# Analysis of AimswebPlus Subtest Performance for K-3 Students, Fall 2020

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**Key Findings:**

Student composite scores mask important information about performance on subtests that assess specific foundational math skills.

Foundational math skills such as mental computation, number fluency, and number comparison are areas for improvement across grade levels.

# Why and how we track K-3 student math performance

## Strong foundational math skills are critical to a student's future academic success.

Development of early mathematical skills may be just as important to students' future academic success as early literacy skills. Students typically make significant gains in mathematics achievement throughout the first two years of school.[1] Identifying early gaps in K-3 math performance can help reduce the need for later intervention. Further, a strong math foundation can positively impact students' achievement in later grades as well as across different content areas.[2] Students who develop strong foundational math skills are more likely to succeed when they encounter more rigorous work in later grades.

## Math achievement is related to high school completion and college attainment.

Students with higher levels of middle school math achievement are more likely to complete high school and persist through college.[3] Middle school math success is considered a gateway to ongoing academic opportunities that translate into differences in student trajectories throughout high school and college.[4] Additionally, research indicates that there is a relationship between the math courses that a student completes in middle school and their likelihood of enrolling in college.[5]

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[1] National Center for Education Statistics (2004). *From Kindergarten Through Third Grade: Children's Beginning School Experiences.* https://nces.ed.gov/pubs2004/2004007.pdf

[2] Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, *115*(6), 1-29.

[3] Generation Next. *Middle Grade Math.* https://gennextmsp.org/middle-grade-math-results/#:~:text=Research%20indicates%20that%20students%20successfully,both%20college%20and%20career%20success.

[4] Wang, Jia, and Pete Goldschmidt. "Importance of Middle School Mathematics on High School Students' Mathematics Achievement." *The Journal of Educational Research* 97, no. 1 (2003): 3-19. http://www.jstor.org/stable/27542459.

Center for Analysis of Postsecondary Education and Employment (2013). Improving Students' College Math Readiness: A Review of the Evidence on Postsecondary Interventions and Reforms. https://www.capseecenter.org/wp-content/uploads/2016/03/improving-students-college-math-readiness-capsee.pdf

[5] National Center for Education Statistics (2007). *The Nation's Report Card: Mathematics 2007.* https://nces.ed.gov/nationsreportcard/pdf/main2007/2007494.pdf

## One of the Board of Education's Goals for the District is that 52% of students in grades 3-8 will score proficient or advanced on the state math assessment (PSSA) by August 2026 (Goal 3).

As of Spring 2019, 21.3% of students in grades 3-8 received a score of proficient or advanced on the State administered math assessment (PSSA-Math).[6] PSSA exams are administered annually, so to track interim student progress the District has identified "leading indicators" for each goal which are tied to more frequent, within-year assessments. In order to reach the 52% proficiency goal for the math PSSA, there must first be an increase in the percentage of students both **overall** (Leading Indicator 3.1) and by **student subgroup** (Leading Indicator 3.2) who score at or above grade level on the District's within-in year math assessment each year.[7]

## The Leading Indicator of progress toward Goal 3 for 2020-21 is that by the Spring test administration, 57.4% of students in grades 3-8 will test at target on their within-year math assessment.

The District uses aimswebPlus assessments to monitor K-3 math progress on the Leading Indicators. The aimswebPlus assessments are standards-based and vary by grade level (see Table 1). AimswebPlus math assessments focus on emerging numeracy skills, such as number recognition and quantity conceptualization, for kindergarten. In first grade, skills shift to number-pair comparisons and math facts, and in second through fifth grade assessments include mental computation, triad number comparisons, and math concepts.

**Box 1. What is a composite score?**

Composite scores measure student performance on a combination of key skills that are critical to becoming proficient in math. Composite scores are comprised of students' individual subtest scores.

Students in each grade take multiple assessments, or "subtests"; each subtest measures a discrete early math skill that students must master in order to become proficient in math. Of all the subtests, some are required for students to receive a "composite score" (See Box 1 and additional information below). Based on their composite score, students are placed into a performance tier that indicates their level of risk of not achieving proficiency in key math skills by the spring of their current school year:

- Tier 1 indicates that students are testing "At Target" and are on track to being proficient in math;

- Tier 2 indicates that students need strategic intervention to ensure progress towards proficiency; and

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[6] Read more about the PSSA-Math here:
https://www.education.pa.gov/K-12/Assessment%20and%20Accountability/PSSA/Pages/default.aspx
[7] For more about tracking progress towards the Goals and Guardrails see https://www.philasd.org/era/goals-and-guardrails/

- Tier 3 indicates that students require intensive intervention to make progress towards proficiency in key math skills.

## In addition to Tier placement based on the composite score, it is critical to evaluate student performance on each of the assessments that comprise the composite.

While using composite scores and Tier placements are useful for tracking progress toward the District's Goal 3, they are not sufficient for making instructional decisions. To better determine what steps should be taken to improve the percentage of students in Tier 1 ("At Target"), we must also closely examine student performance on each of the composite's subtests. This is important to help identify specific skill gaps that need to be addressed to help students reach Tier 1.

## Research questions

This brief explores two research questions to better understand K-3 student performance on the aimswebPlus math subtests:

1. How did students perform on the various subtests that make up the composite assessment for aimswebPlus math?

2. What does subtest performance reveal about students' mathematics skill levels? Where are students performing well, and where are potential areas of growth?

## Understanding aimswebPlus composite performance

Students in kindergarten, second, and third grade must take multiple subtests in order to receive a composite score. The subtests that are required for composite scores in grades K-3 and analyzed in this brief are found in Table 1, along with a short description of the skill that each subtest assesses.[8]

Table 1. aimswebPlus assessments that comprise composite scores, by grade level

| Grade Level | Subtest Name (Required for Composite Score) | Skill Assessed |
|---|---|---|
| Kindergarten | Number Naming Fluency (NNF) | Amount of numbers between 0 and 20 that students can identify in one minute. |
| | Quantity Total Fluency (QTF) | The total number of items students correctly counted/summed in one minute. |
| | Concepts and Applications (CA) | The number of one- and two-step word problems students can solve correctly. This subtest is untimed and 25 questions in length. |

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[8] AimswebPlus assessments were administered virtually in Fall 2020-21 because schools were closed due to Covid-19 and all instruction was taking place online.

| Grade Level | Subtest Name (Required for Composite Score) | Skill Assessed |
|---|---|---|
| First Grade | Concepts and Applications (CA) | The number of one- and two-step word problems students can solve correctly. This subtest is untimed and 25 questions in length. |
| | Number Comparison Fluency - Pairs (NCF-P) | Number of instances a student can identify the larger number in a given pair in one minute. |
| | Math Facts Fluency -1 Digit (MFF-1D) | The number of simple addition and subtraction problems (with only numbers 0 - 10) students can solve correctly in one minute. |
| Second and Third Grade | Concepts and Applications (CA) | The number of multiple-choice math word problems students answer correctly. This subtest is untimed and 29-31 questions in length. |
| | Number Comparison Fluency- Triads (NCF-T) | The number of instances a student can correctly identify where a given number falls on the number line between the two choices in three minutes. |
| | Mental Computation Fluency (MCF) | The number of multiple-choice mental math problems students can solve and answer correctly in four minutes. |

**Note:** Although second and third-grade students participate in the same subtests, the content and rigor of the tests differs based on grade-level standards.

Based on students' performance on each subtest and their National Percentile Ranks, students are placed into one of five performance groups (Table 2).[9]

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[9] The five performance groups do not map onto the three performance tier levels exactly. However, both are calculated using National Percentiles, and depending on how a student performs on the subtests that comprise the composite score used to determine a tier placement, students who fall into the "Below Average" or "Well Below Average" performance groups are likely to also be placed in Tiers 2 or 3. Thus, ensuring that students are performing well on all subtests is critical to their Tier placement.

Table 2. Five possible performance groups based on aimswebPlus assessment

| aimswebPlus Performance Group | Percentile Range |
|---|---|
| Well Above Average | 90 to 100 |
| Above Average | 75 to 89 |
| Average | 26 to 74 |
| Below Average | 11 to 25 |
| Well Below Average | 1 to 10 |

**Source:** AimswebPlus's <u>technical manual.</u>

# How did students perform on the various subtests that make up the composite assessment for aimswebPlus math?

## Based on Fall composite scores, most kindergarten students entered the 2020-21 school year requiring math intervention.

Of the 6,142 kindergarten students who took all three of the Fall 2020 aimswebPlus composite assessments (NNF, QTF, and CA), 51% scored in Tier 3 and 24% scored in Tier 2 (Figure 1). This means that over 80% of tested kindergarteners began the school year needing either strategic or intensive intervention to progress towards math proficiency.

Figure 1. Percentage of kindergarten students placed in each tier based on their composite score in Fall 2020 (n= 6,142)
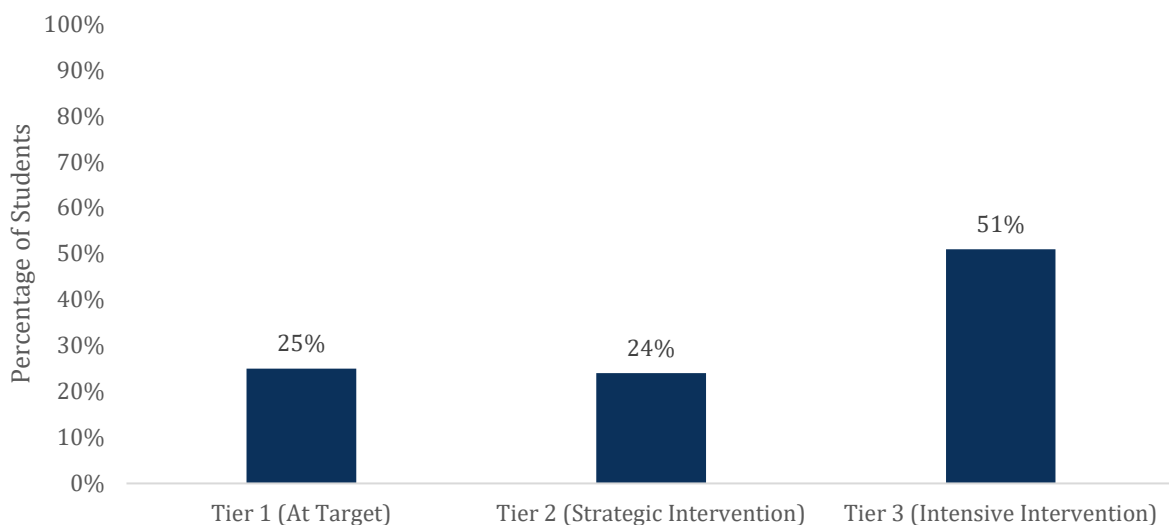


**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

# Over 60% of kindergarten students scored either "Below Average" or "Well Below Average" on their Fall 2020 Number Naming Fluency (NNF) and Quantity Total Fluency QTF subtests.

The NNF subtest is designed to assess a student's ability to correctly name and identify numbers between 0 and 20 within one minute. District-wide, 35% of kindergarten students scored "Well Below Average" on the fall NNF, which is equivalent to knowing and identifying 13 or fewer numbers (Table 3; see Box 2 for the kindergarten Subtest Scoring Guide). About one-quarter (27%) of kindergarten students scored "Below Average" and about one-third scored (31%) "Average."

The QTF subtest is designed to assess a students' ability to count. kindergarten students must correctly identify the total

Box 2. Kindergarten subtest scoring guide

| | Assessment | | |
|---|---|---|---|
| | **NNF**<br>Amount of numbers identified correctly | **QTF**<br>Total number of items correct | **CA**<br>Number of word problems solved |
| Well Below Average (1-10%) | 0-13 | 0-6 | 0-5 |
| Below Average (11-25%) | 14-23 | 7-9 | 6-8 |
| Average (26-74%) | 24-39 | 10-15 | 9-15 |
| Above Average (75-89%) | 40-50 | 16-18 | 16-18 |
| Well Above Average (90-99%) | 51+ | 19+ | 19+ |

**Source:** AimswebPlus's technical manual and SDP's aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

number of dots in each presented item, for as many items as they can, within one minute. About one-third (34%) of kindergarten students scored "Well Below Average" on the fall QTF, corresponding to correctly counting dots in 6 or fewer presented boxes. About one-third of kindergarten students scored "Below Average" or "Average" (29% and 32%, respectively).

The CA subtest is designed to assess a student's ability to solve one- and two- step word problems appropriate to their grade level. This subtest is untimed and consists of 25 items. About one-fourth (23%) of kindergarten students scored "Well Below Average," which is equivalent to correctly solving fewer than five word problems. Twenty-one percent of kindergarten students scored "Below Average," which is equivalent to correctly solving between six and eight word problems.

The NNF and QTF assess students' fluency in foundational math skills, while the CA assesses grade level standards-based math concepts. The performance across these subtests means that the majority of kindergarten students began school year 2020-21 struggling with number identification and basic math concepts such as counting and addition, which are essential building blocks for higher-level math concepts.

Table 3. **All District kindergarteners** by overall National Percentile Rank baseline performance grouping

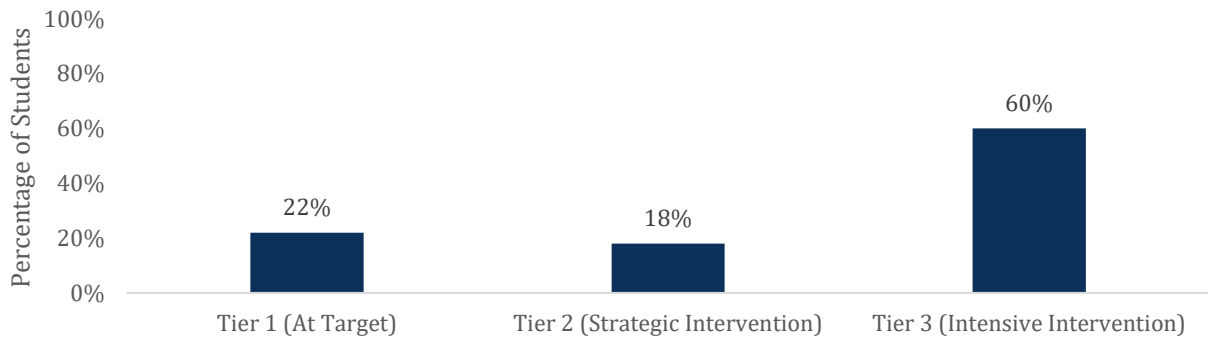|  | Number of Students | Well Below Average (1-10%) | Below Average (11-25%) | Average (26-74%) | Above Average (75-89%) | Well Above Average (90-99%) |
|---|---|---|---|---|---|---|
| NNF | 6,367 | 35% | 27% | 31% | 5% | 2% |
| QTF | 6,302 | 34% | 29% | 32% | 3% | 3% |
| CA | 6,153 | 23% | 21% | 39% | 9% | 8% |

**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

**How to read this table:** This table displays the percentage of kindergarten students who tested into each performance group based on their national percentile rank on each of the subtests that are required for the composite assessment. For example, 27% of kindergarten students tested between the 11th-25th national percentile (NPR) on the Number Naming Fluency (NNF) assessment, placing them in the "below average" performance group.

## Two-thirds of first-grade students needed intensive intervention based on their Fall 2020 composite score.

Of the 7,967 first-grade students who took the Fall 2020 aimswebPlus composite assessment (CA, NCF-P, and MFF-1D), about two-thirds (60%) scored in Tier 3 (Figure 2). About 18% scored in Tier 2 and 22% scored in Tier 1.

Figure 2. Percentage of first-grade students placed in each Tier level based on their composite score n=7,967



**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

## Nearly three-fourths (73%) of first-grade students scored either "Below Average" or "Well Below Average" on the Fall 2020 Number Comparison Fluency-Triads (NCF-P) subtest.

The NCF-P subtest is designed to assess students' ability to identify the larger number in a pair. Half (51%) of first-grade students scored "Well Below Average," which means that students correctly identified the larger number fewer than 13 times (Table 4). About one-fourth of first-grade students scored "Below Average" (22%) and "Average" (23%). This means that the majority of students enter first grade unable to distinguish number values, a foundational math skill.

District-wide, 52% of first-grade students scored "Well Below Average" or "Below Average" on CA, which is designed to test students on grade-level concepts (Table 4). These first-grade students were able to correctly solve a maximum of eight world problems.

Box 3. First grade subtest scoring guide

| | Assessments | | |
|---|---|---|---|
| | **CA** Number of word problems solved | **NCF-P** Number of correct responses | **MFF-1D** Number of add/sub problems solved |
| Well Below Average (1-10%) | 0-5 | 0-13 | 0-4 |
| Below Average (11-25%) | 6-8 | 14-18 | 5-8 |
| Average (26-74%) | 9-16 | 19-28 | 9-15 |
| Above Average (75-89%) | 17-20 | 29-31 | 16-19 |
| Well Above Average (90-99%) | 21+ | 32+ | 20+ |

**Source:** AimswebPlus's technical manual and SDP's aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

The MFF-1D subtest is designed to assess a student's ability to solve simple addition or subtraction problems involving numbers between zero and ten. About one-fourth (27%) of first-grade students scored "Well Below Average," which is equivalent to solving fewer than four addition or subtraction problems in one minute. By comparison, students who scored in the "Average" range (about one-third of all first graders, or 36%) solved between 9 and 15 problems within one minute.

Table 4. **All District first grade students** by overall National Percentile Rank baseline performance grouping

| | Number of Students | Well Below Average (1-10%) | Below Average (11-25%) | Average (26-74%) | Above Average (75-89%) | Well Above Average (90-99%) |
|---|---|---|---|---|---|---|
| CA | 7,974 | 35% | 17% | 34% | 9% | 5% |
| NCF-P | 8,070 | 51% | 22% | 23% | 3% | 1% |
| MFF-1D | 8,147 | 27% | 28% | 36% | 6% | 3% |

**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.
**How to read this table:** This table displays the percentage of first-grade students who tested into each performance group based on their national percentile rank on each of the subtests that are required for the composite assessment. For example, 17% of students tested between the 11th-25th national percentile (NPR) on the Concepts and Applications (CA) assessment placing them in the "below average" performance group.

## About half (52%) of second-grade students scored in Tier 1 based on their Fall composite score.

Of the 8,349 second-grade students who took the Fall 2020 aimswebPlus composite assessment (CA, NCF-T, and MCF) half (52%) scored in Tier 1 (Figure 3), which would indicate that these students do not require intervention to perform at grade level in mathematics. However, 49% of second-grade students did require either strategic or intensive intervention (16% and 32%, respectively).

Figure 3. Percentage of second-grade students placed in each Tier level based on their composite score in Fall 2020 (n=7,679)
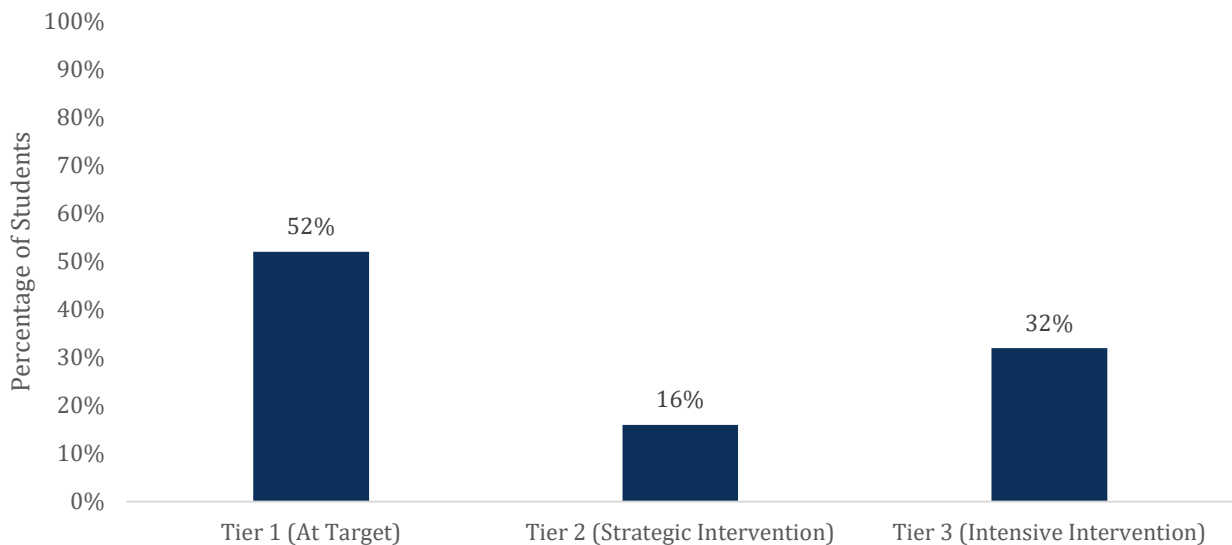
**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

## Less than 20% of second grade students scored "Well Above Average" on each Fall 2020 math subtest.

Although 52% of second-grade students scored in Tier 1 on the composite, it is important to note there is significant variation in scoring demands on each subtest. In some cases, this might influence the number of students that are placed in performance groupings (Figure 3; see Box 4 for the Second Grade Subtest Scoring Guide). For example, similar numbers of second-grade students scored in the "Well Below Average" performance category on the CA and MCF subtest (13% and 14% respectively, Table 5). However, students who scored "Well Below Average" on the CA subtest might answer as many as six word problems correctly, without a time limit, while students would receive this designation on the MCF only they did not solve any mental math problems, ranging from addition to multiplication, correctly in with four minutes (Box 4). Further, it is not possible for a second-grade student to be placed "Well Below Average" in the NCF-T subtest.

The NCF-T subtest is designed to assess students' fluency in number comparison by their ability to correctly identify where a given number falls on the number line. In Fall 2020, 42% of second grade students scored in the "Average" performance category, meaning at minimum they answered one item correctly.

Students who scored in the "Average" performance category on the CA subtest (40%) solved at least ten word problems correctly, while the 44% second grade students who scored in the "Average" performance category on the MCF subtest solved a minimum of three mental math problems correctly.

Box 4. Second grade subtest scoring guide

|  | Assessments | | |
| --- | --- | --- | --- |
|  | **CA**<br>Number of word problems solved | **NCF-T**<br>Number of correctly answered item | **MCF**<br>Number of correctly solved mental math problems |
| Well Below Average (1-10%) | 0-6 | N/A | 0 |
| Below Average (11-25%) | 7-9 | 0 | 1-2 |
| Average (26-74%) | 10-19 | 1-9 | 3-12 |
| Above Average (75-89%) | 20-23 | 10-15 | 12-19 |
| Well Above Average (90-99%) | 24+ | 16+ | 20+ |

**Source:** AimswebPlus's technical manual and data from aimsweb-Star Qlik app, data downloaded on April 6, 2021.

Sixty-eight percent of second-grade students scored average, above average, or well above average on the CA subtest (that is, they answered at least ten word problems correctly), demonstrating a firm understanding of mathematical concepts. However, they struggled with mental computation (MCF) and number comparison (NCF-T)

Table 5. **All District second-graders** by overall National Percentile Rank baseline performance grouping

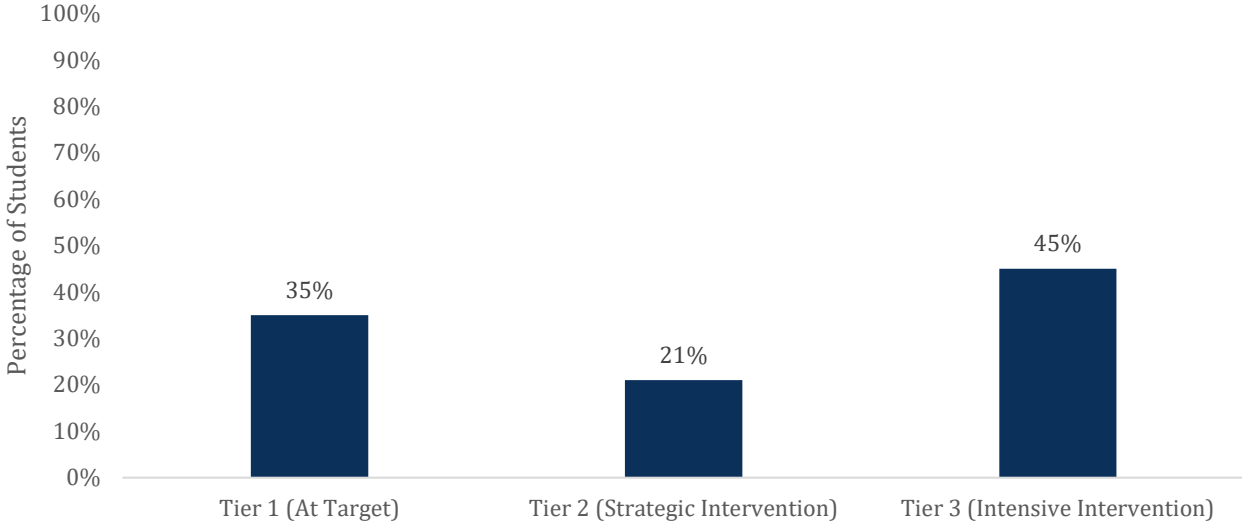|  | **Number of Students** | **Well Below Average (1-10%)** | **Below Average (11-25%)** | **Average (26-74%)** | **Above Average (75-89%)** | **Well Above Average (90-99%)** |
| --- | --- | --- | --- | --- | --- | --- |
| CA | 7,686 | 13% | 18% | 40% | 12% | 16% |
| NCF-T | 7,478 | N/A | 42% | 42% | 10% | 6% |
| MCF | 7,568 | 14% | 15% | 44% | 14% | 12% |

**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.
**How to read this table:** This table displays the percentage of second-grade students who tested into each performance group based on their national percentile rank on each of the subtests that are required for the composite assessment. For example, 15% of students tested between the 11th-25th national percentile (NPR) on the Mental Computation Fluency (MCF) assessment placing them in the "below average" performance group.

## About 45% of third-grade students scored in Tier 3 based on their Fall 2020 composite score.

Of the 8,536 third-grade students who took the Fall 2020 aimswebPlus composite assessment (CA, NCF-T, and MCF), about 45% scored in Tier 3, while about one-fourth of students scored in Tier 2 (Figure 4).

Figure 4. Percentage of third-grade students placed in each tier level based on their composite score in Fall 2020 (n = 7,845)



**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

# Over half of third-grade students scored "Well Below Average" on the Number Comparison Fluency-Triads (NCF-T) subtest.

Similar to the performance of second-grade students, there was significant variation in the subtest performance of third-grade students (Table 6). A larger percentage (52%) of third-grade students scored "Well Below Average" on the NCF-T than on the CA (25%) or MCF (19%). A score of "Well Below Average" on NCF-T is the equivalent of placing a minimum of two numbers correctly on the number line.

While a higher percentage of third-grade students scored in the "Average" category on the MCF (47%) than the CA (34%),

Box 5. Second grade subtest scoring guide

| | Assessments | | |
|---|---|---|---|
| | **CA**<br>Number of word problems solved | **NCF-T**<br>Number of correctly answered item | **MCF**<br>Number of correctly solved mental math problems |
| Well Below Average (1-10%) | 0-6 | 0-2 | 0 |
| Below Average (11-25%) | 7-9 | 3-6 | 1-2 |
| Average (26-74%) | 10-17 | 7-20 | 3-12 |
| Above Average (75-89%) | 18-21 | 21-28 | 13-18 |
| Well Above Average (90-99%) | 22+ | 29+ | 19+ |

**Source:** AimswebPlus's <u>technical manual</u> and SDP's aimsweb-Star Qlik app. Data downloaded on April 6, 2021.

this is the equivalent of solving only a minimum of three mental math problems correctly. While, third-grade students who scored "Average" on the CA subtest, solved between 10-17 word problems. This fall performance data from third grade students indicates a better grasp on mathematical concepts, but highlights gaps in mental computation.

Table 6. **All District third graders** by overall National Percentile Rank baseline performance grouping

| | **Number of Students** | **Well Below Average (1-10%)** | **Below Average (11-25%)** | **Average (26-74%)** | **Above Average (75%-89%)** | **Well Above Average (90-99%)** |
|---|---|---|---|---|---|---|
| CA | 7,850 | 25% | 26% | 34% | 8% | 7% |
| NCF-T | 7,680 | 52% | 17% | 24% | 4% | 3% |
| MCF | 7,735 | 19% | 15% | 47% | 11% | 8% |

**Source:** Aimsweb-Star Qlik app. Data downloaded on April 6, 2021.
**How to read this table:** This table displays the percentage of third-grade students who tested into each performance group based on their national percentile rank on each of the subtests that are required for the composite assessment. For example, 14% of students tested between the 11th-25th national percentile (NPR) on the Vocabulary (VOC) assessment placing them in the "below average" performance group.

# Conclusions

## Students' composite scores mask important information about performance on specific foundational math skills.

Because composite scores combine the results of multiple subtests, each of which measures a discrete foundational math skill or concept, the composite score often masks areas in which students may need extra support or intervention. For this reason, it is important to consider both the composite scores *and* the individual subtest scores. Doing so will allow teachers and administrators to deliver the appropriate instruction to move students closer to proficiency.

## This subtest analysis revealed that foundational math skills, such as mental computation, number fluency, and number comparison, are areas for improvement across grade levels.

A consistent theme across all grades was a high percentage of students entering school 2020-21 with an "Average" understanding of math concepts as reflected by their CA subtest performance, while mental computation, number values, and basic mathematical fluency skills were comparatively lacking. Over 60% of kindergarten students scored "Below Average" or "Well Below Average" on the NNF and the QTF subtests. Over half of first-grade students scored "Well Below Average" on the NCF-P subtest. While composite scores of second- and third-grade students classified a higher percentage as Tier 1, compared to kindergarten and first-grade students, second- and third-grade subtest performance also reveals a need for support in mental computation and number comparison.