RESEARCH BRIEF

Boosting Math Mastery with Frax: The Impact of Frax on 3rd and 4th Graders' Performance on Summative Math Tests

STUDY AT A GLANCE

Study Sample:

- 325 3rd and 4th grade students
- Moderate-sized, suburban public school district in California
- 83% non-white, 51% Hispanic, 18% ELL, 53% economically disadvantaged
- All students scored one grade level below math standards in Fall 2023

Research Methodology:

- 2022-2024 school years
- iReady math assessments completed at the beginning and end of year
- Smarter Balanced Summative Math end-of-year assessment
- Comparison of math growth for students who completed Frax Sector 1 prior to end-of-year testing (n = 107) compared to students with no Frax usage (n = 218)

Main Findings:

- After using Frax, more students met or exceeded Smarter Balanced Summative Math proficiency standards compared to non-Frax users.
- Students who used Frax were more likely to meet iReady growth targets than non-users.
- Students who used Frax had higher math scale score growth in 23-24 compared to 22-23, while non-users had lower score growth.

Introduction

Proficiency with fractions is a critical foundational skill that correlates strongly with success in standardized mathematics tests and future academic achievement, including success in algebra and other advanced math coursework. However, many students struggle with fractions, and poor performance in this area persists well into high school, making early interventions crucial for improving long-term academic outcomes. Studies have found that students with mathematical difficulties, in particular, face persistent challenges with fractions, highlighting the need for targeted instruction and support to help close the achievement gap and promote overall math success.

ExploreLearning's Frax is a standards-aligned program designed to support early fractions learning in the classroom. Frax Sector I, broadly aligned to grade 3 fractions standards, is a game-based and zero-entry program, making it both accessible and engaging to all learners. The program is short and flexible enough to integrate with any existing math curriculum.

The current study explored whether Frax Sector I can be used as an intervention to achieve proficiency in mathematics standards for 3rd and 4th-grade students who need additional supports. In the current study, we focused on students who scored "1-grade level below" on a fall diagnostic math test, which means their performance aligned with the expected skills for the grade level directly below their current grade. While these students are generally ready for grade-level instruction, they often need additional support to achieve higher-than-typical growth and meet grade-level standards. In the current report, we compared year-over-year math growth for students who completed Frax Sector I to a similar performing group of students with no Frax usage. Statistical analyses compared student growth pre-implementation to post-implementation and correlated product usage with student math growth.

Methods

The current study evaluated differences in student math performance from Fall 2022 to Spring 2024. Math achievement data was based on iReady Diagnostic math benchmark assessments administered at the beginning and the end of the academic year, as well as Smarter Balanced Math Summative Assessments administered at the end of the year to students in 3rd grade and above. Math proficiency on the Smarter Balanced Summative Assessment was defined as achieving Level 3 or 4 (met or exceeded standards, respectively).

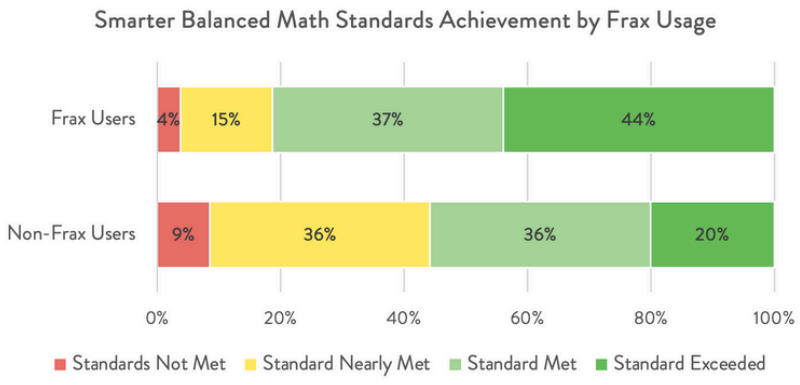
The iReady Diagnostic math tests provide an assessment of proficiency (math scale scores and relative grade level placements), as well as growth targets to help teachers put each student on a path toward grade-level proficiency. Typical growth is what most students at their level are expected to achieve, while stretch growth is a higher goal for students to strive for to make significant progress. The recommendation for typical growth goal achievement is for groups of students to exceed 100% median progress. Stretch growth goals are the annual growth needed for students to advance their proficiency levels. The recommendation for stretch goals is for as many students as possible to reach 100% of their stretch growth target.

All students in the district had access to Frax, and some teachers chose to implement it with their students. Frax Sector 1 consists of 27 Missions, each of which take, on average, 30 minutes to complete. Here, we compare 3rd and 4th-grade students with no Frax usage (n = 218) to students who completed Frax Sector 1 prior to end-of-year testing (n = 107).

Results

Students who completed Frax were more likely to meet grade-level standards on the Smarter Balanced Summative Assessment

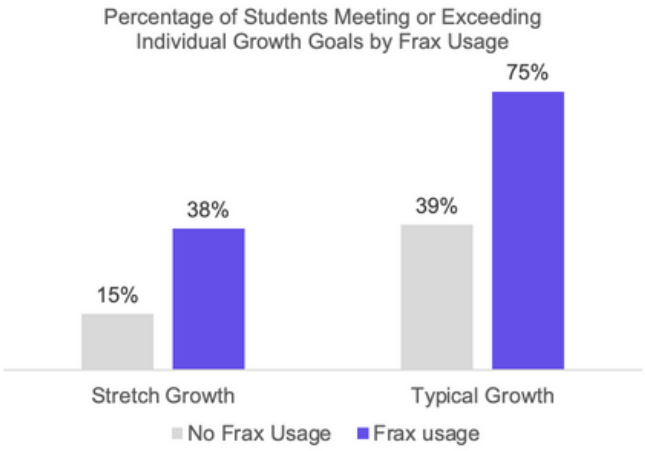
Frax supported more students in achieving grade-level proficiency standards on the Smarter Balanced Summative Assessment[1]. 81% of 3rd and 4th graders who used Frax met (37%) or exceeded (44%) math proficiency standards, despite starting the year scoring 1 grade level below. In contrast, only 56% of similar students who did not use Frax met or exceeded standards.

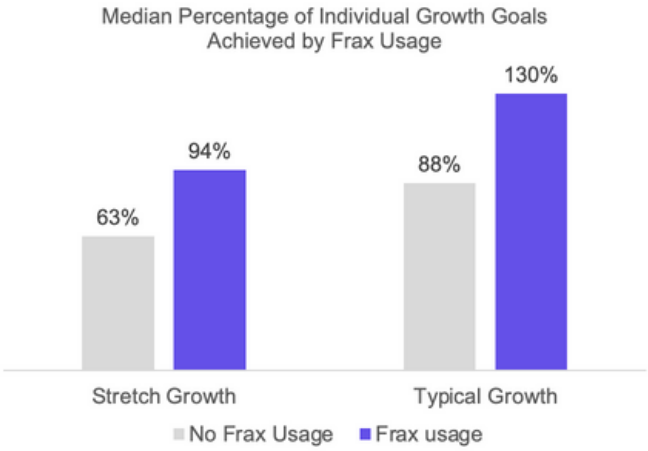


Results (continued)

Students who used Frax were 2.5x more likely to meet ambitious growth goals compared to students with no Frax usage

Frax supported more 3rd and 4th-grade students in achieving high levels of growth in math performance. The graphs below show (1) the percentage of students who met growth goals and (2) the median percentage of typical growth scores achieved by students. Frax users were significantly more likely than non-users to fully meet both typical and stretch goals[2]. Students who used Frax were 1.9x more likely to meet typical growth goals and 2.5x more likely to reach stretch goals compared to non-users, a critical benchmark for propelling students towards proficiency. Additionally, students who used Frax exceeded the i-Ready progress goal for typical growth of 100% group median progress. They also significantly exceeded students without Frax usage in the median amount of stretch growth achieved[3].





After using Frax, students were more like to show accelerated math growth compared to their prior year performance

To look for additional evidence of a causal relationship between Frax usage and student growth, we looked at growth experienced by these students in the prior year (see Table 1 on next page). Both groups of students were similar in their pace of growth before Frax. For instance, Frax users in year 1 (prior to Frax) achieved, on average, 98% typical growth, and non-Frax users in year 1 achieved, on average, 101% of their typical growth. However, in Year 2, the groups showed large differences (tested in the prior analysis). This was also a significant difference compared to their own prior year performance. Using paired samples t-tests, students with no Frax usage showed lower rates of both typical and stretch goals in 23-24 compared to the prior year, while students who used Frax showed higher rates of both typical and stretch goals in 23-24 compared to the prior year.

	22-23 performance		23-24 performance		Year-over-Year Change	
	Typical Growth (Mean %)	Stretch Growth (Mean %)	Typical Growth (Mean %)	Stretch Growth (Mean %)	Typical Growth (Mean Difference)	Stretch Growth (Mean Difference)
Frax Users	98%	69%	124%	89%	+26.0% points	+19.4% points
Non-Frax Users	101%	70%	90%	65%	-10.5% points	-5.4% points

TABLE 1: All students had similar achievement of typical and stretch growth in 22-23 (proir to adoption of Frax. However, in year 2, students with high usage improved in their rate of growth (both typical and stretch growth), while students with NO Frax usage showed a slower rate of growth (both typical and stretch growth).

Conclusions

The current study demonstrated the ability of Frax to support the math learning needs for a group of 3rd and 4th graders who are at a higher risk for failing to meet grade-level proficiency standards. All of the students analyzed in the study began their school year 1 grade level below their peers in math proficiency on a standardized math benchmark test, a signal to their teachers that they may need additional supports and will need to reach more challenging growth targets in order to achieve grade-level proficiency by the end of the school year.

When we compared students who used Frax with fidelity to those with no Frax usage over the 23-24 school year, we observed rapid and significant growth in math performance. We found that students who used Frax were much more successful at reaching those targets and achieving grade-level proficiency. Students who used Frax were significantly more likely to end the year meeting or exceeding grade-level proficiency standards in math on their state Smarter Balanced Summative assessment compared to similar students with no Frax usage. We also found that students who used Frax were significantly more likely to meet or surpass both expected (typical) AND ambitious (stretch) growth goals compared to similar students with no Frax usage. When we looked at score growth from the previous year, we see that only Frax users showed larger growth in the current school year after using Frax compared to their performance the previous year, providing strong evidence that the usage of Frax was the driver behind their ability to grow and succeed in math.

Together with other recent Frax outcomes studies, this evidence suggests that Frax is a powerful tool for supporting the growth of students below grade-level proficiency, helping all students meet growth targets and preparing them to tackle more advanced math instruction in later grades.

Statistical Analyses and Technical Notes

[1]A 2x2 chi-square was conducted to analyze the rates of meeting grade-level proficiency standards on the Smarter Balanced Summative Math Assessment for students with high Frax usage compared to typical instruction (no Frax usage). By the end of the spring, 81% of the students who used Frax met or exceeded math standards compared to 56% of typical instruction students with no Frax usage. The chi-square was significant, $X^2(2, N = 306) = 19.86, p < .001$.

[2]2x2 chi-squares were conducted to analyze the numbers of students reaching 100%+ of their typical and stretch growth goals within each usage group (Frax usage vs no Frax usage). Students who used Frax were significantly more likely to reach their typical growth goals (75%) compared to students with no Frax usage (39%), χ^2 (1, N = 289) = 26.58, $p < .001$. Similarly, students who used Frax were significantly more likely to reach their stretch growth goals (38%) compared to students with no Frax usage (15%), χ^2 (1, N = 289) = 17.06, $p < .001$.

[3]Independent samples t-tests were conducted looking at the difference in average amounts of stretch and typical growth achieved by Frax users and non-users. Students who used Frax achieved significantly higher mean percentages of their typical growth goals (M = 124.04, SD = 49.02) compared to non-users (M = 90.12, SD = 45.22), $t(287) = 5.38$, $p < .001$. Similarly, students who used Frax achieved significantly higher mean percentages of their stretch growth goals (M = 88.87, SD = 35.76) compared to non-users (M = 64.81, SD = 32.82), $t(287) = 5.25$, $p < .001$.

[4]Paired samples t-tests were conducted to look at mean percentage of stretch and typical growth achieved in 22-23 (before Frax) compared to 23-24 (after Frax) for both Frax users and non-users. Students who used Frax achieved significantly higher mean percentages of their typical growth goals in 23-24 (M = 124.04, SD = 49.02) compared to 22-23 (M = 98.03, SD = 53.36), $t(70) = 2.94$, $p = .004$. They also achieved significantly higher mean percentages of their stretch growth goals in in 23-24 (M = 88.87, SD = 35.76) compared to 22-23 (M = 69.48, SD = 35.48), $t(70) = 3.21$, p = .002. on the other hand, students with no Frax usage did NOT show the same pattern of improvement over time. Students with no Frax usage achieved significantly lower mean percentages of their typical growth goals in 23-24 (M = 90.12, SD = 45.22) compared to 22-23 (M = 100.62, SD = 50.55), $t(217) = 2.24$, $p = .026$. They also achieved slightly lower mean percentages of their stretch growth goals in in 23-24 (M = 64.81, SD = 32.82) compared to 22-23 (M = 70.20, SD = 34.58), $t(217) = 1.68$, $p = .094$.