

**Denver Public Schools**  
**Grades: 4 - 12**  
**Program Length: 8 Months**  
**Treatment Year: 2021-2022**

## **Abstract**

This analysis covers all grades using Cognition/LightbulbEd in Denver Public Schools for one year, in 2021-2022. It outlines the following:

- 1) Absolute Gain across all students with complete data
- 2) Effect of Key Metrics
- 3) Effect of Contact Hours
- 4) Math Confidence Data

# Contents

<b>1) Introduction</b>	<b>4</b>
1.1 Background	4
1.2 Program Description	5
<b>2) Data Collection</b>	<b>6</b>
<b>3) Data Analysis</b>	<b>8</b>
3.1 Pre & Post Diagnostic Results	8
3.1.1 Absolute Gain	8
3.2 Key Metrics & Relative Influence	9
3.2.1 Relative Influence of Key Metrics	9
3.2.2 Combined Effects of Key Metrics	10
3.2.3 Contact Hours	10
3.3 Increased Math Confidence	11
<b>4) Findings Summary</b>	<b>12</b>
<b>5) List of Schools</b>	<b>13</b>

# 1 Introduction

## 1.1 Background

Denver Public Schools (DPS) serves 90,250 students in Denver City and Denver County, Colorado. These students attend 207 different schools in the District. DPS' student demographic breakdown includes 52.1% Hispanic, 25.3% White, 13.7% Black/African American, 2.9% Asian, 0.6% Native Indian/Alaska Native, 0.5% Native Hawaiian/Pacific Islander, and 4.8% two or more races. While Cognition had conducted pilot programs with DPS during the Spring semester of the 2020-21 school year, as well as a Summer session in 2021, the 2021-22 school year was the first full implementation of the Cognition program in the District.

Cognition math tutoring was offered to schools by the District as part of their "Transition Priorities," set by the leadership as a response to the challenges and opportunities created by the COVID-19 pandemic<sup>1</sup>. Specifically, it was part of the Grade-level coaching and tutoring provided as a school choice as an initiative of DPS's priority "Accelerating Learning by Re-envisioning Education." The implementation of the program also included Transformative Social-Emotional and Academic Learning (TSEAL) practices that were part of DPS's Social-Emotional and Mental Health transition priority. These practices were developed in partnership with the DPS staff and implemented by Cognition staff and tutors. Additionally, Cognition tutors working in Denver schools were trained in Equity-based learning practices, reflecting the other priority from DPS's transition list.

The curriculum used for the sessions was developed by the Cognition team from the DPS Scope and Sequence documents using the Desmos platform. Schools were given the opportunity to realign the instructional sequence as part of their School Choice options.

<sup>1</sup> *Understanding District Priorities | Denver Public Schools*. (n.d.). Retrieved June 22, 2022, from <https://www.dpsk12.org/district-priorities/>

## 1.2 Program Description

The tutoring sessions were conducted virtually using the Google Meet platform. The target was a 4:1 student-to-tutor ratio for each group, though ratios varied from 1:1 to 5:1 across the District. Denver's School Choice model resulted in a variety of implementations, from before or after-school independent study models, to fully-integrated, differentiated instructional models in math classrooms. The groups prioritized collaborative learning and productive struggle as key values for the way the sessions were conducted.

Groups met on a consistent cadence across each school week, (i.e. same time and same days each week) with exceptions for schoolwide schedule changes, such as testing or field trips. Individual sessions ranged from 25 to 90 minutes. The goal was a minimum of 36 contact hours for each student, as determined by school district leadership. However, the median potential contact hours for the different implementations was only 32 hours, with a median actual contact average of 30 hours for individual students. The partnership also set goals of 70% average attendance and 80% positive engagement, as measured by the tutors after each session. These served as the key interim metrics as sessions progressed.

Cognition math tutoring was offered in 19 schools, serving 1069 students in 112 classes and 338 tutoring groups. The sessions were offered to grades 4 through 12, with 453 students in Elementary (Grades 4 & 5), 312 in Middle (Grades 6, 7, & 8), and 366 in High (grade 9-12)<sup>2</sup>. Our goal was for a single tutor to facilitate all of a student's sessions to effectively support student learning by providing consistency. Students were with their primary tutor in 82.8% of sessions.

<sup>2</sup> Some students were enrolled in multiple classes, leading to the discrepancy between individual students served (1069) and the total number of students listed by grade level (1131).

## 2 Data Collection

Data was collected through automated processes, pre-defined post-session tasks by the tutor, and from student input. It was collected during and at the conclusion of each session. Each school was provided weekly updates to key metrics and access to see the full data set on-demand, except diagnostics. District leadership was provided summary data weekly. At the end of the sessions, data was compiled, analyzed, and provided to the District, along with the raw data.

Metrics measured included:

- Pre- and Post-diagnostic
- Student attendance
  - On time/Late
- Student engagement
  - Measured by tutor feedback
  - Original categories
    - Cooperative
    - Desire to Learn
    - Actively Participated
  - Rated on a Likert scale
    - 1 - None of the time
    - 2 - Little of the time
    - 3 - Some of the time
    - 4 - Most of the time
    - 5 - All of the time
  - New Categories (began April 28,2022)\*\*
    - Persevered with Tasks
    - Listened Actively to Peers and Tutor
    - Participated in Discussions
  - Rated on a Likert Scale
    - 0% of the session time
    - 25% of the session time
    - 50% of the session time
    - 75% of the session time
    - 100% of the session time
- Standards Covered
  - Student progress rated by tutor after each session
  - Categories
    - No Understanding
    - Partial Understanding

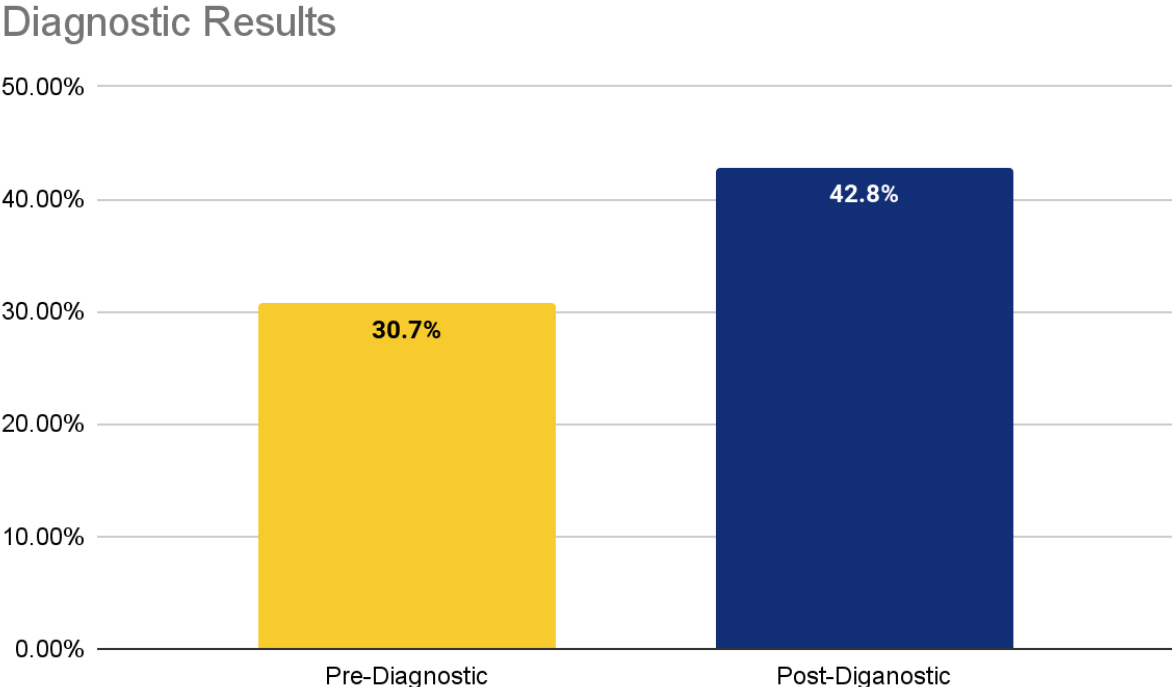
- Complete Understanding
- Student Feedback
  - Student attitudes about the sessions
  - Original categories (measured daily)
    - Did you enjoy going to your math tutoring session?
      - I look forward to my math tutoring sessions and believe they will help me.
      - I enjoy working on math problems with my tutor.
      - I do not enjoy working on math problems with my tutor.
      - I do not find math tutoring helpful and wish I did not have to go.
    - How much did you learn during your math tutoring session?
      - I learned a significant amount about how to solve math problems with my tutor.
      - I learned some about how to solve math problems.
      - I learned a little bit about how to solve math problems.
      - I learned nothing about how to solve math problems.
  - New categories (measured weekly - began March 7, 2022)\*\*
    - Students agree that...
      - I believe my tutor cares about me
      - My tutor encourages me to work hard and do my best
      - My tutor talks to me about my work to help me understand my mistakes
      - I take turns, listen to others and collaborate with my peers
      - I can learn math if I work hard
      - I am better now at math than I was at the beginning of the year
      - I can persevere through challenging material
      - I am proud of my math understanding
    - Answer scale:
      - Very true
      - Somewhat true
      - Not true

### 3 Data Analysis

The following data is an evaluation of overall changes in math performance, and the effects of attendance, engagement, and contact hours on the results.

#### 3.1 Pre- & Post-Diagnostic Results

Figure 3.1:



##### 3.1.1 Absolute Gain

Due to the variety of implementations, not every student received a pre- and post-diagnostic. However, a representative sample across the three age divisions was measured (183 Elementary, 148 Middle, and 43 High). Across all student results, the absolute gain was 12.1%. Elementary students made a 13.6% gain, Middle School students 10.5%, and High School students grew 12.3%.



## 3.2 Key Metrics and Relative Influence

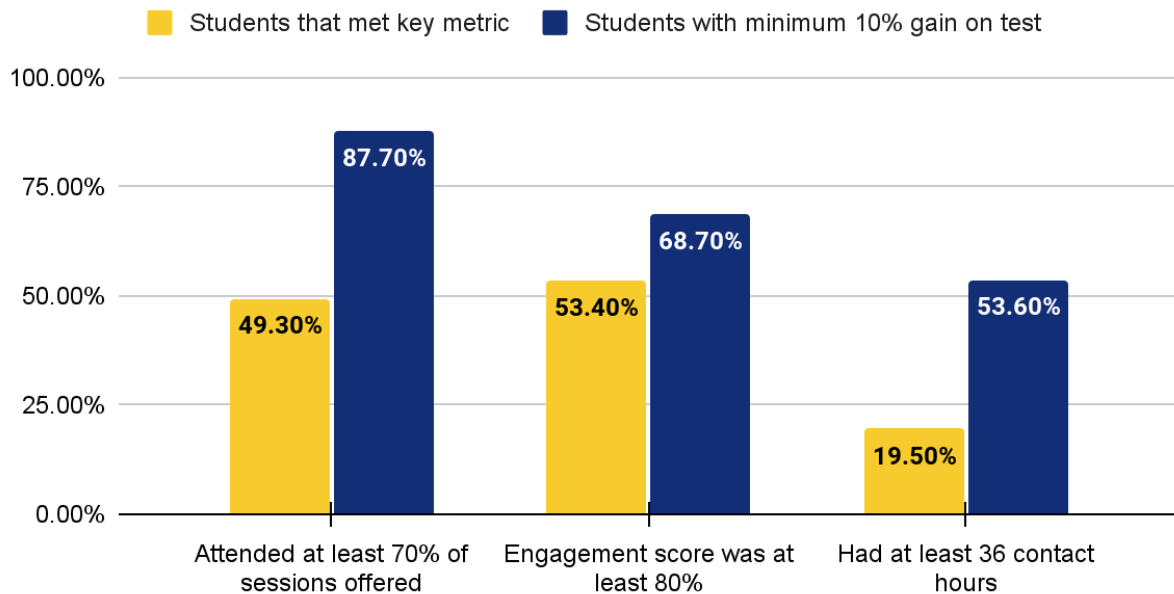
In discussions with DPS leadership, we determined three key metrics. These were evaluated weekly in meetings with school and district staff. The criteria were 70% session attendance, 80% engagement score (as measured by the tutors in their post-session tasks), and 36 overall contact hours.

Figure 3.2 denotes the percentage of students who met the following criteria and the relative influence of those metrics:

- 1) Attended at least 70% of sessions offered
- 2) Engagement score was at least 80%
- 3) Had at least 36 contact hours

Figure 3.2:

### Key Metrics and Relative Influence



### 3.2.1 Relative Influence of Key Metrics

The graphic above (Figure 3.2) denotes the relative influence of those metrics on student performance, as measured by the absolute gain between the pre-diagnostic and post-diagnostic. The first number is the percentage of students in the entire program (n=1069) who met the metric. The second is the percentage of students with a 10% gain

who met the metric. The goal is to examine the relative influence of the metrics on reaching the absolute growth goal of 10%.

In all three categories, there is a significant difference between the overall averages and the averages of students who achieved the targeted gain. The two most dramatic differences are in attendance and contact hours. Less than 50% of the students in the program met the attendance goal. Yet, almost 88% of the students who had an absolute gain of 10% or more met the attendance goal. Due to program design and attendance issues, less than one-fifth of students met the goal for contact hours. However, more than half of the students who met or exceeded 10% absolute gain had 36 or more contact hours.

### **3.2.2 Combined Effects of Key Metrics**

More narrowly, we examined the outcomes of only the students who were measured using the pre- and post-diagnostic tests (n=374) and those who met the absolute gain goal (n=179). One comparison, in particular, demonstrated the importance of reaching all three key metrics relevant to the student's performance on the post-diagnostic:

- If a student met all three criteria, their **average absolute gain was 19.4%\***.
- If a student failed to meet all three, their average absolute gain was a loss of 4.1%\*.

### **3.2.3 Contact Hours**

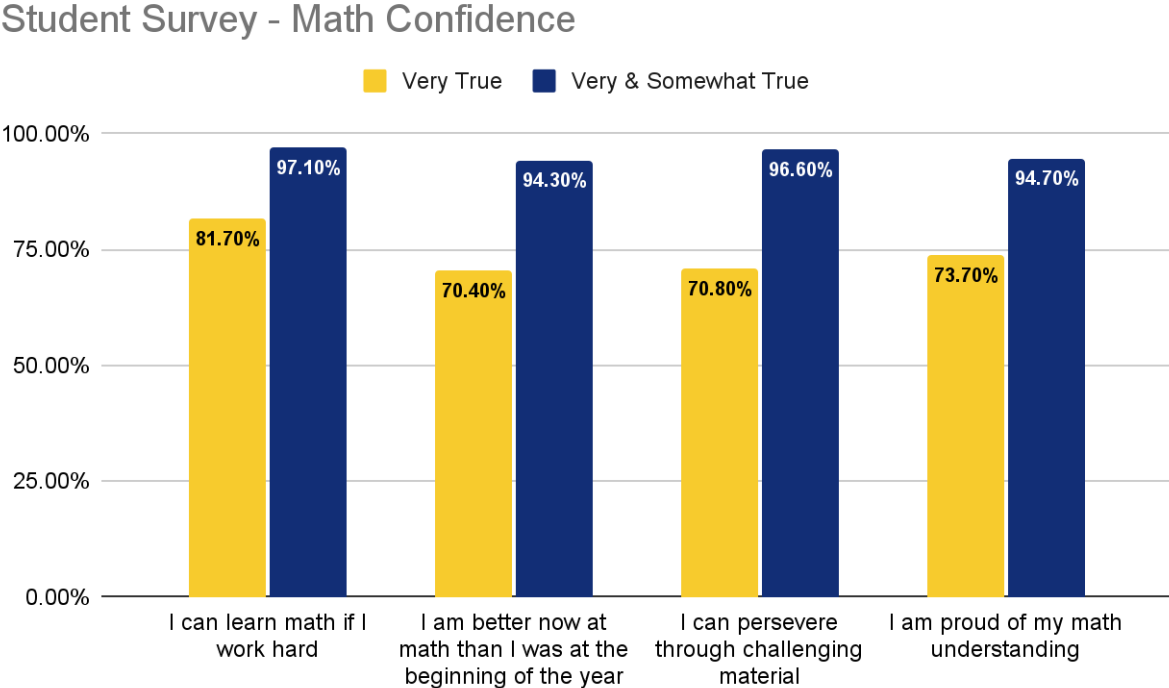
The data revealed a clear divide between the contact hours of those who reached the absolute gain goal of 10% and those who did not. Both the average and the median number of contact hours for those who achieved the 10% absolute gain (35.2 and 31.9, respectively) is higher than the average and the median number of contact hours for those who did not reach the absolute gain goal (28.6 and 24.1).

\*Gain from pre- to post-test as measured by the percentage of items answered correctly

### 3.3 Increased Math Confidence

Another interesting result from our data was the increase in the number of questions attempted by students from pre-diagnostic to post-diagnostic (n=374). While most students completed both tests, 1 of 8 students (12.5%) answered more questions on the post-diagnostic than on the pre-diagnostic. The increase was dramatic: the students averaged 7.5 more questions attempted on the post-diagnostic, an increase of 49.5% from pre-diagnostic. This suggested an increase in math confidence for the students who attended Cognition sessions in Denver. This conclusion was further supported by our findings in the student survey, which focused directly on SEL (social emotional learning) outcomes. Students responded “Very True” to the prompt “I can learn math if I work hard” 85.6% of the time on the survey, and 97.7% of the time responded “Very True” or “Somewhat True”. (Compared to 81.7% and 97.1% for all students.)

Figure 3.3



## **4 Findings Summary**

While the variety of implementations in Denver reduced the amount of pre- to post-diagnostic data available, the information we did receive gave clear indications for future implementations.

Implementing a tutoring program for a school presents a multitude of options: Before or after school, at-home sessions, sessions integrated into the math classroom for differentiated instruction, sessions conducted for a select group of students for remediation, etc. However, Denver's data points to the importance of key metrics for any implementation to be successful. First, consistent attendance is a key indicator of success. Excessive absences correlate to reduced outcomes. Second, dosage matters. While program design in Denver often was insufficient to meet the dosage target, successful students got a higher dosage of tutoring than the students who did not reach the absolute gain goal. Finally, engagement affects outcomes. Program design should ensure that students have accountability for engagement.

## 5 List of Schools

Table 5.1 shows the list of treatment schools and grades used in the analysis.

Table 5.1

School Name	Grade(s)
Centennial Elementary	4,5
Dr. Martin Luther King, Jr. Early College	6,7,8
Eagleton Elementary	4,5
Edison Elementary	4,5
Florence Crittenton High School	9,10,12
Florida Pitt Waller Elementary*	4,5
Florida Pitt Waller Middle*	6,7,8
Gust Elementary	4,5
Noel Community Arts School	9,10,11
North High School	10,11
Northfield High School	9,10
Place Bridge Academy Elementary*	4,5
Place Bridge Academy Middle*	6,7,8
Prep Academy	6,7,8,9,10,11
Respect Academy	11,12
Valdez Elementary	4,5
Westerly Creek Elementary	4,5
West High School	9,11
West Middle School	6,8
Willow Elementary	4,5

\* Florida Pitt Waller and Place Bridge Academy are single schools but the programs were separated into separate schools for their Cognition tutoring implementations.