

# DreamBox Math (2021-22)

ESSA Evidence Level III study conducted at The  
William Penn School District, PA

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## EXECUTIVE SUMMARY

DreamBox Learning contracted with LearnPlatform by Instructure, a third-party edtech research company, to examine the relationship between usage of DreamBox Math and student math outcomes at The William Penn School District in Pennsylvania. LearnPlatform designed the study to satisfy Level III requirements (Promising Evidence) according to the Every Student Succeeds Act (ESSA).

### Study Sample, Measures, and Methods

This treatment-only study occurred during the 2021-22 school year and included 1,851 K-6 students from eight elementary schools who use DreamBox. The William Penn School District is predominantly African American (87.84%) and almost all students (98.92%) are eligible for Free or Reduced Lunch.

Researchers used two measures to provide insights into DreamBox Math implementation and evidence about potential impacts of DreamBox Math on student learning outcomes: DreamBox usage and Savvas™ Mathematics Diagnostic and Screener Assessment (MSDA) scores.

Researchers used a variety of quantitative analytic approaches. First, researchers conducted descriptive statistics to describe participant characteristics and support implementation analyses. Researchers then conducted regressions and partial correlations to examine how DreamBox Math use related to student math outcomes from fall 2021 to spring 2022. The analyses included student-level covariates to control for potential selection bias. In addition, researchers calculated standardized effect sizes (Hedge's  $g$ ) to determine the magnitude of changes in student outcomes.

### Main Implementation and Research Findings

*Student usage.* Overall, students completed an average of 4.2 DreamBox Math lessons weekly and spent an average of 70 weekly minutes on the platform.

*Student outcomes.* Researchers conducted regressions and partial correlations to examine the relationship between DreamBox Math usage and math achievement while controlling for grade, race, English Language Learner (ELL) status, Individualized Education Program (IEP) status, and fall Savvas™ MSDA achievement results.

Overall, students who completed more lessons and spent more time in DreamBox Math had higher math achievement at the end of the study, and these relationships were statistically significant.

## DreamBox Implementation



59% of students completed 3.5 or more weekly lessons in DreamBox Math



71% of students spent between 55 and 120 weekly minutes on DreamBox Math

## Student Outcomes



Students who completed at least 3.5 lessons in DreamBox Math had higher end-of-year Savvas™ MSDA scores compared to students who completed less than 3.5 weekly lessons.



Students who spent at least 55 weekly minutes in DreamBox Math had higher end-of-year Savvas™ MSDA scores compared to students who spent less than 55 weekly minutes in the platform.



For all grade, students who completed more DreamBox Math weekly lessons had higher spring Savvas™ MSDA achievement. These were statistically significant relationships ( $p$ 's < .05) for students in Kindergarten and Grades 1, 2, 4, and 6.



For all grade, students who spent more time in DreamBox Math (weekly minutes) had higher spring Savvas™ MSDA achievement. These were statistically significant relationships ( $p$ 's < .05) for students in Grades 4 and 6.



Among students who identified as black (African American) and students who identified as white, students who completed more lessons in DreamBox (lessons weekly) and those who spent more time in DreamBox Math (weekly minutes) had higher spring Savvas™ MSDA achievement.

## Conclusions

This study provides results to satisfy ESSA evidence requirements for Level III (Promising Evidence) given the study design and positive, statistically significant findings.

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## Introduction

DreamBox Learning recognizes that a significant number of students in the US do not develop the mathematical proficiency needed to succeed in math beyond the middle school grades. Teacher surveys have indicated that students entering algebra courses do not have sufficient prior mathematical knowledge in the areas of whole number arithmetic, fractions, and proportions (NMAP, 2008). This lack of readiness is associated with negative downstream effects for students. The DreamBox Learning K-8 Math learning solution aims to solve this problem and ensure that all students are prepared for high school mathematics, as well as STEM college and career standards.

As part of their ongoing efforts to demonstrate the efficacy of DreamBox Math, DreamBox Learning contracted with LearnPlatform by Instructure, a third-party edtech research company, to examine the relationship between usage of DreamBox Math and student outcomes. After collaborating on the co-development of an updated logic model (see Appendix A) for DreamBox Learning Math (Shah & Styers, 2022), LearnPlatform initially designed the study to satisfy Level II requirements (Moderate Evidence) according to the Every Student Succeeds Act (ESSA), however, implementation of DreamBox Math at The William Penn School District was very robust and as such did not yield a large enough comparison sample of non-users.

The current study had the following research questions to satisfy Level III requirements (Moderate Evidence) according to the Every Student Succeeds Act (ESSA):

### Program Implementation Research Questions

1. How many DreamBox Learning Math lessons were completed by Grades K-6 students during the 2021–22 school year?
2. Among DreamBox Learning Math users, what were the usage patterns?

### Effectiveness Research Questions

After controlling for students' prior math achievement, grade, race, and IEP status,

3. How were different DreamBox Learning Math usage patterns related to Grade K-6 students' spring 2022 math achievement?
  - a. Which usage pattern(s) of DreamBox Learning Math had the greatest impact on Grade K-6 students' spring 2022 math achievement?
4. What was the overall impact of DreamBox Learning Math on Grade K-6 students' spring 2022 math achievement?
  - a. How did the impact of DreamBox Learning Math vary by student grade, and racial identity?
  - b. What was the impact for students who had free or reduced-price lunch (FRL) status and English language learner (ELL) status?

## Methods

This section of the report briefly describes the setting, participants, measures, and analysis methods.

### Setting

The study included the William Penn School District in Pennsylvania and an analysis sample of K-6 students across 8 schools.

### Participants

There were 1,851 students in the final analytic sample. According to demographic data provided by the district, the racial breakdown of students in the sample was as follows: African American (87.84%), White (5.29%), Hispanic (2.70%), followed by Native American and Alaskan (1.51%), and Asian (1.84%). Students who identified as Native Hawaiian and Multiracial each comprised less than 1% of the sample. Females made up 51.54% of the group, while males accounted for 48.46%. In addition, 15.83% of the K-6 students were identified as participating in special education, i.e., they have an IEP. Almost all students (98.92%) were classified as having free and reduced lunch (FRL) status. Lastly, English language learners constituted 4.21% of the sample (Appendix B).

### Measures

This study included the following measures to provide insights into DreamBox Math implementation and evidence about the potential impacts of DreamBox Math on student outcomes.

*DreamBox Math Usage Metrics.* Researchers utilized 2021-22 student-level usage (i.e., average weekly lessons and weekly minutes). According to DreamBox, measuring intended usage of the product aligns most closely with the number of lessons students are completing. DreamBox's recommendation to learning guardians is that their students complete five lessons per week, and lesson completion is the single best indicator of student progress through the curriculum. Notably, students are credited with completing a finished lesson regardless of whether they have passed or failed it. Time may also be a practical measure of intended usage but can include a considerable amount of non-productive usage. These usage data informed the extent to which students used DreamBox Math during the school year and whether students' use of DreamBox Math related to math learning outcomes on Savvas™ MSDA.

*Standardized Student Assessments.* Researchers used Savvas™ MSDA, a computer-administered assessment measuring students' strengths and weaknesses relative to grade-level math content at three time points, to assess students' math skills. Measures of student math outcomes included pretest (i.e., fall 2021) and posttest (i.e., spring 2022) assessment composite scores.

### Data Analysis

Researchers used a variety of quantitative analytic approaches. First, researchers conducted descriptive statistics to describe participant characteristics and support implementation analyses. Researchers then conducted regressions and partial correlations to examine how DreamBox Math use related to student math outcomes from fall 2021 to spring 2022. The analyses included student-level covariates to control for potential selection bias. In addition, researchers calculated standardized effect sizes (Hedge's *g*) to determine the magnitude of changes in student outcomes.

## Program Implementation Findings

The charts below highlight DreamBox Math use during the 2021-22 school year based on DreamBox Learning’s internal usage data (Table 1). Overall, students completed an average of 4.2 DreamBox Math lessons (SD = 2.4) per week and spent an average of 70 minutes in DreamBox Math (SD = 25) per week.

Table 1: Average DreamBox Math student usage by grade

	K	Gr 1	Gr 2	Gr 3	Gr 4	Gr 5	Gr 6	Total
 Number of students	<b>258</b>	<b>248</b>	<b>267</b>	<b>256</b>	<b>326</b>	<b>225</b>	<b>271</b>	<b>1,851</b>
 Average DreamBox Math lessons completed per week	<b>4.4</b>	<b>5.6</b>	<b>3.8</b>	<b>5.0</b>	<b>4.0</b>	<b>3.4</b>	<b>3.5</b>	<b>4.2</b>
 Average time spent in DreamBox Math (minutes) per week	<b>58</b>	<b>76</b>	<b>77</b>	<b>81</b>	<b>64</b>	<b>74</b>	<b>63</b>	<b>70</b>

Researchers conducted a *k*-means cluster analysis to group students by similar levels of DreamBox Math usage based on the number of average weekly lessons completed and the amount of time (average weekly minutes) spent on DreamBox Math.

For average weekly lessons, students fell into three usage categories ranging from low usage (0–3.4 weekly lessons), to moderate usage (3.5–6.7 weekly lessons), and high usage (6.8–16.8 weekly lessons) (Figure 1). DreamBox Learning recommends students complete 5 lessons per week.

For average weekly minutes, students fell into three usage categories ranging from low usage (4–54 weekly minutes), to moderate usage (55–84 weekly minutes), and high usage (85–120 weekly minutes) (Figure 2). Completing five lessons per week in DreamBox Math usually takes students one hour per week. Appendix C shows a breakdown of the mean weekly lessons or weekly minutes within each usage category.

Fifty-nine percent of students completed 3.5 or more weekly lessons in DreamBox Math and 33% completed the recommended weekly dosage of 5 DreamBox Math lessons.

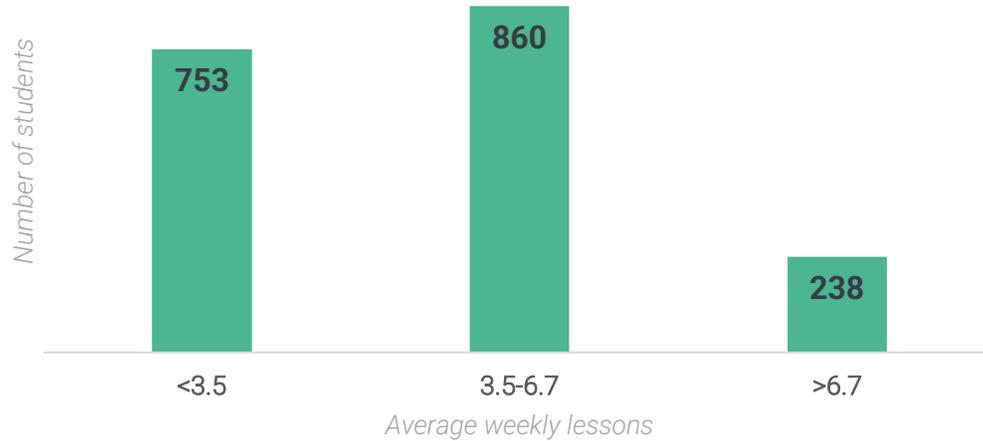


Figure 1. Overall distribution of average weekly lessons on DreamBox Math

Seventy-one percent of students spent between 55 and 120 weekly minutes on DreamBox Math.

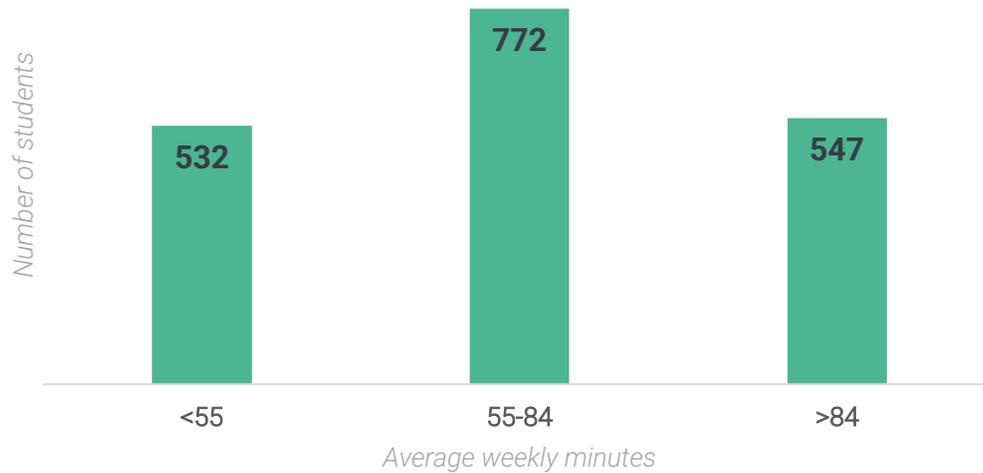


Figure 2. Overall distribution of average weekly minutes spent on DreamBox Math

## Student Findings

To answer the remaining study research questions, researchers conducted descriptive statistics, regression, and partial correlations. Researchers reported statistically significant findings at the  $p = .05$  level. To determine the magnitude of the relationship, researchers calculated standardized effect sizes. Before running regression and partial correlations, researchers examined unadjusted Savvas™ MSDA scores at the beginning, middle, and end of the year (see Figure 3). Overall, all students showed MSDA growth from fall 2021 to spring 2022.

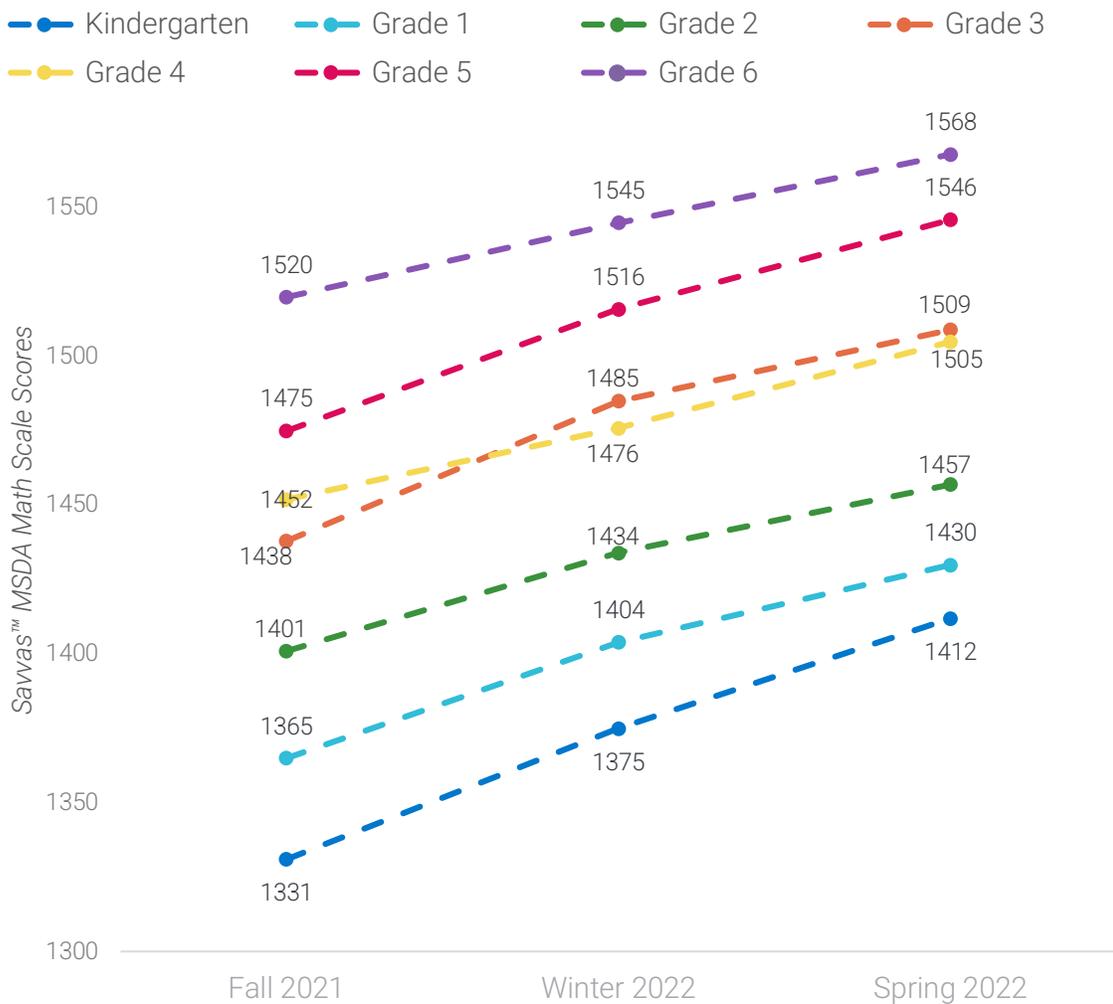


Figure 3. Savvas™ MSDA scores increased from fall to spring for DreamBox Math students

## Effectiveness Findings for 2021–22 School Year

Researchers first examined whether greater usage of DreamBox Math related to higher spring Savvas™ MSDA achievement using regression models that included fall Savvas™ MSDA achievement, grade, race, ESL status, and IEP status as covariates. Researchers report statistically significant findings at the  $p = .05$  level. Statistically significant findings are marked green (positive effect size) or red (negative effect size) in graphs. Findings that are not statistically significant are marked yellow (see Appendix D for details).

### Overall Relationship Between Average Weekly Lessons and Student Math Outcomes on Savvas™ MSDA

**Key Finding 1.** Students who completed between 3.5–6.7 weekly lessons (moderate use) and between 6.8–16.8 weekly lessons (high use) in DreamBox Math had higher end-of-year Savvas™ MSDA scores compared to students who completed less than 3.5 weekly lessons (low use) (Figures 4).

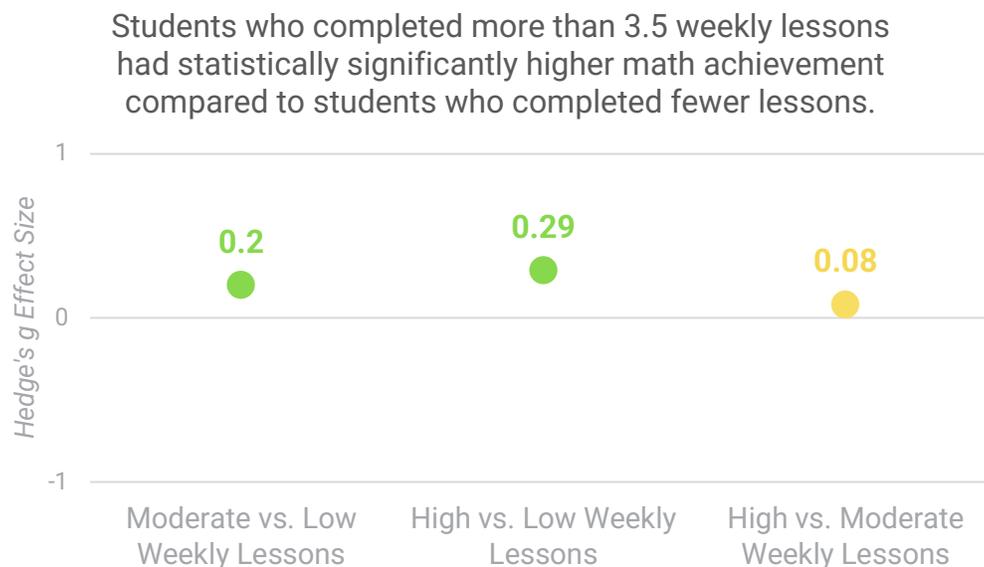


Figure 4. Relationship between average weekly lessons and student math outcomes on Savvas™ MSDA in terms of Hedge's  $g$  effect sizes

### Overall Relationship Between Average Weekly Minutes and Student Math Outcomes on Savvas™ MSDA

**Key Finding 2.** Students who spent between 55–84 weekly minutes (moderate use) and between 85–120 weekly minutes (high use) in DreamBox Math had higher end-of-year Savvas™ MSDA scores compared to students who spent less than 54 weekly minutes (low use) in the platform (Figures 5).

Students who completed more than 55 weekly minutes had statistically significantly higher math achievement compared to students who used the program for less time.

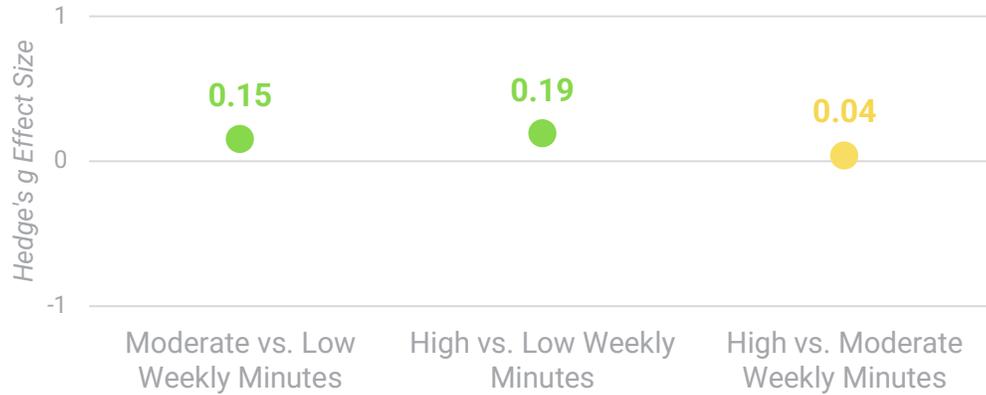


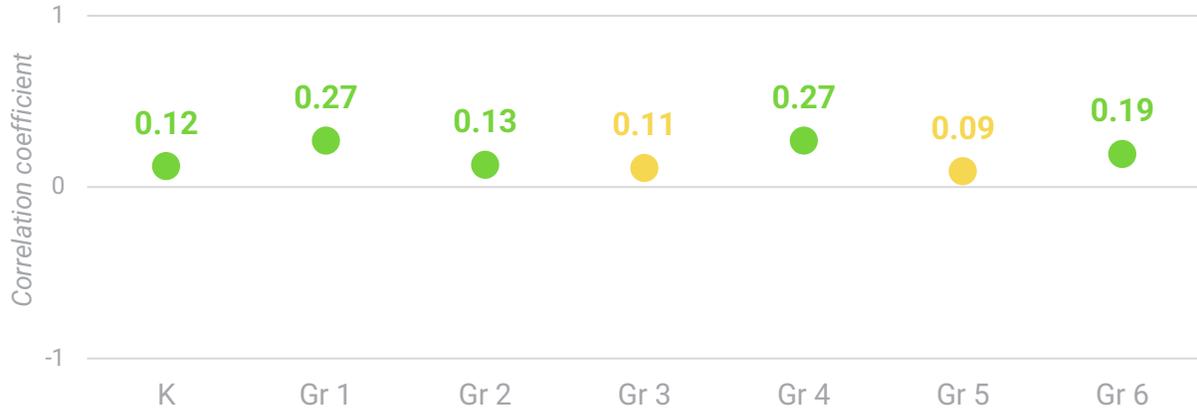
Figure 5. Relationship between average weekly minutes and student math outcomes on Savvas™ MSDA in terms of Hedge's *g* effect sizes

### Relationship Between Average Weekly Lessons and Student Math Outcomes on Savvas™ MSDA by Grade

Researchers examined whether greater usage of DreamBox Math related to higher spring Savvas™ MSDA achievement for each grade. Each partial correlation included fall Savvas™ MSDA scores, race, IEP status, and ELL status as covariates.

**Key Finding 3.** Positive results were observed for all grade levels, and these differences for Kindergarten and Grades 1, 2, 4, and 6 students were statistically significant relationship ( $p < .05$ ), such that students who completed more DreamBox Math weekly lessons had higher spring Savvas™ MSDA achievement.

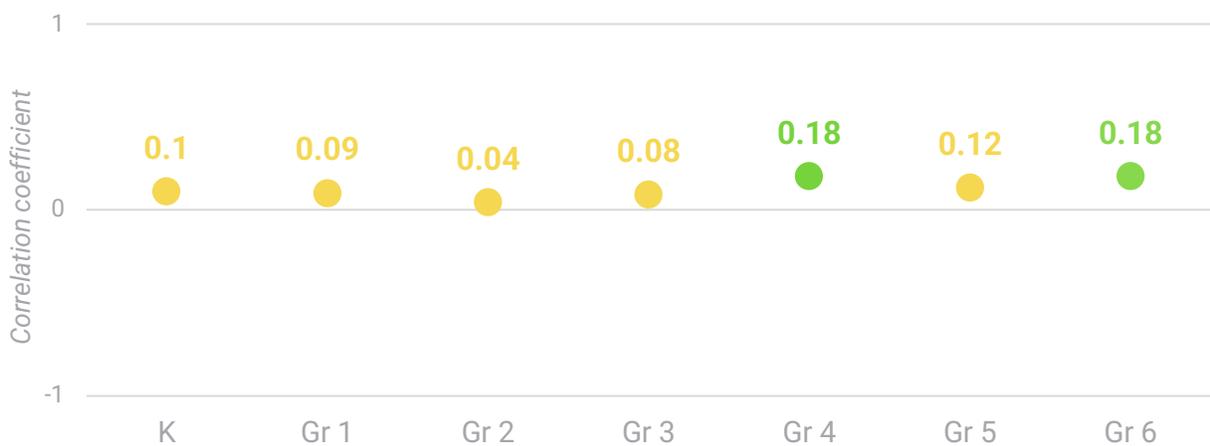
Kindergarten, Grades 1, 2, 4, and 6 students who completed more weekly Dreambox lessons had statistically significantly higher spring math achievement. This relationship was not significant for grades 3 or 5.



**Relationship Between Average Weekly Minutes and Student Math Outcomes on Savvas™ MSDA by Grade**

*Key Finding 4.* Among Grades 4 and 6 students, there was a positive, statistically significant relationship ( $p < .05$ ), such that students who spent more time in DreamBox Math (weekly minutes) had higher spring Savvas™ MSDA achievement. The results for Kindergarten and Grade 5 students were approaching significance.

Grade 4 and 6 students who spent more weekly minutes in Dreambox had statistically significantly higher spring math achievement. This relationship was not significant for other grades.



**Relationship Between DreamBox Usage and Student Math Outcomes on Savvas™ MSDA by Race**

**Key Finding 5.** Among students who identified as black (African American) and students who identified as white, there was a positive, statistically significant relationship ( $r$ 's = 0.10-0.16 and 0.29-0.39, respectively;  $p < .05$ ), such that students who completed more lessons in DreamBox (lessons weekly) and those who spent more time in DreamBox Math (weekly minutes) had higher spring Savvas™ MSDA achievement (Appendix D).

### **Relationship Between DreamBox Usage and Student Math Outcomes on Savvas™ MSDA by Free or Reduced-Price Lunch (FRL) Status**

**Key Finding 6.** Among students who had FRL status, there was a positive, statistically significant relationship ( $p < .05$ ), such that students who completed more lessons in DreamBox (weekly lessons) and those who spent more time in DreamBox Math (weekly minutes) had higher spring Savvas™ MSDA achievement ( $r$ 's = 0.12-0.18; Appendix D).

### **Relationship Between DreamBox Usage and Student Math Outcomes on Savvas™ MSDA by ELL Status**

**Key Finding 7.** Among students who had ELL status, there was no statistically significant relationship between DreamBox usage and spring Savvas™ MSDA achievement (Appendix D).

## Conclusions and Recommendations

In sum, the findings support a relationship between DreamBox Math usage and improved math skills for K-6 students. Given positive outcome findings, this study provides results to satisfy ESSA evidence requirements for Level III (Promising Evidence). Specifically, this study met the following criteria for Level III:

- ✓ Correlational design
- ✓ Proper design and implementation
- ✓ Statistical controls through covariates
- ✓ At least one statistically significant, positive finding

Researchers recommend the following next steps:

- Students who completed at least 3.5 weekly lessons had higher scores on Savvas™ MSDA. DreamBox should continue to explore ideal implementation at other sites using this baseline information.
- DreamBox Learning should consider recruiting a comparison district to better understand how students who use DreamBox Math compare to students using other math programs (ESSA Level II).

### Acknowledgements

The authors would like to extend their deepest thanks to Chelsae Long who supported the preparation of this report in numerous ways and Avery Wall for her editorial review.

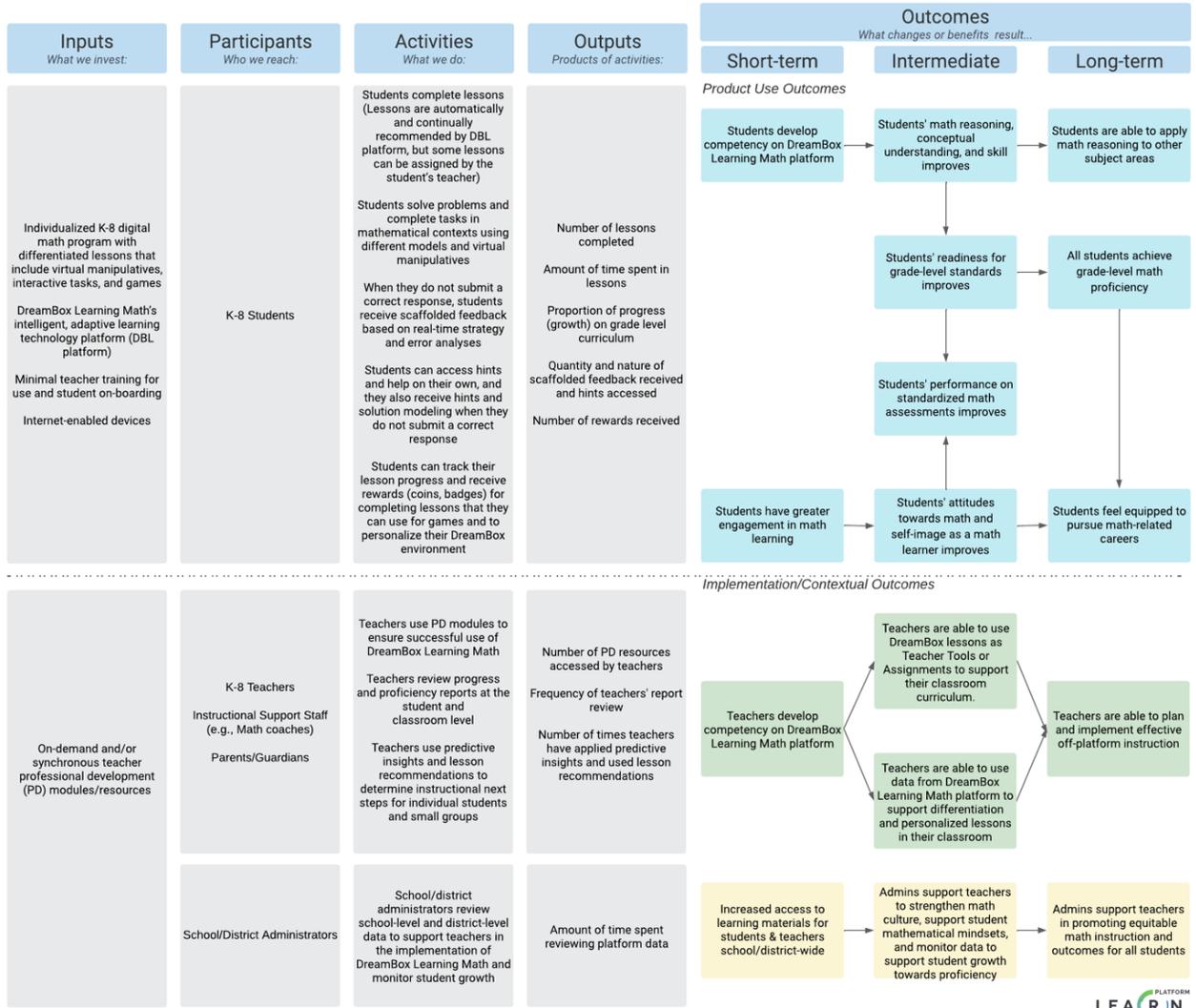
## References

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: National Academies Press.

# Appendix A. DreamBox Math Logic Model



**Problem Statement:** A significant number of students in the US do not develop the mathematical proficiency to succeed in math beyond the middle school grades. This lack of readiness is associated with negative downstream effects for students. The DreamBox Learning K-8 Math learning solution aims to solve this problem and ensure that all students are prepared for high school mathematics and STEM college and career standards.



\*Recommended dosage : students complete at least 5 lessons per week, requiring approximately 60 minutes of time for a single student, small groups of students, or an entire class.

Figure 1. DreamBox Learning Math logic model

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Prepared for DreamBox Learning, September 2022



## Appendix B. Additional Information on Study Participants

The present study included eight elementary (K-6) schools in The William Penn School District that serves large suburban locales in Pennsylvania. Table B1 documents school-level demographic data for the participating elementary schools.

Table B1. Description of participating schools

	A	B	C	D	E	F	G	H
Total students at school	217	542	306	148	304	336	343	358
Number of participating students	157	409	221	110	253	221	229	251
% Students on Free & Reduced Lunch	99	99	100	99	98	98	99	100
% English Language Learner status	0	18	1	1	1	0	0	0
% American Indian/Alaskan Native	3	1	1	3	0	1	0	3
% Asian	6	2	1	0	4	1	0	2
% Black	68	80	94	95	86	94	97	94
% Hispanic or Latino	4	6	2	0	4	2	0	1
% Two or more races	0	1	0	0	2	0	0	0
% Native Hawaiian/Pacific Islander	1	0	0	0	0	0	0	0
% White	18	10	2	3	4	2	0	2

Source: 2021-2022 data retrieved from district SIS database

## Appendix C. Additional Information on Program Implementation

Table C1. Descriptive statistics for the weekly lessons' usage categories

Usage categories: weekly lessons	<i>n</i>	Mean	SD
<3.5 weekly lessons	753	2.1	0.8
3.5–6.7 weekly lessons	860	4.9	0.9
>6.8 weekly lessons	238	8.7	1.9

Table C2. Descriptive statistics for the weekly minutes' usage categories

Usage categories: weekly minutes	<i>n</i>	Mean	SD
<55 weekly minutes	532	40	11
55–84 weekly minutes	772	70	9
>84 weekly minutes	547	100	10

## Appendix D. Additional information on Outcome Findings

### Overall Relationship Between Average Weekly Lessons and Student Math Outcomes on Savvas™ MSDA

Table D1. Math Skills on Savvas™ MSDA by Weekly Lessons on DreamBox Math (covariates: fall Savvas™ MSDA achievement, grade, race, ESL status, and IEP status)

Group Comparisons	Coefficient	Standard Error	t-value	p> t	Effect Size
<3.5 weekly lessons compared to 3.5–6.7 weekly lessons	15.80	2.44	6.47	0.000***	0.20
<3.5 weekly lessons compared to >6.8 weekly lessons	22.51	3.62	6.22	0.000***	0.29
3.5–6.7 weekly lessons compared to >6.8 weekly lessons	6.71	3.48	1.93	0.054	0.08

### Overall Relationship Between Average Weekly Minutes and Student Math Outcomes on Savvas™ MSDA

Table D2. Math Skills on Savvas™ MSDA by Weekly Minutes on DreamBox Math (covariates: fall Savvas™ MSDA achievement, grade, race, ESL status, and IEP status)

Group Comparisons	Coefficient	Standard Error	t-value	p> t	Effect Size
<54 weekly minutes compared to 55 – 84 weekly minutes	11.46	2.70	4.24	0.000***	0.15
<54 weekly minutes compared to >85 weekly minutes	14.77	2.93	5.03	0.000***	0.19
55 – 84 weekly minutes compared to >85 weekly minutes	3.31	2.67	1.24	0.216	0.04

### Relationship Between Average Weekly Lessons and Student Math Outcomes on Savvas™ MSDA by Grade

Table D3. Partial correlation coefficients and associated p-values for grade-level analyses (covariates: fall Savvas™ MSDA achievement, race, IEP status, and ELL status)

	<i>n</i>	Partial Correlation Coefficient	<i>p</i> -value
Kindergarten	258	0.13	0.040*
Grade 1	248	0.27	0.000***
Grade 2	267	0.14	0.025*
Grade 3	256	0.11	0.094
Grade 4	326	0.27	0.00***
Grade 5	225	0.09	0.164
Grade 6	271	0.19	0.002**

### Relationship Between Average Weekly Minutes and Student Math Outcomes on Savvas™ MSDA by Grade

Table D4. Partial correlation coefficients and associated *p*-values for grade-level analyses (covariates: fall Savvas™ MSDA achievement, race, IEP status, and ELL status)

	<i>n</i>	Partial Correlation Coefficient	<i>p</i> -value
Kindergarten	258	0.10	0.098
Grade 1	248	0.09	0.140
Grade 2	267	0.04	0.493
Grade 3	256	0.08	0.212
Grade 4	326	0.18	0.002**
Grade 5	225	0.12	0.087
Grade 6	271	0.18	0.003**

### Relationship Between Average Weekly Lessons and Student Math Outcomes on Savvas™ MSDA by Race, FRL, and ELL Status

Table D5. Partial correlation coefficients and associated *p*-values for analyses by grade, FRL status, and ESL status (covariates: fall Savvas™ MSDA achievement)

	<i>n</i>	Partial Correlation Coefficient	<i>p</i> -value
American Indian or Native Alaskan	28	0.34	0.099
Asian	34	0.21	0.249

Black/African American	1,626	0.16	0.000***
Hispanic	50	0.12	0.426
Multiracial	10	0.77	0.074
White	98	0.39	0.000***
FRL Status	1,831	0.18	0.000***
ESL Status	78	-0.18	0.135

### Relationship Between Average Weekly Minutes and Student Math Outcomes on Savvas™ MSDA by Race, FRL, and ELL Status

Table D6. Partial correlation coefficients and associated  $p$ -values for analyses by grade, FRL status, and ESL status (covariates: fall Savvas™ MSDA achievement)

	<i>n</i>	Partial Correlation Coefficient	<i>p</i> -value
American Indian or Native Alaskan	28	0.18	0.387
Asian	34	0.26	0.152
Black/African American	1,626	0.10	0.000***
Hispanic	50	0.03	0.821
Multiracial	10	0.33	0.519
White	98	0.29	0.004**
FRL Status	1,831	0.12	0.000***
ESL Status	78	0.04	0.745