imagine math facts®

Enhancing Student Math Performance: A Study on the Impact of Imagine Math Facts on Imagine Math Benchmark Performance

Executive Summary

This study explored the influence of utilizing Imagine Math Facts on student learning performance. By analyzing data from a broad sample encompassing districts and schools nationwide, we explored the correlation between students' engagement with the Imagine Math Facts product and their improvement on the Imagine Math Benchmark assessment. Our analysis uncovered a positive relationship between higher student engagement with Imagine Math Facts and enhanced mathematics benchmark scores. While the observed effect was relatively modest, our findings underlined the fundamental value of Imagine Math Facts in improving math outcomes; the utilization of Imagine Math Facts demonstrated potential in contributing positively to student learning performance.

INTRODUCTION

Prior research has revealed the critical role of achieving math fact fluency — addition, subtraction, multiplication, and division — in fostering subsequent mathematical proficiency (Geary, 2011). Particularly, early acquisition of math fact fluency correlates with later success in advanced mathematical domains such as algebra and geometry (Nelson et al., 2016; Steel & Funnell, 2001).

The development of math fact fluency plays an important role in releasing cognitive capacity essential for learning advanced mathematical principles. As students enhance their math fluency, they transition to a reliance on semantic memory (Baroody, 2006; Lemaire & Siegler, 1995). Furthermore, achieving math fact fluency and automaticity enables students to reallocate cognitive resources from basic computations to tackle more complex concepts (Fuchs et al., 2005; Parkhurst et al., 2010).

Imagine Math Facts is a digital education program that aims to enhance math fact fluency in addition, subtraction, multiplication, and division. Utilizing an engaging 3D video game environment, the program tailors practice to individual user needs, offering differentiated instruction, and emphasizing practice on unlearned mathematical facts. Analysis of data collected from Imagine Math Facts users indicates that students generally attain fluency within as little as 4–5 hours of engagement. Consequently, employing Imagine Math Facts empowers educators to support students of varying proficiency levels in achieving math fluency more rapidly, thereby allowing for the optimization of instructional time (Berrett & Carter, 2017).

This study aims to explore the correlation between Imagine Math Facts usage and students' mathematics learning outcomes. We assessed students' mathematics learning performance by analyzing their progress in the Imagine Math Benchmark assessments administered in fall and spring.

ANALYTICAL SAMPLE

This research encompassed the utilization patterns of students in Grades 1 to 5 who had access to both Imagine Math (IM) and Imagine Math Facts (IMF). The study included program data from August 1, 2022, to June 30, 2023 resulting in a total cohort of 72,693 students distributed across 35 states, 162 districts, and 617 schools.

Students took the Imagine Math Benchmark assessments during the fall, winter, and spring terms. These assessments are alternatively referred to as Benchmark 1 (B1), Benchmark 2 (B2), and Benchmark 3 (B3) assessments, respectively. To compute Imagine Math Benchmark performance growth, we determined the change between Benchmark 1 and Benchmark 3 assessments (that is, B3 – B1). Descriptive statistics for key variables are summarized in Table 1 below.

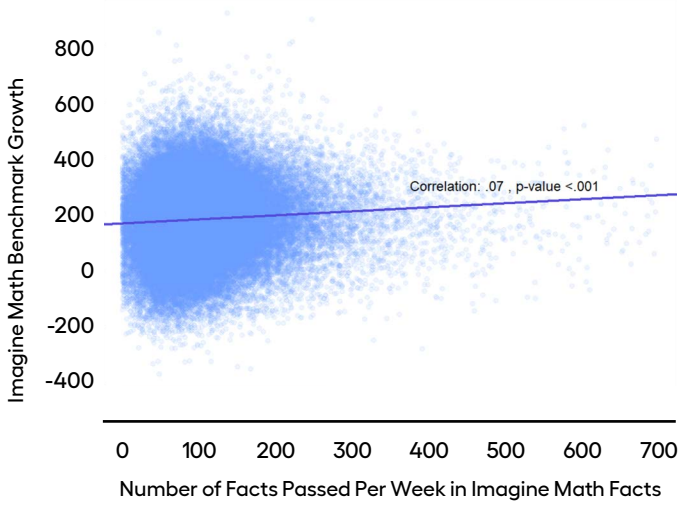
Table 1: Descriptive Statistics of the Analytical Sample

	IM Benchmark Growth (B3 - B1)	IMF Facts Passed	IMF Facts Passed Per Week	IM Lessons Passed	IM Lessons Passed Per Week	IM Benchmark 1 Score
Min	-369	0	0	0	0	-974
Q1	98	233	62.05	4	.2	75
Median	186	569	92.38	11	.46	245
Mean	183	747	104.2	21.69	.76	237
Q3	270	1122	130.4	27	.97	384
Max	918	2499	698.5	481	15.37	1339

CORRELATION ANALYSIS OF FACTS PASSED AND IMAGINE MATH BENCHMARK GROWTH

The relationship between the number of facts passed in Imagine Math Facts per week and Imagine Math Benchmark growth is presented in Figure 1. Each data point represents an individual student, with the x-axis denoting the weekly facts passed on Imagine Math Facts and the y-axis representing the Math Benchmark growth.

Figure 1. Imagine Math Benchmark Growth vs. Number of Facts Passed Per Week in Imagine Math Facts



The correlation coefficient, computed at .07, suggests a small, positive linear relationship between the two variables. This association was found to be statistically significant with a *p*-value of <.001 indicating that the observed correlation is unlikely to be due to random chance alone. This finding implies a tendency for growth to increase with more facts passed per week. Ultimately, despite the small effect, this finding suggests that regular product usage could contribute to growth improvements.

REGRESSION ANALYSIS OF FACTS PASSED AND IMAGINE MATH BENCHMARK GROWTH

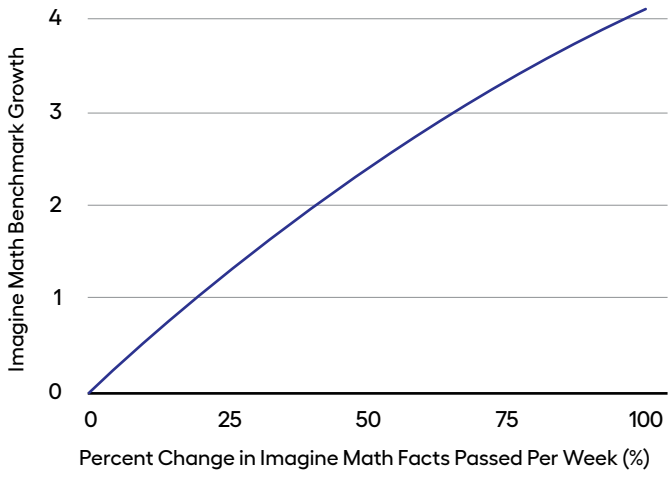
A linear regression model was employed to investigate the association between Imagine Math Benchmark growth and the number of facts passed per week in Imagine Math Facts, while considering additional variables that may potentially influence the outcomes. Specifically, the model controlled for the influence of student grade level and school affiliation, which may introduce variability in growth outcomes. These variables were treated as categorical variables. Furthermore, the student's first Imagine Math Benchmark assessment score, which was completed prior to product utilization, was included as a control variable to mitigate potential biases stemming from pre-existing ability in mathematics.

To address the skewness inherent in the data, a log-transformation was applied to the key independent variables, i.e., facts passed per week. By incorporating these covariates into the analysis, the model aimed to isolate the unique contribution of Imagine Math Facts passed per week to Imagine Math Benchmark growth while accounting for the influence of other relevant factors.

Table 2: Association Between Imagine Math Benchmark Growth and Facts Passed Per Week in Imagine Math Facts

Dependent Variable: Imagine Math Benchmark Growth (B3 – B1)	Estimate	Std. Error	t value	*p*-value
(Intercept)	51.49	21.20	2.43	.015
log(Facts Passed Per Week)	5.96	.57	10.47	<.001
log(Lessons Passed Per Week)	183.70	1.28	143.72	<.001
Benchmark 1 Quantile Measure	-.33	0	-151.18	<.001
Grade 2 Indicator	90.25	1.30	69.40	<.001
Grade 3 Indicator	-44.49	1.33	-33.52	<.001
Grade 4 Indicator	-17.60	1.40	-12.56	<.001
Grade 5 Indicator	.96	1.60	.60	.55

Figure 2. Association Between Percent Change in Imagine Math Facts Passed Per Week and Imagine Math Benchmark Growth



The results of the regression analysis revealed several important insights regarding the factors influencing the Imagine Math Benchmark growth. The coefficient of log-transformed facts passed per week in Imagine Math Facts indicates a positive relationship with growth, with a value of 5.96, suggesting that, holding other variables constant, a 10% increase in facts passed per week in Imagine Math Facts was associated with about .6 increase in Imagine Math Benchmark growth.

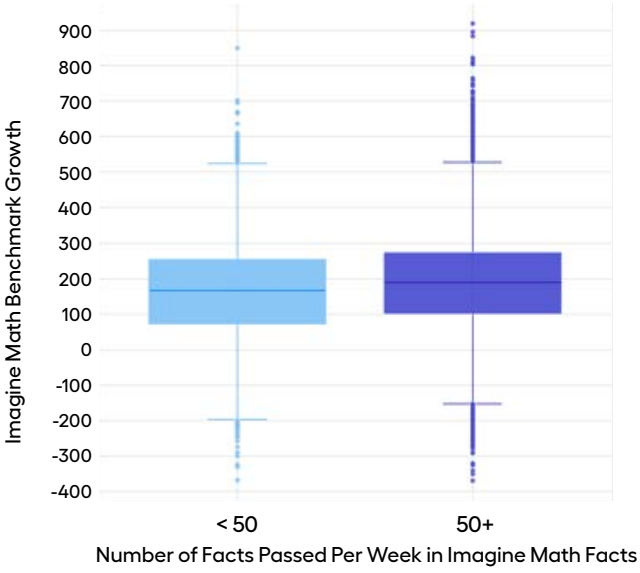
The chart in Figure 2 illustrates the relationship between the percent change in the number of facts passed per week in Imagine Math Facts and Imagine Math Benchmark growth while holding other variables constant. The observed results show that as students pass more facts in Imagine Math Facts, they subsequently achieve increased growth on the Imagine Math Benchmark assessment.

THE IMPACT OF NUMBER OF FACTS PASSED PER WEEK: A COMPARISON ACROSS STUDENT GRADE LEVELS

As the recommended usage for Imagine Math Facts is 10–15 minutes per session, 4–5 times per week (Imagine Learning Help Center, 2023), and the time taken to complete a fact ranges from a few seconds to a few minutes, we utilized this data to establish program usage segmentation thresholds. For the purposes of this study, we selected 50 Imagine Math Facts passed per week as an approximate midpoint of the range of recommended program usage to distinguish higher and lower program users. Students who passed 50 or more facts in Imagine Math Facts per week were considered to have used the program at or above recommended levels. Students who passed fewer than 50 facts in Imagine Math Facts per week were considered to have used the program below recommended levels.

The box plot in Figure 3 illustrates the relationship between student's facts passed per week levels and their corresponding Imagine Math Benchmark growth outcomes, categorized into two groups: those with below 50 facts passed per week and those with above 50 facts passed per week. Each box in the plot represents the distribution of growth within each usage group. The comparison between the two groups revealed a notable difference in growth outcomes; students with 50 facts passed per week or more tend to exhibit higher Imagine Math Benchmark growth compared to those with below 50 facts passed per week. The Pearson's correlation analysis performed on Imagine Math Benchmark growth and a binary indicator denoting whether the student had achieved at least 50 facts passed per week on Imagine Math Facts yielded a correlation coefficient of .07, with a *p*-value of <.001. This finding suggests that increased facts passed per week beyond the 50 threshold is associated with enhanced Imagine Math Benchmark growth.

Figure 3. Imagine Math Benchmark Growth vs. Number of Facts Passed Per Week in Imagine Math Facts



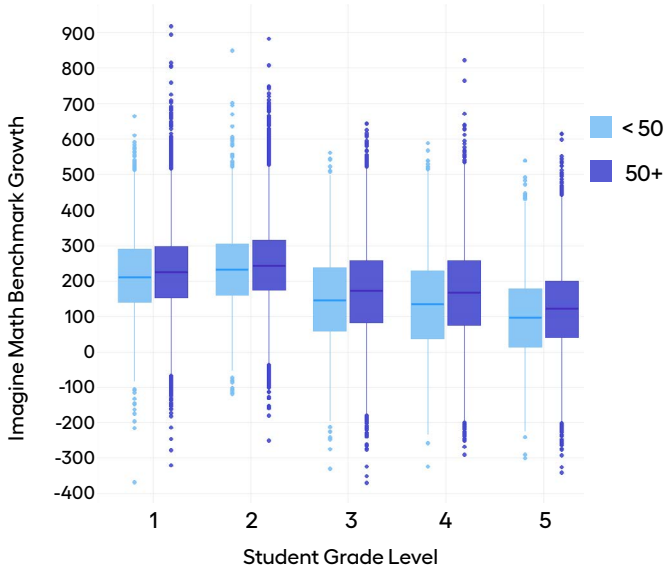
Box plots, also known as box-and-whisker plots, visually represent the distribution of data. Within each box, thick horizontal black lines denote median values.

Note: The boxes extend from the 25th to the 75th percentile of each group's distribution of values. The vertical extending lines denote adjacent values (below the 25th percentile and above the 75th percentile). Dots indicate any outliers.

The additional box plot in Figure 4 extends the analysis by comparing growth outcomes across different student grades within the two usage level categories: students with less than 50 facts passed per week and students with 50 facts passed per week or more. Similarly to the previous comparison, this plot illustrates that within each student grade group, individuals with more Imagine Math Facts usage (i.e., having 50 facts passed per week or

more) consistently demonstrate higher growth levels compared to those with lower usage. This consistent pattern across different grade level groups reinforces the earlier finding and suggests that the positive association between higher Imagine Math Facts passed per week and increased Imagine Math Benchmark growth is robust across grades.

Figure 4. Imagine Math Benchmark Growth vs. Number of Facts Passed Per Week in Imagine Math Facts: by Grade



LIMITATIONS

Given the lack of inclusion of specific predictor variables such as demographic data, the model's capacity to account for potential influences on performance beyond product usage is limited.

CONCLUSION

This research offers important insights into the influence of using Imagine Math Facts on students' mathematics proficiency, particularly regarding improvements in Imagine Math Benchmark assessment performance. The results indicate that increased engagement with Imagine Math Facts correlates with enhanced math learning performance. Although the observed effects were modest, these findings show the value of utilizing Imagine Math Facts in contributing positive impact on student mathematics learning.

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