

# Frax Improves Math Proficiency for Struggling Students in 3rd and 4th Grade

## STUDY AT A GLANCE

### Study Sample:

- Large suburban US school district
- 2021-2023 school years
- 462 3rd grade students
- District Student Racial Diversity:  
43% Hispanic/Latino, 13%  
Black/African American, 36% White,  
78% Economically disadvantaged

### Research Methodology:

- Retrospective analysis was conducted with students who scored two grade levels below their peers on a 3rd-grade baseline (BOY) math assessment
- Students either (1) had no Frax usage, (2) high Frax usage in 3rd grade, or (3) high Frax usage in 4th grade
- Outcome measure was each student's percentile ranks on their End of Course (EOC) math assessment

### Main Findings:

- Students who used Frax in either 3rd or 4th grade showed large and sustained math achievement improvement compared to peers who did not use Frax
- At-risk students who used Frax were 2x more likely to achieve on-grade level status on 4th grade EOC tests

## Introduction

Previous studies have found that compared to higher-achieving students, students with mathematical difficulties struggle persistently with fractions (Jordan et al, 2017; Siegler and Pyke, 2013) and need more explicit fractions instruction support to close this gap (Ladegaard Pedersen, et al., 2023).

The current study explored whether Frax: Sector I can be used as an intervention to support proficiency in grade-level mathematics standards for students who are identified as “struggling learners” by 3rd-grade benchmark testing.

## Methods

The district partnered with ExploreLearning to evaluate differences in student performance from Fall 2021 to Spring 2023 based on program use for the general student population and for students who were initially labeled as academically at-risk. Math achievement data was based on their scores on diagnostic math benchmark assessments that were administered at the beginning of the academic year (BOY) and at the end of the year (EOC). In the current study, we defined struggling learners as students who scored “2 or more grade levels below” their peers on their 3rd-grade BOY diagnostic math assessment.

Frax Sector I is designed as a zero-entry program so that students with no previous knowledge of fractions can begin using the program immediately. It consists of 27 consecutive 30-minute Missions that take, on average, 13 hours to complete. Student progress was analyzed within three groups based on their usage of Frax: (1) no/low usage group (completed less than 5 missions), (2) high Frax usage in 3rd grade (20 or more missions completed), and (3) high Frax usage in 4th grade (20 or more missions completed).<sup>1</sup>

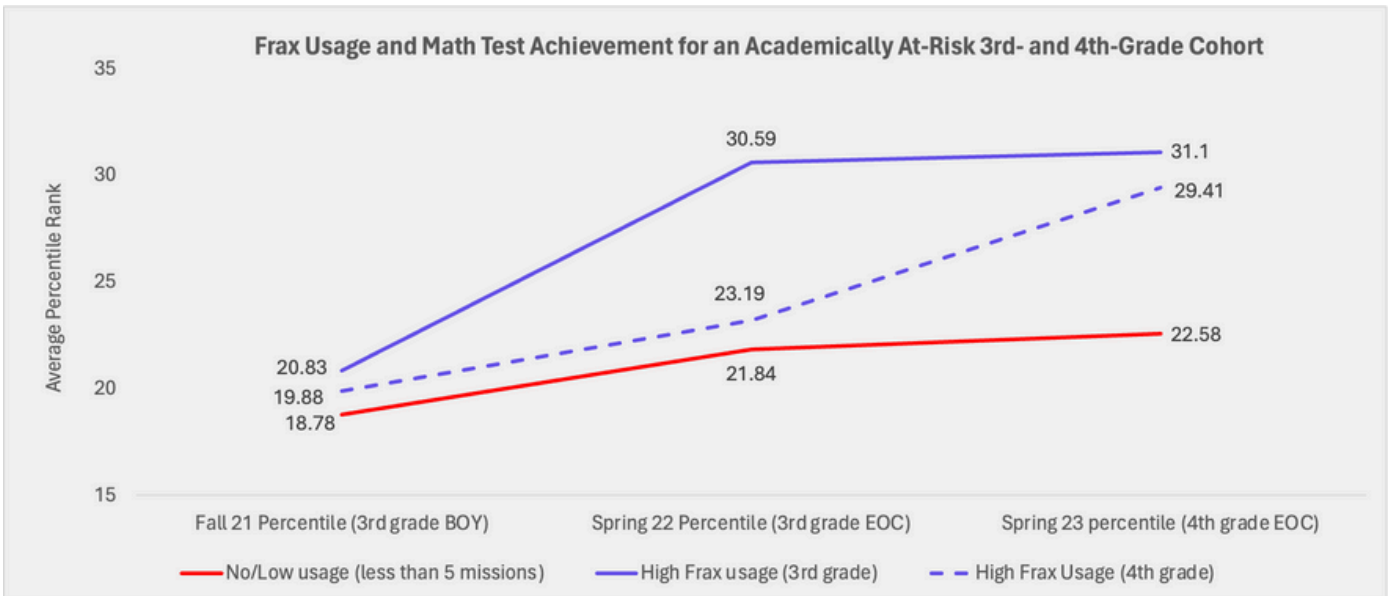
## Results

All students scored 2 or more grade levels below their peers on the BOY 3rd grade assessment (range 9th - 29th percentile, median = 19th percentile). Students who had high Frax usage in 3rd grade improved on average by 10 percentile points, compared to average growth of 3 percentile points in the no-usage groups<sup>2</sup>. These students were also significantly more likely to move towards grade-level proficiency;

**learners who struggled in math and used Frax were 3x more likely to approach on-grade level proficiency by the end of 3rd grade (31%) compared to similar non-Frax users (10%)<sup>3</sup>.**

In Year 2, a new group of students started Frax. These students showed an average growth of 6 percentile points from Spring 22 to the Spring 23 EOC math assessment, compared to less than 1 percentile point change in the no Frax group<sup>4</sup>. By the end of the 2 year assessment period, both groups of Frax users achieved similar scores<sup>5</sup> and significantly outperformed non Frax users<sup>6</sup>. Additionally, **learners who struggled in math and used Frax were 2x more likely to reach on-grade level proficiency by the end of 4th grade (30%) compared to similar non-Frax users (15%)<sup>7</sup>.**

Demographics	No Frax Usage (<5 lessons)	Frax Usage in 3rd grade (>20 lessons)	Frax Usage in 4th grade (>20 lessons)
<b>Sample Size</b>	349	81	32
<b>Female</b>	55%	47%	53%
<b>Black</b>	22%	16%	25%
<b>Hispanic</b>	48%	49%	53%
<b>White</b>	25%	28%	22%
<b>English Learner</b>	25%	25%	41%
<b>504 Eligible</b>	15%	19%	3%



## Statistical Analyses and Technical Notes

<sup>1</sup> Preliminary 2x2 chi-square tests were conducted to see if there were differences in proportions of all demographics (female, black, Hispanic, white, ELL, and 504 Eligible students) between Frax usage students and non-Frax usage students. All tests were not significant (all  $p$ 's > .22).

<sup>2</sup> An independent samples t-test was conducted looking at the difference in individual growth in percentile rank from BOY '21 to EOC '22 testing for the Frax users ( $n = 81$ ) compared to non-Frax users ( $n = 375$ ). Students in the high Frax usage group experienced significantly larger fall-spring math growth ( $M = 9.77$ ,  $SD = 14.89$ ) than the non-Frax usage group ( $M = 3.14$ ,  $SD = 12.92$ ),  $t(454) = 4.56$ ,  $p < .001$ , Cohen's  $d = .48$ .

<sup>3</sup> A 2x2 chi-square was conducted to analyze the rates of students approaching grade-level proficiency on EOC '22 testing (early-on grade level or above/1 grade level below or lower) within each usage group (Frax Usage Year 1/no Frax usage Year 1). Students in the high Frax usage group were significantly more likely to approach grade-level proficiency than students with no usage,  $\chi^2(1, N = 462) = 25.72$ ,  $p < .001$ .

<sup>4</sup> A one-sided independent samples t-test was conducted looking at the difference in individual growth in percentile rank from EOC '22 to EOC '23 testing for the Year 2 Frax users ( $n = 32$ ) compared to non-Frax users ( $n = 343$ ). Students in the high Frax usage group experienced significantly larger fall-spring math growth ( $M = 6.22$ ,  $SD = 18.10$ ) than the non-Frax usage group ( $M = .71$ ,  $SD = 17.39$ ),  $t(373) = 1.71$ ,  $p = .044$ , Cohen's  $d = .31$ .

<sup>5</sup> An independent samples t-test was conducted to see if EOC 23 percentile rank differed between the two Frax usage groups (Year 1 vs Year 2). The difference was not significant ( $p = .69$ ).

<sup>6</sup> An independent samples t-test was conducted looking at the difference in EOC '23 percentile rank scores for all Frax users ( $n = 113$ ) compared to non-Frax users ( $n = 349$ ). Students in the high Frax usage group achieved significantly higher math percentile ranks ( $M = 30.62$ ,  $SD = 20.16$ ) than the non-Frax usage group ( $M = 22.58$ ,  $SD = 18.47$ ),  $t(460) = 3.93$ ,  $p < .001$ , Cohen's  $d = .42$ .

<sup>7</sup> A 2x2 chi-square was conducted to analyze the rates of students meeting grade-level proficiency (on-grade level or above/below satisfactory or lower) within each usage group (Frax Usage Year 1 or 2/no Frax usage both years). Students in the high Frax usage group were significantly more likely to meet grade-level proficiency than those without usage,  $\chi^2(1, N = 462) = 12.40$ ,  $p < .001$ .