



DC has bold goals to improve math performance this decade

The pandemic adversely affected the math achievement of many students, especially those from low-income backgrounds. To address this challenge and accelerate the progress of all learners, the Office of the State Superintendent of Education (OSSE) and the District of Columbia Public Schools (DCPS) have established bold goals for math performance by 2028.[4] Charter schools create their own goals and submit them to the Public Charter School Board (PCSB) for approval. Currently, PCSB has transitional goals coming out of the pandemic and is working to craft a new accountability system that will monitor school performance in math.

As part of DCPS's new five-year strategic plan, A Capital Commitment, the goal for math performance on the state assessment is to achieve an 80% pass rate by 2028. When OSSE submitted an amendment to the state's Every Student Succeeds Act (ESSA) plan to the U.S. Department of Education, the agency set a performance target of 56% of students meeting or exceeding expectations in math by 2030.[5]

DC BRIGHT SPOTS FOR MATH GROWTH

To identify the schools that are making the most progress in math achievement, EmpowerK12 (EK12), a nonprofit organization that supports data-driven education in the District of Columbia, used the updated DC School Report Card data, which prioritizes equity and growth, and nationally normed assessment data provided to us by LEAs. We focused on math growth metrics, which measure how much students improve their skills over time, regardless of their starting point. The analysis focused on schools that serve an average or high proportion of economically disadvantaged students, a group that includes most DC students and who often face systemic barriers and gaps in educational opportunity nationwide.

For grades 3-10, using the latest available data OSSE, EK12 calculated the percentage of points each school earned for math growth in each grade band (i.e., upper elementary grades 3-5, middle grades 6-8, and high school grades 9-10) for the 2022-23 school year. Economically disadvantaged student group performance has the largest portion of possible points in the new state report card. The schools that earned the highest percentage of possible points for math growth in their grade band were designated as "bright spots." **At these schools, students' math proficiency improved by an average of 23 percentage points across all performance levels on the state math test last year.**[6]

For lower elementary grades K-2, we analyzed the average percent of within-year expected growth that students made on the Measures of Academic Progress (MAP) and i-Ready nationally normed assessments during the 22-23 school year, provided to EK12 in a separate data collection. **Bright Spot lower elementary schools improved the percentage of economically disadvantaged students achieving on grade level in math by 18 points** last year to 68%.

We conducted interviews and focus groups with instructional leadership teams from eight of the bright spot schools. Additionally, we talked with eight award-winning teachers identified as having excellent math growth data from non-bright spot schools across the District who also supported the learnings that contributed to this report.

Bright Spots by Grade Band

Lower Elem. (K-2)	Upper Elem. (3-5)	Middle (6-8)	High (9-10)
Beers	Burroughs	Center City Petworth	Anacostia
Cleveland	DC Prep Anacostia	DC Prep Benning	Cardozo
Friendship Blow Pierce	Harmony	DC Prep Edgewood	Cesar Chavez
Moten	KIPP DC Promise	DC Scholars	Dunbar
Patterson	KIPP DC Spring	Friendship Blow Pierce	E.L. Haynes
Payne	LaSalle-Backus	Friendship Ideal	Friendship Collegiate
Stanton	Powell	KIPP DC AIM	Girls Global
Thomas	Raymond	Leckie	IDEA
Walker-Jones	Stanton	Walker-Jones	Ron Brown
Whittier	Whittier	Washington Global	Thurgood Marshall

Special Feature

DCPS Early Elementary

DC Public Schools campuses showing high growth in grades K-2 are exemplifying the research-backed strategies described in this report. Educators at Whittier Elementary School and Walker-Jones Education Campus both described the importance of making math lessons feel safe for students and educators to try, and sometimes fail, in learning new math concepts. School leaders coach teachers and students to "enjoy an incorrect response" in math – that in fact, a wrong answer provides the opportunity to exhibit curiosity and learn more about mistakes in mathematical thinking than a correct answer may have.

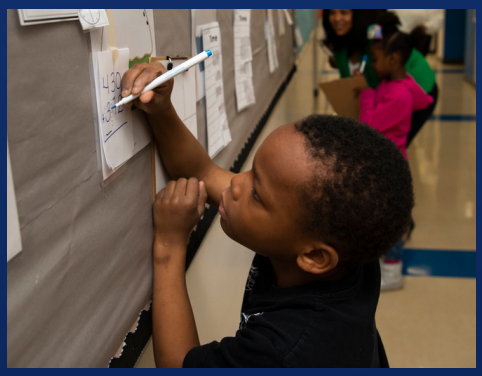
"Mistakes are greatly celebrated. We make sure that we have a culture in our building that students are not afraid to make mathematical mistakes, but instead they talk about those mistakes, and they learn from them," said Ms. Agarwal, math instructional coach at Walker-Jones EC.

Students and teachers at both campuses use wrong answers as a starting point to reflect on their own process in solving a problem. To build bridges between ELA and math, students at Whittier write about their approach to math problems, and then use a rubric to examine their own writing and that of their classmates.

This thinking extends to supporting teacher preparation and development. At Whittier, teachers practice giving their math lessons, and teaching conceptual understanding of math, with fellow educators and the math instructional coach before giving those lessons in the classroom.

DCPS campuses are also using creative strategies to take advantage of every moment available for math instruction. At Whittier, each Wednesday is focused on math, with students in different grade bands getting a dedicated math block of time. In the early grades at Walker-Jones, students supplement daily afternoon math blocks with teacher-led small groups, blended learning, and independent work time. Weekly, teachers at both Whittier and Walker-Jones meet as a group to review data and collaboratively plan future lessons, including how to modify and scaffold content for students with disabilities and English learners.

Twenty-two DCPS schools, including several Bright Spots schools are using an approach to math and family engagement called "DREAM with Families," an initiative that provides support and partnership to families so they can further share numeracy and early math skills with elementary grades students at home. Schools with the DREAM (DCPS Road to Equity and Achievement in Math) with Families program have access to teacher professional development and a "family playlist" of activities to do at home with younger students that support math learning – for example, counting apples and oranges in the grocery store, or practicing fractions while cooking. Students and parents can record a short video of the student sharing about the activity and reflecting on their own math practice, helping teachers to further understand where students may need additional support in the classroom. Whittier and Walker-Jones have also developed approaches to partnering with families around math content and practices: Walker-Jones hosts monthly math family nights, where parents and caregivers are able to experience what students are learning and how it's taught. At Whittier, the school hosts Saturday parent sessions to share core mathematical concepts that are important across grade levels – for example, how to introduce students to fractions in the early grades, so that by the time they reach fractions in the classroom, they have a real-world understanding.



STRATEGY 1

DEVELOP STUDENTS' MATH CONFIDENCE

Bright Spot schools' educators, students, families, and communities believe in universal math potential, and that everyone can be a "math person" with the right support and relevant material.

The award-winning teachers and Bright Spot school instructional leaders who spoke with us described how, with the right support, all students can access and master grade-level material, build procedural fluency, develop complex problem-solving and critical thinking skills, and become "math people."

> "My students are incredibly resilient, they have so much grit, they are creative problem-solvers, and they make a way."
>
> **Caylah Green, Math teacher and instructional coach, Hart Middle School**

What does the research say about universal math potential?

Decades of rigorous research confirm what Bright Spot educators believe: all students can learn mathematics when they have access to high-quality mathematics instruction and are given sufficient time and support to master a challenging curriculum.[7] Several factors influence students' math learning outcomes and attitudes, such as their beliefs about their own math potential, their sense of belonging and engagement in math classrooms, and their exposure to diverse and meaningful math tasks and contexts.

Students who adopt a growth mindset, or the belief that they can improve their math skills through effort and feedback, tend to achieve higher levels of math success than those who have a fixed mindset, or the belief that their math ability is predetermined and unchangeable.[8] A rigorous study of the 2012 administration of the PISA international math test analyzed student survey and test score data from the U.S. and China to compare how students felt about their math skills and their achievement. After controlling other student variables, such as socioeconomic status, the author found that math self-efficacy, or the belief one can be good at math, was linked with higher math achievement.[9] Students who feel valued, respected, and supported by their teachers and peers in math classrooms are more likely to participate, explore, and enjoy math activities than those who experience alienation, isolation, or marginalization.[10]

How are DC bright spot educators developing math mindsets in their classrooms?

Many DCPS schools follow UnboundEd's GLEAM framework (Grade-Level, Engaging, Affirming, and Meaningful) for math instruction, which provides a holistic approach to teaching that is more than just technical actions or skills. The framework focuses on educator mindset and planning to ensure that instruction provides all students, with a focus on Black and Brown students, with grade-level content that engages and affirms their identities and experiences.

Bright Spot teachers told us that truly supporting students requires deep investment and a team effort among educators, their school community, systems, and city leaders. They stated that the payoff is more than students' math growth: it will ensure students have the tools to access opportunities from which they have been excluded by virtue of their background or where they live. By creating more inclusive and empowering math environments, DC's Bright Spot educators believe they help students of color develop positive math identities and dispositions, as well as enhance their mathematical competence and confidence. This can lead to more equitable math outcomes for students of color and benefit society by increasing diversity and innovation in math and STEM fields.

As part of OSSE's DC Math teacher bootcamp, a cohort of middle and high school educators are participating in a nationally-recognized course on growth mindsets. Educators are from all eight wards in both DC Public and public charter schools and are learning to develop their own growth mindset approach and how to foster students' growth mindsets when it comes to learning mathematics. They are then coming together in a PLC format to discuss takeaways and plan for implementation in their classrooms and schools.

DC Parents Share the Belief that Everyone Can be a "Math Person"

To better understand the math education landscape as experienced by families, Education Reform Now Advocacy commissioned a survey of DCPS and DC public charter school parents, fielded by SurveyUSA from February 22-27, 2024. **When parents were asked if they believe anyone can become a "math person" with the right teaching methods and support, 89% of all parents agreed, including 90% of economically disadvantaged families.**[11] In addition, most families are interested in more resources and opportunities around math instruction.

More highlights from the survey:

Parents ranked math as the most important subject their kids take among nine academic subjects options presented, followed by English and then science.

50% of parents say math education needs updating and improvement, and support making math education apply more directly to the real world.

30% of parents correctly identified the percentage of kids on grade level in math.

70% would like to see a math innovation and research hub.

87% agree Mayor Bowser and the DC Council should invest more in improving math education in the District.

66% would like their child to receive additional math tutoring at school.

STRATEGY 2

MAXIMIZE EFFECTIVE INSTRUCTIONAL TIME

Bright Spots utilize daily and weekly scheduling and data to ensure students receive real-time support and intervention.

Teachers across the District and the nation are looking for new ways to help their students achieve math proficiency, especially in the wake of the pandemic that disrupted many students' learning. Their challenge is maximizing the amount of effective math instructional time each student receives. Part of that calculus for DC's Bright Spot educators is to ensure every student is exposed to high-quality, grade-level instruction while receiving individualized opportunities to improve their skills. Educators use student data and intentional scheduling of math and intervention blocks, including opportunities for small group, blended learning, and one-on-one tutoring, during the regular school day to address this challenge.

Data use refers to the practice of collecting, analyzing, and acting on student performance data, such as test scores, exit tickets, or formative assessments. Teachers analyze data to identify students' strengths and gaps, tailor instruction to meet their needs, and monitor their progress over time. Data can also inform decisions about grouping students, differentiating instruction, and providing feedback. Scheduling of math and intervention blocks refers to the way schools allocate time for math instruction and additional support for students who need it. Most often, this does not mean adding time for additional direct teacher instruction in math. Rather, Bright Spot schools are finding a variety of types of focus time on math that meet that specific student's need – whether it is practicing a weaker skill or learning a more advanced one.

What does the research say about data and scheduling to maximize effectiveness?

One of the key factors that enable teachers and schools to provide personalized and responsive math instruction is the use of data. Classroom data, such as exit tickets, help teachers identify students' strengths and weaknesses, monitor their progress, and adjust their instruction accordingly. Formative and summative assessment data that are collected annually or seasonally allow school instructional leadership teams to evaluate the effectiveness of their math programs, policies, and practices, and make informed decisions about resource allocation and professional development. According to an Institute of Education Sciences (IES) meta-analysis, the practice of using student achievement data to support instructional decision making leads to improved academic outcomes.[12]

Effective instructional time is another crucial element of successful math education. It refers to the amount and quality of time that students spend on learning math content and skills, both inside and outside the classroom. Strategies can vary depending on the grade level, the curriculum, the instructional strategies, and the students' needs and abilities. The question of how to best schedule math instructional time during a typical school day has no definitive answer in the research literature.

One of the most common scheduling models in American schools is the traditional 50-minute period, which is often criticized for being too short and fragmented to allow for meaningful and engaging math instruction. An alternative model that has gained popularity in recent years is block scheduling, which consists of longer periods of 75 to 90 minutes, typically with fewer classes per day. Block scheduling aims to provide more continuity and depth in learning, reduce transition time and disruption, and increase student-teacher interaction. Several studies have compared the outcomes of block scheduling and traditional scheduling on math achievement, but the results have been mixed and inconclusive.[13]

Another way of organizing math instructional time is to provide additional time for students who need extra support or enrichment. This can be done through various strategies, such as intervention classes, tutoring sessions, pull-out programs, or extended-day or extended-year programs. These strategies aim to target the specific needs and gaps of individual students, and to prevent them from falling behind or losing interest in math. Research evidence suggests that these strategies can have positive impacts on students' math achievement and confidence, especially when they are aligned with the regular math curriculum, delivered by qualified and trained instructors, and monitored for progress and effectiveness.[14] However, these strategies also pose some challenges, such as finding adequate time and resources, coordination among all staff at the school, and avoiding stigma or isolation for the students who participate.

How do DC Bright Spots use data and maximize instructional time?

> "My school, I like the direction we are headed in. We just started a new intervention block model where 45 minutes is devoted strictly to intervention. It is for foundational skills and that's all that is allowed unless a student is already on or exceeding grade level and they're doing project-based learning."
>
> **Charles Brown, Center City Public School**

The award-winning teachers we interviewed for this report attribute some of their success to having daily intervention classes or blocks in the schedule to bring students up to speed. They utilize every available minute with intentionality to practice math skills, integrate problem solving across the curriculum, and provide more time for creative instruction. While different schools take different approaches to scheduling that best fit their students' needs, the common thread was that school leaders gave teachers the time they said they needed.

Bright Spot schools use assessments for multiple purposes, well beyond informing educators about student learning and progress. In their classrooms, students receive the results from assessments quickly, accelerating their ability to correct student- and classroom-level misconceptions immediately.

KIPP Promise Academy in Ward 7 is a Bright Spot elementary school for its math growth in 2023 which also posted math achievement rates pre-pandemic that were higher than some Ward 3 schools. Educators there described how they schedule their math block right after lunch and before specials and recess. The time for math instruction is "double blocked" with a first block that includes a lesson, time for independent practice, and exit ticket completion. Then, teachers transition into a "responsive block" where they immediately respond to student misconceptions gleaned from the exit ticket data by extending the lesson, pulling students into small groups, or using manipulatives if necessary.

STRATEGY 3

HIGH-QUALITY INSTRUCTIONAL MATERIALS, DEPLOYED COHERENTLY

Bright Spot schools implement high-quality curriculum with collaborative district-level support and supplement with personalized learning platforms to accelerate learning instead of remediating.

Instructional coherence focuses on the alignment of curricula, educator professional development, student assessments, and accountability systems to high academic standards.[15] For math learners, this means that the conceptual and procedural strategies for learning a math skill are aligned across days, weeks, and years. It also means concepts are aligned across different types of instruction -- offered by lead teachers, as well as support provided through interventions, tutoring, and other individualized practice.

What does the research say about the importance of instructional coherence and acceleration?

The research on instructional coherence suggests it can positively impact student achievement, especially in mathematics. A coherent approach from the system to the classroom level, inclusive of curriculum, professional development, and observation tools, can improve student achievement by 0.14 standard deviations on the state test.[16] At the classroom level, a large-scale longitudinal study in Kentucky found statistically significantly greater improvement in math achievement for struggling students when intervention initiatives focused on both the quality of pull-out intervention and coherence between pull-out intervention and classroom instruction, suggesting the alignment of daily lessons and student interventions may be more important than simply choosing an evidence-based intervention strategy.[17] Moreover, instructional coherence can enhance student motivation, engagement, and self-regulation, as well as teacher collaboration and professional.[18] By aligning the different elements of the instructional system around a common vision and set of standards, instructional coherence creates a more consistent and supportive learning environment for math learners.

One of the challenges facing math educators in the aftermath of the pandemic is how to address the learning gaps that many students have experienced without sacrificing grade-level content. A key debate is how much time teachers should spend meeting students where they are skill-wise in math versus moving forward with grade level content while finding ways to provide just-in-time help for students who need it. A recent study from Zearn, a nonprofit that offers an online math program used widely across the country, including in many DC schools, sheds light on the benefits of this approach compared to remediation. The study, based on data from millions of elementary students, shows that learning acceleration leads to higher engagement and achievement than remediation, especially for students of color and those from low-income backgrounds.[19] By adopting learning acceleration as an instructional strategy, educators can ensure that all students have access to rigorous and relevant math content while addressing their individual needs.

Special Feature

Friendship Blow Pierce

Friendship Blow Pierce, a campus with an elementary and middle school in Ward 7, is named a Bright Spot for high math growth at the K-2 and 6-8 levels. Teachers and instructional leaders attribute their success to a shared culture of collaboration, coaching, and learning. As students fully returned to in-person learning after the COVID-19 pandemic, Friendship Blow Pierce, like most DC schools, faced a critical question: What do students need now?

The answer aligns with several of the research-backed strategies discussed here: maximizing instructional time and individualized support for students and creating space for students to build confidence in themselves as math learners.

"Our scholars needed more attention, and we had to figure out how to give them that," said a top Blow Pierce teacher, Shatavia Kelley, who led her students to PARCC scores that surpassed the District's pre-pandemic average. "One key strategy was having two teachers in the classroom, which allowed us to deploy interventions in the moment. With two teachers, you could get a lot more done, better implement small-group instruction, and differentiate based on student skill sets."

To ensure every student's success, Friendship Blow Pierce adopted a schoolwide approach to collaboration and coaching that involved multiple layers of support and feedback through professional development sessions every Friday. These sessions helped to foster a culture of learning and honesty among teachers, coaches, and school leaders, who constantly reflected on their practices and needs in mathematics instruction.

This mindset and attitude toward learning and reflecting on errors then extends to students at Blow Pierce. In addition to embracing collaboration, teamwork, and smart instructional strategies, Blow Pierce educators emphasize the importance of students feeling safe enough to raise their hands and ask questions or make mistakes. When students support each other's math learning, "that's when you see real growth."

Finally, teachers also find ways to share expertise and resources across content areas to enhance their instruction and interventions in math. "I don't teach reading, but I'm always collaborating with my ELA colleagues because guess what, there's something they're doing in reading that will help my scholars in math. Including reading teachers in math interventions was a game changer," said Ms. Kelley.

Principal Gregory Spears also described the importance of exposing students to grade-level rigor and depth, "Instead of trying to download things for the students, students grapple with the things they learn, the concepts. They talk about their thinking or demonstrate it."

How do DC Bright Spots accelerate learning by coherently implementing high-quality instructional materials?

Bright Spot educators use curriculum that is designed to let students discover, inquire, predict, explain, share, and explore. Just like mathematical content, problem solving must be actively taught; curricula and instructional materials must make space and time to build those skills just as they make time to teach addition or algebra. Educators reported that they implement Eureka Math, Illustrative Math, and Building Blocks as their core curriculum along with online supplemental learning platforms from i-Ready Learning, Zearn, and Teach to One Roadmaps. Each of these curricula and tools meet the standard for being considered high quality by Ed Reports, a nonprofit curriculum and tools review organization.[20]

Multiple Bright Spot schools reported that teachers meet weekly to collaborate with a math instructional coach to review upcoming lessons and student data and develop a plan for direct instruction, intervention, and enrichment activities aligned with the curriculum and student interests. One of the DCPS Bright Spots praised the implementation of their new Building Blocks curriculum to promote pre-kindergarten early numeracy and the use of Teaching Strategies GOLD assessment platform. With the Building Blocks curriculum, Pre-K students develop their mathematical thinking and learning through play; hands-on, teacher-led mathematical experiences; and songs and stories.[21]

At the middle school level, one award-winning educator discussed the importance of her school's commitment to learning acceleration. Chavez's Tiffany Smith attributes her students' math success to her commitment to building her students' confidence as a math learner and critical thinker. She knows that math is more than procedures and that ELA skills are important in helping students format their responses and justify their process; every lesson starts with a critical thinking problem. Ms. Smith's top advice to other teachers is to take a moment to look deep into exit tickets for student misconceptions and to focus on celebrating students with genuine praise that specifies the exact skill they mastered.

DC Bright Spots use high-quality online instruction to support student learning

Zearn is an interactive online math platform developed by a nonprofit of the same name. Students start Zearn lessons by watching short, animated videos that conceptually explain math ideas and then problem solve in an interactive format. The platform's activities are scaffolded and provide real-time feedback on every problem so that students learn from their mistakes immediately. Zearn released a study using DCPS i-Ready formative assessment data that found students who consistently used Zearn Math outscored matched peers by 7.5 points on the spring i-Ready Diagnostic, gaining 11 more weeks of math learning in one academic year.[22] OSSE is currently in its fourth year offering Zearn licenses and accompanying professional development and implementation support to interested charter LEAs.

Similarly, Friendship Public Charter Schools piloted Teach to One Roadmaps, an online math learning tool developed by the nonprofit New Classrooms at the Friendship Blow Pierce campus, a Bright Spot for math growth. Teach to One Roadmaps includes digitally enabled assessments, teacher planning tools, instructional content, and reporting for teachers. Data provided by the school and vendor to EK12 for analysis showed statistically significant correlations between students who increased their pace of mastery in Teach to One and their improved scores on the PARCC math assessment. Using Teach to One data, we were able to predict students' PARCC scores within 7 points and their growth percentile within 10 percentile points more than 95% of the time.

STRATEGY 4

HOLISTIC INSTRUCTION THAT CREATES MATH PROBLEM SOLVERS

Math instructional time prioritizes conceptual understanding and blends in procedural knowledge with math fact fluency to build mathematical thinkers.

Effective math teaching does not adopt the "drill-and-kill" tactics that were pervasive in classrooms most of us attended when we were kids. To achieve math proficiency and agency, every student needs to learn procedural fluency in meaningful ways. This means teaching how procedures are linked to concepts, helping students develop and use various strategies and methods, giving students ample opportunities to choose the best strategy or method for each problem, and assessing students' understanding of all aspects of fluency. Nearly every DC Bright Spot school instructional leadership team and math teacher interviewed for this report discussed the importance of integrating conceptual and procedural knowledge using examples and problems with which their students could identify.

What does the research say about the best instructional strategies that build students' math skills?

In January 2023, NCTM released a synthesis of relevant research in a position paper on procedural fluency that declared an emphasis on mathematical reasoning and decision-making over rote application of procedures.[23] Before students can learn how to perform mathematical procedures, they need to understand the concepts and ideas behind them. Teaching procedures and concepts together in ways that make sense to students helps them learn math better and faster.[24] This approach also allows students to develop their own reasoning strategies, which reinforce their conceptual understanding; simply following a memorized algorithm does not. When students apply a procedure they do not understand, they are more likely to make mistakes and fail to notice when the answer does not make sense.

As students reach secondary grade levels, the importance of math fact fluency and having a repertoire of strategies to deploy them becomes critical. Research has shown that math fact fluency is strongly correlated with math achievement and academic performance across grades and domains.[25] Students who master math facts can focus on understanding the concepts and strategies behind math problems, rather than spending time and energy on calculating basic facts. Math fact fluency also enables students to check their work and catch errors, which improves their accuracy and confidence. A longitudinal study found that math fact fluency in first grade was a significant predictor of algebra readiness in eighth grade.[26]

Additionally, students who engage in math problems that are relevant, challenging, and connected to their lives are more likely to develop deeper conceptual and procedural knowledge of math, as well as critical thinking and problem-solving skills, than those who only encounter rote, abstract, and disconnected math exercises.[27]

How do DC Bright Spots implement this balance of conceptual and procedural knowledge?

A common theme we heard from Bright Spots was the amount of intentional time spent on activities to build teachers' capacity to teach conceptual math knowledge. When we interviewed Burroughs Elementary last fall, a Bright Spot school for growth that was also recognized by EmpowerK12 as a Bold Performance school for having math and reading achievement that exceeded pre-pandemic averages for similar schools, we learned about their weekly practice of having teachers deliver upcoming math lessons with a coach and fellow teachers present. Their peers provide feedback about the possible student misconceptions that could result from the lesson and how they can adjust to improve. Several other Bright Spot DCPS elementary schools shared about a similar practice in interviews for this report.

Similarly, teachers come together at KIPP Promise once a week on Tuesdays for "math meeting," a very structured and supportive environment where teachers prepare their lessons for the next five days. Prior to joining the meeting, each teacher completes all the upcoming assignments, independent practice activities, and exit tickets themselves. They discuss the big ideas of upcoming math lessons, scale the rigor of each proposed lesson from high to low, and identify the common misconceptions that may arise together. During the day they analyze exit ticket data, diving into students constructed responses and scratch work, to formulate a plan to reteach or accelerate learning using the intervention block later in the afternoon.

From Bright Spot secondary school leaders, we heard a commitment to ensuring alignment between teachers and tutors. They ensure their school staff invest time prepping tutoring partners on the curriculum and tools they utilize in classrooms, and some schools use apps that allow teachers and tutors to communicate about student needs.

> "If you show kids they can be successful in math, that's when the learning starts."
>
> **Derrick Gooding, Middle School Math, Friendship Public Charter School**

Special Feature

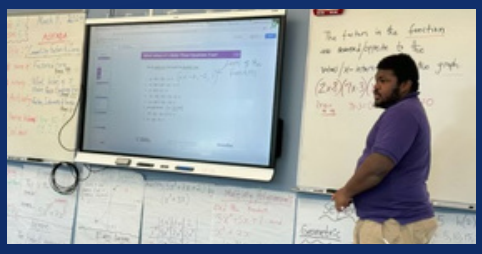
DCPS High Schools

DC Public Schools identified as Bright Spots for high school math growth shared several strategies that are contributing to their successes with students. Math instructional leaders associated with the two DCPS high schools located east of the river in 22-23 talked about their strategies for building confidence in students as math learners. At Anacostia, teachers encourage students to never leave an answer blank. This strategy leads to students attempting more challenging concepts and gives teachers more information about any gaps in students' learning, building a culture of intervention and collaboration.

At Ron Brown, which had the highest high school growth to proficiency in the District, educators employ multiple strategies to create a safe, welcoming learning culture and help all students realize they are "math people." Each period opens with a circle conversation, where teachers check in with students, practice positive affirmations as a group, and discuss a topic of importance to the students, such as neighborhood safety or the school's cell phone policy. Math lessons are then structured with an entry point for students that taps into their prior knowledge without requiring a right answer – for example, what the student sees, and what he notices – inviting them into the lesson from a place of wondering and discovery. Leaders discussed their shift away from giving the answer, to guiding the student to discover it for themselves. "If I give them the answer up front, I rob them of the opportunity to come up with their own ideas," said Michael Dohr, math department chair at Ron Brown. This "productive struggle" deepens students' conceptual knowledge and increases their sense of ownership over the material.

Leaders also spoke to using creative scheduling and outside resources to take advantage of every possible moment for learning. Both schools have tutoring partners to provide additional one-on-one time for some students. At Ron Brown, the school employs time blocking within periods to ensure teachers set time for developing students' problem solving skills and mathematical growth mindset, teach an efficient and effective lesson, and allow ample time for independent student work while they actively progress monitor. Teachers use planning time to identify the possible misunderstandings collaboratively and proactively for each lesson, and then monitor students' understanding through exit tickets. By sorting the tickets into high, medium, and low understanding levels, math educators can rapidly develop a re-teaching plan for commonly missed concepts.

Finally, instructional leaders at both schools spoke to using small groups or cohorts of students to support differentiation within the classroom. Using the Relay Graduate School of Education's model for analyzing data and student work, the Anacostia math instructional team meets regularly to assess which math concepts may require further instruction and created flexible groupings in classrooms to address this data. Ron Brown also utilizes data to identify cohorts of students who can benefit from targeted math instruction at an accelerated pace.



Bright Spot educators also conveyed that student learning requires more than just translating knowledge by telling students what to do. They create spaces of encouragement, support, understanding, and success. They emphasize that children need to feel physically and emotionally safe to learn. Here are some of the social-emotional strategies they see as fundamental to their success:

Set students up for success and celebrate it when it happens.

Resoundingly, the educators told us that success does not come from learning, it's a prerequisite for learning. Students need opportunities to use what they already know; when educators and peers recognize and celebrate them for what they know now, it builds their confidence to learn more. At both the student and classroom level, one strategy is to prioritize, track, and celebrate growth. Students feel successful as individuals and as a team, and more learning ensues.

Make space for mistakes.

These educators don't punish students for a lack of knowledge, skill, or preparation. Instead, they accept failure as natural and an opportunity to learn, using math errors as teaching moments. Making and then learning from mistakes is the surest way the educators help students build problem solving skills. Punitive consequences deter students from even trying.

Actively and deliberately create trusting relationships.

At Bright Spot schools, students relate to (or at the very least trust) their teacher. This takes different forms in different places: some take a family-oriented approach, where adults are supportive and caring for students without being overly permissive. Other educators embrace similarities, acknowledge differences, and seek to learn from their students. Every educator mentioned how they encourage connection and relationship-building and demonstrate that they appreciate and respect students' whole selves.

Celebrate and make it fun!

Over and over, we heard how teachers are celebrating students' growth as math learners early and often. Sometimes the rewards were fruit snacks for early elementary students, being named "Math Rock Star" for the week, or including students who demonstrate math skill mastery in celebration videos. They also utilize math games online or more traditional ones like "math war" that students find fun and barely realize they are building their math fact fluency.

STRATEGY 5

SUPPORT TEACHER PREPARATION AND ONGOING DEVELOPMENT

To limit student misconceptions, Bright Spot instructional leadership teams provide ongoing support for teacher implementation of curriculum and conceptual understanding.

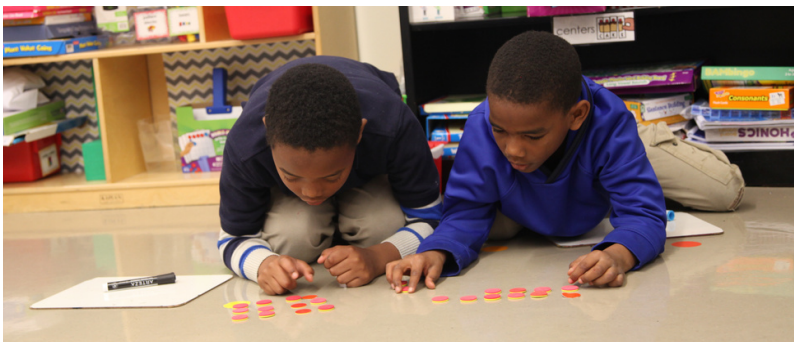
Bright Spot teachers said their schools give them the knowledge, training, flexibility, resources, time, and team to do their best work. As one teacher put it, "You shouldn't have to be the LeBron James of teaching" to have successful students.

What does the research say about math teacher preparation and support?

One of the key factors that influences student achievement in mathematics is the quality and content knowledge of their teachers. Research has shown that teachers who have a deeper understanding of mathematical concepts, procedures, and connections are more effective at helping their students learn and apply them in various contexts. Moreover, teachers who have specialized training and certification in mathematics tend to produce better outcomes for their students than those who teach math as a generalist or out-of-field.[28]

However, many math teachers in the U.S. lack adequate preparation and support to teach the subject effectively. According to a recent report by the National Council on Teacher Quality, only 15% of undergraduate programs earn an A by adequately covering all the math topics and pedagogy that elementary teachers need.[29] Furthermore, many math teachers do not receive sufficient professional development, coaching, or feedback to improve their practice and address their students' needs,[30] and unfortunately, many elementary teachers do not themselves feel adequately confident in their own basic math skills.[31]

To address these challenges, researchers recommend deepening teachers' content and pedagogical knowledge through coursework, workshops, coaching, and online resources,[32] supporting teachers to use formative assessment and data-driven decision making to monitor student progress,[33] and creating professional learning communities where teachers can collaborate, reflect, and learn from each other, as well as from experts and researchers.[34]



What approaches to teacher preparation and support do Bright Spot educators say help them shine?

Bright Spot teacher panels were asked the most effective support they have received, as well as what their peers might need to improve. These are topics they raised as promising practices.

Have more than one person in the classroom at a time.

Some schools include math coaches, specialists, or interventionists in the classroom to provide individualized or small group instruction in classes where students have a wide range of understanding. Others use co-teachers or rotating teacher teams, especially for teachers who are new to the profession or school. Not only does this give students the attention they need, but it also creates consistency in instruction—if one teacher is absent, there's no interruption to learning.

Allow and encourage educators to be flexible and innovative.

Bright Spots educators have the time and ability to make decisions, choose tools, and adapt curricula and instructional materials. For some educators, the curriculum is generally on target and appropriate for the students they serve. For others, it's the opposite. Regardless of which group they're in, the Bright Spots reported they can use their own professional judgment to adapt what works (and set aside what doesn't), focusing on teaching grade level standards and using technology to support but not replace teaching.

Develop skills and content knowledge but use "person power" wisely.

All the Bright Spot teachers are experts in their content. Some use professional development during the summer and some during the school year, but all report that constantly pursuing knowledge and skills is essential to their practice. They can use targeted PD to hone their craft because their schools utilize coaches to help them reflect on lessons, specialists to analyze data, interventionists to work with students with specialized learning needs, "departmentalization" in elementary grades so that teachers can focus on math, or peer teachers with complementary skills. Their schools build a team to support their successful teaching practices.

Plan ahead, and plan together.

Making, executing, and adapting daily lesson plans takes a lot of preparation and planning. On top of that, Bright Spot teachers have strategic long-term plans, which they report is key to keeping them organized and making sure they can cover the content, leave time for students to practice new skills, and discover where re-teaching is needed – all while building fluency and problem-solving skills along the way. Some use the "off-season" for long-term planning and curriculum development. Others engage in collaborative planning across grade level and content teams, or even with other schools if their grade-level team is small.

ADDITIONAL RELATED TOPICS AND RESOURCES

"There is a negative feeling just associated with math that the kids have developed... you have to address how they are feeling coming into your space and how they are feeling about the content, how they are going to feel about seeing a fraction and not dismiss that. And let them know it's okay and guide them through that feeling."

Elizabeth McPherson, H.D. Woodson High School

Culturally Responsive Math Instruction

Mathematics is often seen as a neutral and objective subject that transcends cultural differences. However, research shows that students of color face various barriers and challenges in learning and engaging with math, such as stereotypes, biases, low expectations, and lack of representation.[35] To address these issues, educators adopt more culturally responsive and inclusive approaches to math instruction that value and affirm the diverse identities, experiences, and perspectives of their students.

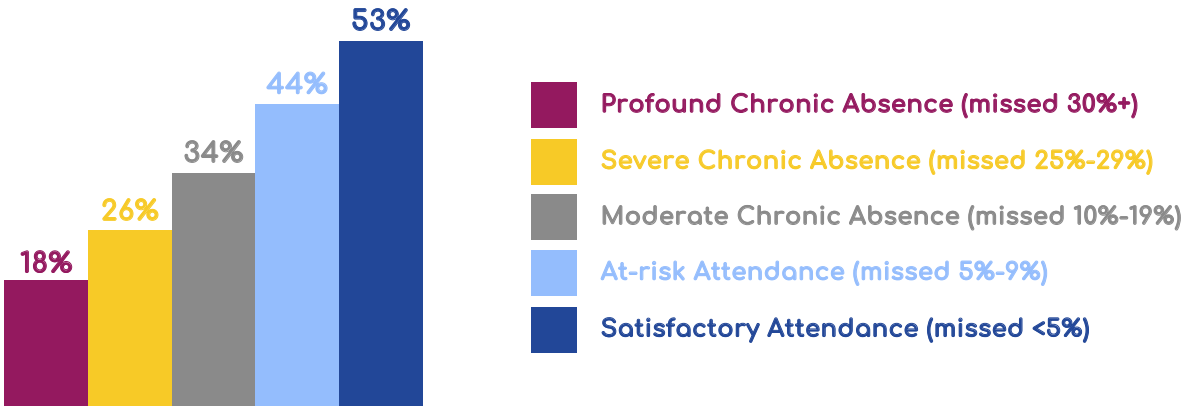
Research supports this approach to building math learning communities, or groups of students and teachers who collaborate and communicate around math problems – classrooms should foster positive relationships, trust, and belonging. These communities can create opportunities for students of color to express their mathematical thinking, share their insights and strategies, and connect math to their lives and interests.[36]

Bright Spot educators described how they modify examples in the curriculum by utilizing content and approaches their students can relate to. According to these award-winning teachers, successful learners see themselves in the content, in their teachers, and in their school. Bright Spots teachers ask students what their interests are and include them in the curriculum, and they show students that math content and procedures are a way to learn more about those interests. Research supports their decision to creatively adjust content through relevant examples and inspiring messages,[37] and follows best practice in developing an effective sociocultural approach to equity in math education.[38]

Chronic Absenteeism and High-Impact Tutoring

Chronic absenteeism has a profound impact on student achievement. Only 18% of DC students who were profoundly chronically absent during the 2022-23 school year demonstrated that they were on or above grade level in math or reading. Using data from a large sample of DCPS and DC public charter schools representing more than 85% of enrolled students, EK12 compared spring MAP and i-Ready results for students based on what percent of the school year they missed due to absence of any kind. **The data show a significant impact on student performance when missing more than 5% of the school year, or more than one day a month on average.**

Percent On or Above Grade Level in Math or Reading by Absenteeism Status



High-impact tutoring is emerging as a strategy to combat chronic absenteeism. High-impact tutoring is a research-based practice of supplementing classroom instruction in a one-on-one or small group setting where a trained, quality tutor and student meet frequently and consistently, with a focus on math and/or literacy. OSSE made a three-year investment of $35 million to promote and expand the use of high-impact tutoring, especially at schools serving high proportions of economically disadvantaged students. The District plans to serve at least 10,000 students through HIT by fall 2024 across 90% of schools where there is a great concentration of students who need academic support.[39]

A study released in February 2024 from the National Student Support Accelerator at Stanford University, found "evidence of a strong causal link between tutoring specifically and attendance." Researchers were able to look more directly at causality by comparing attendance on days they were scheduled for tutoring compared to days they were not. DC students who were profoundly chronically absent the year prior to receiving tutoring were 7.3% more likely to attend school on days they had scheduled tutoring sessions. If tutoring were built into the daily school schedule going forward, this would translate into these students attending 5 more days of school over the course of the year. DC middle school students were statistically significantly more likely to attend classes the day they were scheduled for tutoring, increasing their probability of attending by 11.4% which translates to an additional 3.1 more days of schooling.[40]

A comprehensive analysis of randomized control trials of academic interventions, including tutoring, found that high impact tutoring can boost learning outcomes substantially, especially in math, equivalent to students receiving an extra 3-15 months of schooling.[41]

Artificial Intelligence and Math Education

One of the emerging trends in math education is the use of artificial intelligence (AI) to enhance and personalize learning. The prospects of AI are just starting to unfold, with limited research support for now. However, AI might be able to help teachers enhance their own mastery of math knowledge and skills to teach it more effectively, diagnose students' strengths and weaknesses, provide immediate feedback, and customize content and instruction according to each student's needs and preferences. AI might also be used to engage students with interactive and gamified activities, such as adaptive quizzes, simulations, and virtual reality. One recently released randomized control trial study found that an AI-based professional development program that took educators an average of 11 hours to complete was correlated with improved math performance of their students.[42] EK12 and the DC Math Hub will keep a close eye on research related to AI in education.

Math Classroom Observation

One of the challenges of math education is to assess the quality of instruction and provide feedback for improvement. Traditional classroom observation tools, such as checklists or rating scales, are often generic and subjective, and do not capture the specific aspects of math teaching and learning, such as mathematical discourse, conceptual understanding, or problem solving. Several math-specific classroom observation tools have been developed and validated by researchers, based on the principles and standards of effective math instruction. These tools are designed to measure the quality of math teaching and learning in more depth and detail than traditional tools, and to provide actionable feedback for improvement. Examples of research-based math observation tools:

- **Mathematical Quality of Instruction from Harvard University** [43]
- **Math Observation Protocol from TNTP** [44]
- **Math Classroom Observation Rubric from Instruction Partners** [45]

Dyscalculia and Supporting Young Students Struggling in Math

According to the Handbook of Clinical Neurology, developmental dyscalculia, or the numeracy equivalent to dyslexia for language acquisition, is a "developmental learning disability that manifests as a persistent difficulty in comprehending even the most basic numeric and arithmetic concepts, despite normal intelligence and schooling opportunities."[46] It affects about 5 to 8% of school-age children nationwide, or roughly the same as those affected by dyslexia.[47] Unlike its reading sibling, there is limited high-quality research in the field that provides guidance about assessing students for dyscalculia and the best strategies for supporting students with the disability. The Institute for Education Sciences (IES) has identified six basic approaches to helping students struggling with math:[48]

Provide systematic instruction to develop math understanding.

This includes reviewing and integrating prior concepts and sequencing instruction to build concept understanding gradually.

Teach clear and precise mathematical language.

For example, rather than using the terms "carrying" or "borrowing" in addition and subtraction, use the term "regrouping" to underscore that the operation involves changes to place value.

Use well-curated concrete and semi-concrete representations of math concepts.

Generally, concrete tools like manipulatives should give way to simpler representations like line drawings and finally to abstract representations like numerical equations.

Use the number line to demonstrate math concepts and procedures.

For example, number lines can be used to demonstrate comparing magnitude and operations for both whole numbers and fractions, measuring time or temperature, or graphing coordinates and data.

Give explicit instruction on word problems focused on deepening students' understanding and ability to apply math ideas.

This includes providing students with strategies to solve different types of word problems, such as the principles of Mathematical Language Routines (MLRs)[49] or schema-based instruction.[50]

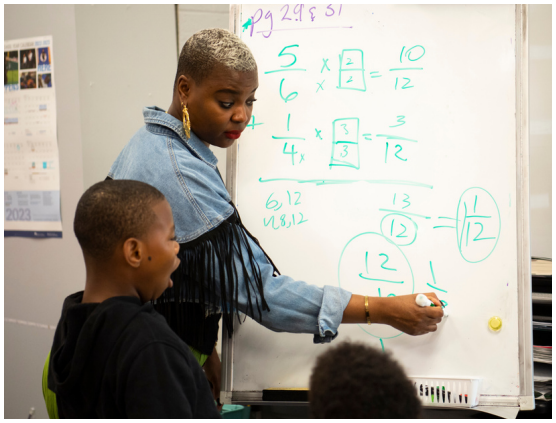
Include regular, timed activities to build math fluency.

Students may be motivated by beating their own time on successive timed math exercises. Timed activities can be used for more than just basic math facts like multiplication tables, including common tasks needed for complex problems, such as equivalents for fractions.

ATTRIBUTIONS AND CREDITS

We thank the following individuals for their contributions and feedback in the creation of this report. Each organization and person's participation in this project in no way indicates an endorsement of this report, and all errors are the responsibility of the EmpowerK12 authors.

- Center City PCS: Charles Brown, Emily Strohbeck, Dr. Kate Merrill, Russ Williams
- Cesar Chavez PCS: Sanjay Mitchell, Tiffany Smith
- DC Deputy Mayor for Education: Rebecca Ryan
- DC Education Research Collaborative: Dara Shaw, Fanny Terrones, Victoria Nelson
- DC Policy Center: Chelsea Coffin
- DC Public Schools: Caylah Green, Charles Hunt, Clinton Turner, Constance Thayer, Corinne Colgan, Elizabeth McPherson, Jennifer Burkett, Jerry Ilar, Joshua Wiley, Michael Dohr, Monai Chavers, Noelani Davis, Robert Thomas, Tiffany Johnson, William Haith
- Education Forward DC: Vincent Alexis-Laona
- Education Reform Now Advocacy: Cesar Toledo, Jessica Giles
- Friendship PCS: Candice Tolliver-Burns, Derrick Gooding, Gregory Spears, Patricia Brantley, Shatavia Kelley
- IDEA PCS: Heidi Simonsen
- KIPP DC: Sylvana Asante, Tiffanie Williams, Vemia Lee
- Office of the State Superintendent of Education (OSSE): Kelley Scholl, Miryam Oziel
- Rocketship PCS: Jeanice Stewart
- TNTP: Christine Love, Marni Bromberg
- University of the District of Columbia: Dr. Kelly Ivy



ENDNOTES

[1] Council of the Great City Schools. (2021). How Well Do Large City Public Schools Overcome the Effects of Poverty and Other Barriers? Retrieved from https://www.cgcs.org/Page/1288

[2] Hughes, B. (2024). PISA Exam Tests Real-World Math Skills. But That's Not What U.S. Schools Teach. The 74 Million. Retrieved from https://www.the74million.org/article/pisa-exam-tests-real-world-math-skills-but-thats-not-what-u-s-schools-teach/

[3] National Center for Education Statistics. (2023). PISA 2022 Mathematics Literacy Results. Retrieved from https://nces.ed.gov/surveys/pisa/pisa2022/mathematics/trends/

[4] District of Columbia Public Schools. (2023). A Capital Commitment: 2023-2028 Strategic Plan. Retrieved from https://dcpsstrong.com/strategic-plan/

[5] DC Office of the State Superintendent of Education. (2022). 2022 DC State Plan Accountability Addendum. Retrieved from https://osse.dc.gov/sites/default/files/dc/sites/osse/page_content/attachments/2022%20DC%20State%20Plan%20Accountability%20Addendum%20%20-%20Appendix%20A%20%28Adjusted%20Long%20Term%20Goals%29.pdf

[6] EmpowerK12. (2024). Estimate of the net percent of students who improved from "approaching expectations" to "meeting expectations" or "partially met" to "approaching" or "did not yet meet" to "partially met" based on reported Growth to Proficiency values and a large sample of student level data

[7] National Council of Teachers of Mathematics. (2012). Closing the Opportunity Gap in Mathematics Education. Retrieved from https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/Opportunity%20Gap.pdf

[8] Dweck, C. S. (2006). Mindset The New Psychology Of Success. Random House.

[9] Wu, Y. (2016). Universal Beliefs and Specific Practices: Students' Math Self-Efficacy and Related Factors in the United States and China. International Education Studies, 9(12): 61-74. Retrieved from https://files.eric.ed.gov/fulltext/EJ1121512.pdf

[10] Rattan, A., Good, C., & Dweck, C. S. (2012). "It's ok — Not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students. Journal of Experimental Social Psychology, 48(3): 731–737.

[11] Education Reform Now Advocacy. (2024). DC Parents See Math as Most Important Subject, Subject Most in Need of Updating; Needs to Better Apply to Real World; District-Wide Strategy Needed

[12] Institute for Educational Sciences. (2009). Using Student Achievement Data to Support Instructional Decision Making. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/PracticeGuide/dddm_pg_092909.pdf

[13] Biesinger, K. D., Crippen, K. J., & Muis, K. R. (2008). The impact of block scheduling on student motivation and classroom practice in mathematics. The Journal of Educational Research, 101(3): 140-147.

[14] Higgins Averill, O., Baker, D., & Rinaldi, C. (2014). A Blueprint for Effectively Using RTI Intervention Block Time. Intervention in School and Clinic, 50(1): 29-38.

[15] Narechania, K. (2022). Instructional coherence isn't a trendy reform. It's necessary—and it works. Fordham Institute Flypaper. Retrieved from https://fordhaminstitute.org/national/commentary/instructional-coherence-isnt-trendy-reform-its-necessary-and-it-works

[16] Newmann, F. M., Smith, B., Allensworth, E., & Bryk, A. S. (2001). Instructional Program Coherence: What It Is and Why It Should Guide School Improvement Policy. Educational Evaluation and Policy Analysis, 23(4): 297-321. https://doi.org/10.3102/01623737023004297

[17] McGee, D.L., Gonulates, F., Hodgson, T., & Brewer, M. (2020). The long term impact of a coherence based model for mathematics intervention. School Science and Mathematics, 120(4), 220-231.

[18] O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K–12 curriculum intervention research. Review of Educational Research, 78(1): 33-84.

[19] TNTP & Zearn. (2021). Accelerate Don't Remediate: New Evidence from Elementary Math Classrooms. Retrieved from https://tntp.org/wp-content/uploads/2023/02/TNTP_Accelerate_Dont_Remediate_FINAL.pdf

[20] EdReports. (2024). Reviews of K-12 instructional materials. Retrieved from https://www.edreports.org/reports/math

[21] District of Columbia Public Schools. (2024). Early learning curriculum & assessment. Retrieved from https://dcps.dc.gov/ece

[22] Zearn. (2023). Students in District of Columbia Public Schools gained an additional 11 weeks of math learning in one year with Zearn. Retrieved from https://webassets.zearn.org/Implementation/EfficacyResearch2022DistrictwideStudyDC.pdf

[23] National Council of Teachers of Mathematics. (2023). Procedural Fluency: Reasoning and Decision-Making, Not Rote Application of Procedures Position. Retrieved from https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/PROCEDURAL_FLUENCY.pdf

[24] Osana, H.P., and Pitsolantis, N. (2013)."Addressing the Struggle to Link Form and Understanding in Fractions Instruction." British Journal of Educational Psychology 83 (March): 29–56.

[25] Woodward, J. (2006). Developing automaticity in multiplication facts: integrating strategy instruction with timed practice drills. Learning Disability Quarterly, 29(4): 269-289.

[26] Geary, D.C., Hoard, M.K., Nugent L., & Bailey, D.H. (2013). Adolescents' Functional Numeracy Is Predicted by Their School Entry Number System Knowledge. PLoS ONE 8(1): e54651.

[27] Boaler, J., & Staples, M. (2008). Creating mathematical futures through an equitable teaching approach: The case of Railside School. Teachers College Record, 110(3): 608-645. Retrieved from https://ed.stanford.edu/sites/default/files/boaler__staples_2008_tcr.pdf

[28] Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. American Educational Research Journal, 42(2): 371-406.

[29] National Council on Teacher Quality. (2022). Preparation for Teaching Elementary Mathematics. Retrieved from https://www.nctq.org/dmsView/NCTQ_Teacher_Prep_Review_Preparation_for_Teaching_Elementary_Mathematics_2022

[30] Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning Policy Institute. Retrieved from https://files.eric.ed.gov/fulltext/ED606743.pdf

[31] Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). Report of the 2018 NSSME+. Horizon Research, Inc. Retrieved from http://www.horizon-research.com/report-of-the-2018-nssme

[32] Darling-Hammond, L., & Bransford, J. (Eds.). (2005). Preparing teachers for a changing world: What teachers should learn and be able to do. Jossey-Bass.

[33] Goertz, M. E., Olah, L. N., & Riggan, M. (2009). From testing to teaching: The use of interim assessments in classroom instruction. Consortium for Policy Research in Education.

[34] Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., & Hewson, P. W. (2003). Designing professional development for teachers of science and mathematics. Corwin Press.

[35] Nasir, N. S. & Cobb, P. (2006). Improving Access to Mathematics: Diversity and Equity in the Classroom. Multicultural Education Series. Teacher's College Press.

[36] Gutstein, E. et al. (2017). Reimagining the mathematics classroom: Creating and sustaining productive learning environments, K–6. National Council of Teachers of Mathematics.

[37] Boaler, J. (2016). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching. Jossey-Bass.

[38] Cobb, P. & Nasir, N. S. (2015). Mathematics, identity, and African American students. In S. J. Cho (Ed.), Selected regular lectures from the 12th International Congress on Mathematical Education: 245-262. Springer.

[39] DC Policy Center. (2024). 2022-23 State of DC Schools: Challenges to pandemic recovery in a new normal.

[40] National Student Support Accelerator. (2024). Early Findings Show Evidence that High-Impact Tutoring Increases Student Attendance in D.C. Schools. Stanford University. Retrieved from https://studentsupportaccelerator.org/news/early-findings-show-evidence-high-impact-tutoring-increases-student-attendance-dc-schools

[41] Roland, G. & Fryer J. (2017). The Production of Human Capital in Developed Countries: Evidence from 196 Randomized Field Experiments. Handbook of Field Experiments, Vol. 2.: 95-322. Retrieved from https://scholar.harvard.edu/fryer/publications/production-human-capital-developed-countries-evidence-196-randomized-field

[42] Copur-Gencturk, Y., Li, J., Cohen, A.S., & Hawley Orrill, C. (2024). The impact of an interactive, personalized computer-based teacher professional development program on student performance: A randomized controlled trial. Computers & Education 210(3), 104963.

[43] Center for Education Policy Research. (2024). Mathematical Quality of Instruction (MQI). Harvard University. Retrieved from https://cepr.harvard.edu/mqi

[44] TNTP. (2024). Math Observation Protocol. https://tntp.org/wp-content/uploads/Tools/classroom-observation-protocol-math.pdf

[45] Instruction Partners. (2024). Math Classroom Observation Rubric. Retrieved from https://instructionpartners.org/wp-content/uploads/2021/11/2021%E2%80%9322-Math-IPG-Public.pdf

[46] Castaldi, E., Piazza, M., & Iuculano, T. (2020). Chapter 5 - Learning disabilities: Developmental dyscalculia. Handbook of Clinical Neurology 174: 61-75. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/B9780444641489000053

[47] Sparks. S.D. (2023). Dyscalculia and Dyslexia: Reading Disabilities Offer Insights for Math Support. Ed Week. Retrieved from https://www.edweek.org/teaching-learning/dyscalculia-and-dyslexia-reading-disabilities-offer-insights-for-math-support/2023/05

[48] Institute for Educational Sciences, U.S. Department of Education. (2021). Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades. Retrieved from https://ies.ed.gov/ncee/wwc/PracticeGuide/26

[49] Stanford University. (2024). Principles for the Design of Mathematics Curricula and MLRs. Retrieved from https://ul.stanford.edu/resource/principles-design-mathematics-curricula-and-mlrs

[50] Powell, S.R. (2011). Solving Word Problems using Schemas: A Review of the Literature. Learn Disabil Res Pract. 2011 May 1; 26(2): 94–108. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3105905/

DC Math Hub

LEARN MORE AT

dcmathhub.org

empowerk12.org/research