RESEARCH BRIEF

The Transformative Impact of Frax for Fractions Proficiency

A Study of 3rd and 4th-Graders' Performance on a State Standards Test

STUDY AT A GLANCE

Study Sample:

- K-6 public charter school in the Western United States
- Large, suburban locale
- Student Diversity: ~70% white, 15% Hispanic, 20% economically disadvantaged

Research Methodology:

- 2-year longitudinal study of 124 3rd and 4th-grade students
- Year 1 included survey and interview data from the teacher who implemented Frax
- Outcome metrics = fall and spring iReady math scores; state assessment fractions score

Main Findings:

- In Year 1, over 80% of students began below grade-level in math proficiency.
- After using Frax for an average of 16 hours, ALL students met or exceeded 3rd-grade fractions proficiency standards, outperforming non-Frax users.
- Qualitative teacher feedback noted increased student enjoyment, engagement, self-confidence, and interest in math after using Frax.
- Year 2 data found improved performance on 4th-grade fractions standards, showing long-term benefits of Frax.
- A new cohort of 3rd graders in Year 2 had similar improvements, reinforcing Frax's impact on fractions mastery.

Introduction

Proficiency with fractions is an important foundational skill. Unfortunately, many students struggle with learning fractions, and teachers consistently report poor student performance of fractions well into high school. Understanding fractions has been shown to be a predictor of long-term success in algebra and overall mathematics, making interventions to support early fractions proficiency crucial.

ExploreLearning Frax is a standards-aligned program designed to support early fractions learning for students. Frax is a game-based and zero-entry program, accessible and engaging to early learners. Frax was first released in early spring 2021. In fall 2022, a cohort of teachers representing a diverse group of students were invited to participate in a year-long user testing program. They used Frax with their students and provided product feedback via surveys (October, March) and interviews (January, May).

One of those teachers, Jessica*, was a 3rd-grade teacher at a public charter school in the United States. After using Frax with her students, her school was so impressed with the improvements in fractions knowledge that they decided to implement Frax as a pilot with all their 3rd-grade students and assess the outcomes the following year. Below is a spotlight on the charter school's data, usage, and growth, and insights from Jessica on the power of Frax for supporting students.

*Name changed for this report

School Details

The school involved in this research was a K-6 public, charter school in the Western United States. The school is located in a large suburb, with student demographics that reflect the district as a whole (70% white, 15% Hispanic, 20% FRPL). The charter school is a top-ranking school within its area, outperforming most schools in the county for state test scores in both proficiency and growth. Their 3rd and 4th-grade students were split into three classes: a class of advanced students and two classes of typical level instruction. In the analyses in this report, we focused on comparisons across the typical level classrooms.

Year 1: Pre-Implementation Insights

In Year 1, we worked with 3rd-grade teacher Jessica as she used Frax with her students for the first time. Jessica has specialized experience in both elementary math education and special education, with endorsements in math, ESL, and Gifted and Talented. She has 10 years of experience teaching, including teaching special populations such as language intervention, resource teaching, and students with autism.

Jessica's students represented a diverse range of academic preparedness, with over 80% of her class demonstrating below grade-level math proficiency expectations at the beginning of the year and close to 30% of her students qualifying for special education support.

In discussing the particular challenges of teaching fractions to her students, Jessica mentioned the following:

HIGH LEVELS OF STUDENT CHALLENGES.

Jessica's class comprised students on grade level or below, with a high percentage of students with IEPs and/or existing struggles in mathematics. Advanced students were in another class, making her class a particularly high-risk group of students for academic struggles. Jessica also noted that this cohort had experienced significant COVID-related learning disruptions. The 3rd-grade cohort in fall 2022 was seen by many teachers as coming into class lacking the necessary skills for classroom success, including basic math knowledge, on-grade reading levels, appropriate social behavior, attention spans, and engagement.

LOW BASELINE KNOWLEDGE OF FRACTIONS.

Most of the students came into Jessica's classroom with little to no fractions knowledge. Aside from some understanding of area models, she did not feel that her students were coming in with any significant knowledge of fractions. Jessica said:

> *"I always start the year [by] asking the kids to write down everything they know about fractions. And this group sat there and said, 'What if I don't know anything about fractions?'"*

CHALLENGES IN FRACTIONS LEARNING.

Jessica planned to use Frax at the same time as in-class fractions instruction to improve engagement and understanding. Specific learning goals included understanding fractions on a number line and fraction equivalence. In discussing her goals, she said:

> *"Part of a whole and part of a set is usually pretty easy for 3rd graders to understand, but on a number line...[and] equivalence is so hard."*

Jessica hoped that using Frax would make the toughest part of fractions learning go more smoothly, leaving them better prepared for meeting 4th-grade standards the following year.

Year 1: Post-Implementation Insights

In the spring, Jessica rated the degree of change she observed in her students in a variety of areas as a result of using Frax in the classroom. The largest changes she observed were increased enjoyment in math, deepening math interest, and increased math test scores.

INCREASED STUDENT ENJOYMENT AND ENGAGEMENT

Increased enjoyment in math was the largest area of change observed by Jessica. She largely felt that her students, who are "digital natives," were succeeding with Frax because they were enjoying it. She cited the gamification, rewards, and room personalization as particularly engaging aspects of the program. Even during the first interview, just a short time into using the program, Jessica noted an increase in confidence and pride in students because of the knowledge gained from Frax.

> *"They're excited about [Frax]; they love it…Whenever I ask anything about fractions, their hands are the first ones up…and they're so proud to tell me they learned it on Frax."*

IMPROVED CLASSROOM CLIMATE

Enjoyment led to higher levels of learning and higher levels of engagement and confidence in class. Classroom conversations were more productive, teaching was more efficient, and student participation was higher due to Frax.

> *"They were understanding it way faster than ever before… I teach grade level, and I was able to get through fractions faster than the other grade level group, just about as fast as the advanced class."*

After just a few weeks of usage, Jessica found this translated into observed increases in students' performance on mathematics assessments.

> *"My students have understood fractions better than any previous class. We took our mid-unit test today. Only two students scored below 70%. Most of my students scored above 80%."*

INCREASED STUDENT KNOWLEDGE AND TEST SCORES

By the end of the school year, Jessica observed large gains on state standardized assessments compared to previous years and compared to her peers.

> *"For our state testing…I had more level fours [above grade level] than I have ever seen in a grade-level class before. And on the fractions area of the state testing…compared to the other grade level class, my class did a lot better. Even my students who scored overall below grade level on the end-of-year testing scored on grade level in fractions…My students are better prepared for 4th grade than ever before."*

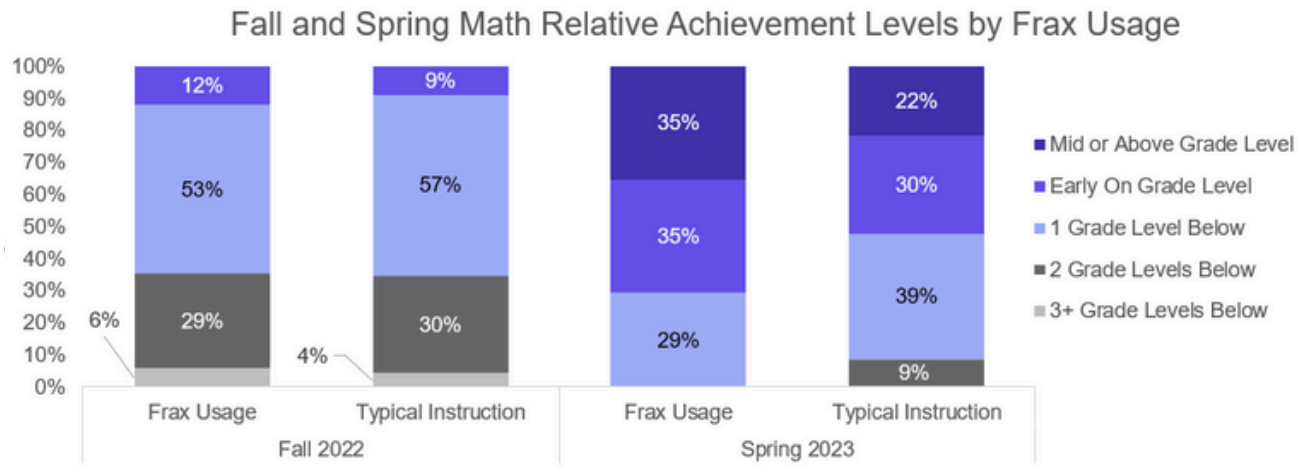
Year 1 Data Insights

The charter school utilized iReady Diagnostic testing in math as a way to assess student progress. Students completed both a fall and a spring assessment, with growth between the assessments compared to benchmark goals. An overall math scale score is used to classify students into criterion-referenced grade-level placements: mid grade-level or above, early-on grade level, 1 grade level below, 2 grade levels below, or 3+ grade levels below. Additionally, iReady generates two measures for every student that can be used to help teachers understand how a student is progressing and what support they may need.

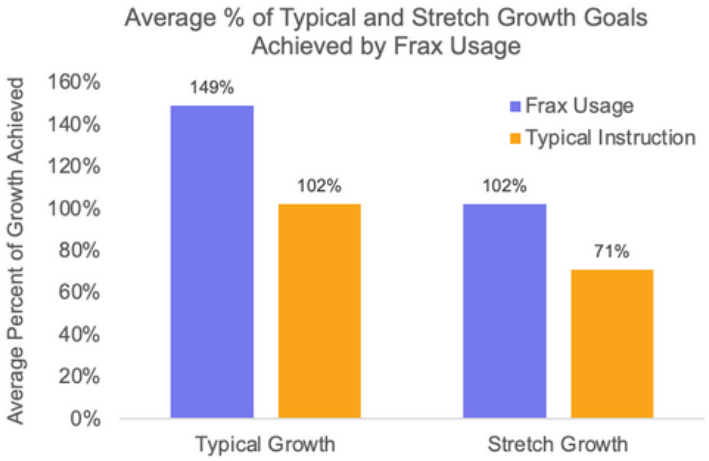
Typical growth is the average annual score increase that students at a similar grade and baseline placement level are expected to make. The more ambitious stretch growth is designed to be achievable but challenging; this number is the amount of growth needed for a student at that baseline score to advance their proficiency levels, with students who are further behind having larger growth targets. In the analyses below, we examined each student's percentage of their typical and stretch growth targets achieved. Students' math proficiency was also assessed using the state achievement assessment results. In 3rd and 4th grade, students receive a score for fractions of Below Proficiency, Approaching Proficient, Proficient, or Highly Proficient.

Between fall iReady testing and spring iReady testing dates, Jessica had 17 students that reached the criteria for fidelity usage of Frax (20+ missions in Sector 1) and who had completed testing data for both fall and spring testing windows. In all of the following analyses, we use data only from these 17 students to represent the impact of Frax usage compared to no Frax usage.

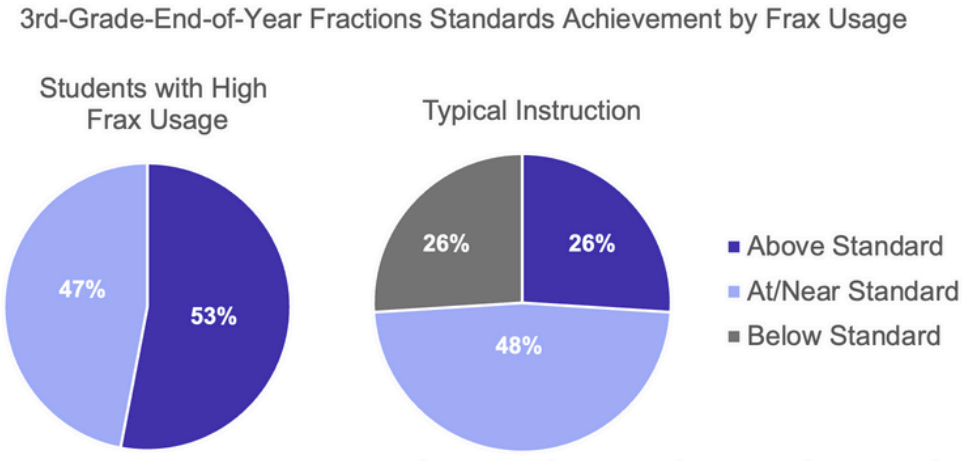
On the fall iReady math assessment, 88% of Jessica's students scored below grade-level proficiency standards. This achievement level was similar to the other typical instruction classroom in the grade, as shown in the graph below. After using Frax, Jessica's students saw significant improvement in math standards achievement. All of her students who were two or more grade levels below their peers in the fall improved at least one full grade level from fall to spring. By the spring testing, 70% of students who used Frax approached or met grade-level math proficiency, compared to 52% of students in the class who did not use Frax.



Year 1 Data Insights (continued)



For both typical and stretch growth measures, students with high Frax usage achieved significantly more of their projected targets compared to students without Frax usage.[1] On average, students who used Frax achieved 149% of their typical growth goals compared to 102% in the other class. Similarly, students who used Frax achieved 102% of their stretch growth goals, compared to only 71% in the other class. This demonstrates that Frax supported all students in achieving the growth needed to advance their proficiency level. Students with high Frax usage also demonstrated significantly higher levels of fractions knowledge compared to the typical instruction classroom.[2] 100% of the students in Jessica's class who used Frax met state assessment standards for 3rd-grade fractions proficiency, with 53% of those students exceeding standards. In comparison, 26% of students in the other classroom failed to meet proficiency standards, and only 26% exceeded standards.

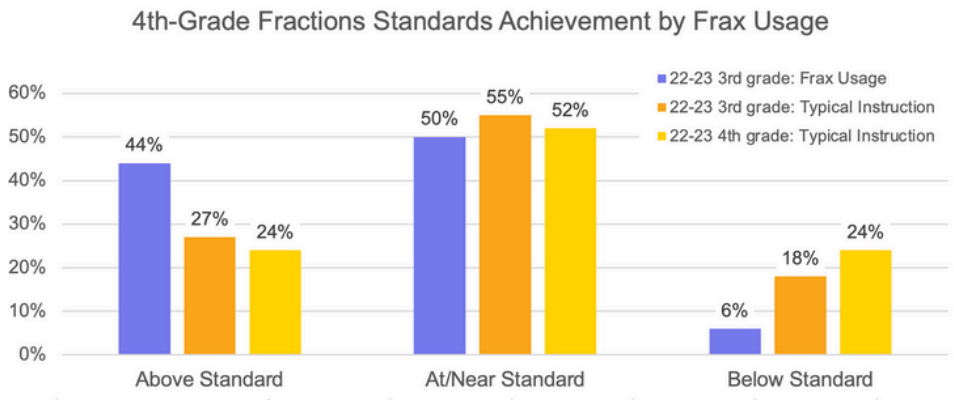


Overall, the data from Year 1 shows that despite starting out below-grade level proficiency in math, Jessica's students demonstrated higher-than-expected growth in math. Compared to an equivalent class that did not use Frax, Jessica's students showed more growth in math skills and higher fractions knowledge, with ALL students who used Frax meeting or exceeding state grade-level fractions proficiency standards. This improvement was the result of around 16 hours of usage of the Frax program. These results demonstrate both the efficacy and efficiency of the Frax program for improving fractions knowledge for all levels of learners.

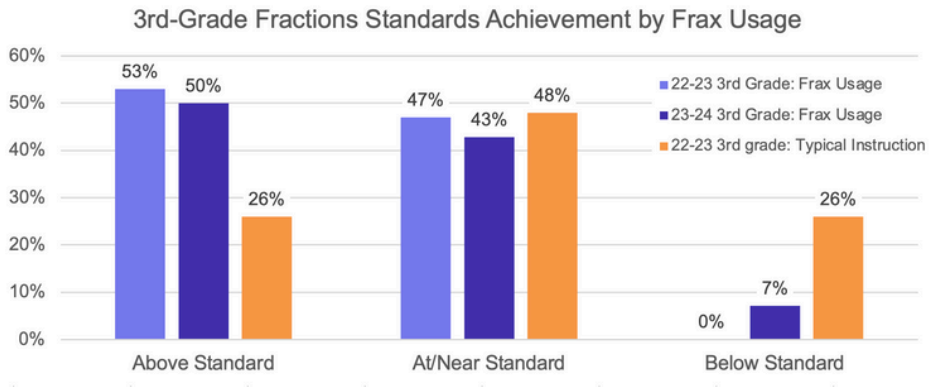
Year 2 Data Insights

We followed Jessica's students into 4th grade to test the hypothesis that using Frax in 3rd grade also prepares students with a solid conceptual foundation in fractions, making 4th-grade content easier to learn. To test this, we looked at Jessica's students' test scores on the state fractions assessment the following year (4th grade). We compared their achievement to students in the class that received typical instruction in 3rd grade and who did not use Frax in 3rd or 4th grade. Because this was a small sample size (n = 11), we also looked at 4th-grade students in typical-level classes who also did not use Frax from the 22-23 school year (n = 42).

Students who used Frax in 3rd grade significantly outperformed students with no Frax usage on the 4th-grade fractions standards test.[3] 44% of Jessica's students scored above standards, compared to 27% of the typical instruction 3rd-grade class and 24% in the prior year 4th-grade cohort. Only 6% of Jessica's students scored below standards, compared to 18% of the typical instruction 3rd-grade class and 24% in the prior year 4th-grade cohort. Frax prepared these students for success in more advanced fractions, outperforming their peers who did not use Frax AND outperforming typical 4th-grade fractions performance at this school.



The administration team at the charter school was impressed with the outcomes and was eager to see how Frax could impact performance across the school. In the 23-24 school year, all teachers at the school were given access to Frax. Both Jessica and the other 3rd-grade teacher used Frax in 23-24, and again we assessed student performance on the state fractions assessment. Both classes performed very well, and largely mirrored the performance improvement seen in the prior year. 93% of students in both 3rd-grade classes at the school in the 23-24 school year performed at or above state grade-level standards expectations for fractions. This finding underscores just how easy it is for new teachers to get students to use Frax and to observe large impacts in the first year of implementation.



Conclusions

The present report summarizes the highlights from a two-year research study conducted with a public charter school in the Western United States. In Year 1, we worked with 3rd-grade teacher Jessica* as she used Frax with her students for the first time. Jessica's students represented a diverse range of academic preparedness, with 82% of students demonstrating below grade-level math proficiency expectations at the beginning of the year, and 29% of her students qualifying for special education support. Many of Jessica's students had significant challenges due to COVID-related learning disruptions and little to no pre-existing fractions knowledge.

After using Frax, ALL of the teacher's students met or exceeded state standards for 3rd-grade proficiency in fractions, significantly outperforming a similar class of students who did not use Frax. This resulted in significant improvements in overall math proficiency standards as well, with all students moving out of the highest-risk category for academic failure. All of this was achieved with an average use time of 16 hours of Frax, showing that Frax is both efficient and effective for helping students achieve fractions standards mastery and improving math achievement.

Qualitative feedback from Jessica provided evidence that the benefits of Frax extended beyond test performance. The largest changes Jessica reported after her students used Frax were increased enjoyment and a deepening interest in math. Students had fun playing Frax, and this led to more self-confidence and pride in their math learning. Higher levels of class engagement and participation, along with increased preparation for in-class instruction, helped to make teaching more efficient, saving classroom time and reducing student frustration.

The benefits observed here extended into the second year. In Year 2, these students showed improved performance on 4th-grade fractions standards compared to students at the charter school who did not use Frax. Frax helps students develop a conceptual foundation in fractions, making increasingly more complex fractions content easier to learn. Additionally, when a new 3rd-grade cohort used Frax, the improvements in fractions knowledge observed matched Year 1, providing additional evidence that Frax is an important and necessary tool for supporting the teaching and learning of fractions.

*Name changed for this report

APPENDIX: Statistical Analyses and Technical Notes

[1]Two independent samples t-tests were conducted looking at the difference in percentage of typical and stretch growth achieved for students in the Frax class compared to the typical instruction class. Both analyses these tests were significant (all p's < .001), with Frax users outperforming non-Frax users.

	Frax Users	Typical Instruction				
	Mean(SD)	Mean(SD)	*df*	*t*	*p*	Cohen's D
Typical growth	148.71 (62.21)	102.43(50.31)	38	2.60	.013	.82
Stretch growth	101.71(41.11)	70.52(33.61)	38	2.64	.012	.83

[2]A 2x2 chi-square was conducted to analyze the rates of meeting or exceeding grade-level proficiency standards for fractions for students with high Frax usage compared to typical instruction (no Frax usage). By the end of the spring, 100% of the students who used Frax met or exceeded standards compared to only 74% of typical instruction students with no Frax usage. The chi-square was significant, $X^2(2, N = 40) = 5.22$, $p = .02$.

[3]A 2x2 chi-square was conducted to analyze the rates of exceeding grade-level proficiency standards for fractions for students with high Frax usage compared to typical instruction (no Frax usage) in 4th grade. By the end of the spring, 44% of the students who used Frax exceeded standards compared to only 25% of typical instruction students with no Frax usage. The chi-square approached significance, $X^2(2, N = 69) = 2.21$, $p = .069$. A 2x2 chi-square was also conducted to analyze the rates of failing to meet grade-level proficiency standards for fractions for students with high Frax usage compared to typical instruction (no Frax usage) in 4th grade. By the end of the spring, only 6% of the students who used Frax failed to meet standards compared to 23% of typical instruction students with no Frax usage. The chi-square approached significance, $X^2(2, N = 69) = 2.16$, $p = .071$.