RESEARCH BRIEF

Frax Supports Math Achievement in Upper Elementary Grades

Results from a matched comparison of 4th and 5th grade students

STUDY AT A GLANCE

Study Sample:

- 4th and 5th-grade students
- Large, suburban US school district
- District Student Racial Diversity: 52% Hispanic/Latino, 23% Asian, 15% White, 50% economically disadvantaged (FRPL)
- All students scored in the one or two grade levels below standards relative placement on a baseline math diagnostic

Research Methodology:

- 2023-2025 school years
- iReady Math Diagnostics were analyzed from fall 2023 (Grades 2/3) and spring 2025 (Grades 4/5)
- 1:1 statistical matching was used to create 265 pairs of students matched on baseline math scores and grade level
- Compared performance of matched students based on Frax usage levels: high (Sector 2), moderate (Sector 1), and no/low usage

Main Findings:

- **Students who completed Frax Sector 2 were around 1.7x more likely to meet grade-level standards** than students with low or no usage (82% vs. 47%)
- **Achievement gains increased in a stepwise pattern with greater program use**—from 58% meeting standards after Sector 1 to 82% after Sector 2
- Among Grade 4 students, Sector 2 completers outperformed Sector 1 completers by an average of +6.7 points, **equivalent to nearly seven additional weeks of traditional instruction,** from only ~10 hours of targeted Frax Sector 2 learning.

Introduction

Research consistently shows that early difficulties with fractions don't resolve on their own—they grow. In fact, the gap in fraction knowledge between higher- and lower-achieving students widens across middle school. Siegler & Pyke (2013) found that differences in students' understanding of fraction magnitudes and whole-number division strongly predict their performance on fraction arithmetic and broader mathematics achievement. Together with earlier work (Siegler et al., 2012), the evidence is clear: early misunderstandings in fraction magnitude become long-term learning barriers, shaping students' readiness for algebra and their trajectory in later STEM learning.

Despite how critical early fraction understanding is, teachers are often asked to address these challenges without the tools they need. A 2025 nationally representative EdWeek Research Center survey found that only 15% of math teachers said teaching fractions, decimals, or percentages is "not at all challenging." Fractions are conceptually complex and often hindered by whole number bias. Effectively addressing this requires models, representations, and practice opportunities with timely feedback and support, which is highly challenging for teachers to implement with typical curricula.

Thus, **providing teachers with effective, research-based tools proven to improve fractions understanding has enormous potential to interrupt the widening gap and improve long-term math outcomes.**

ExploreLearning Frax is a research-based program designed to build foundational fractions knowledge. Organized into progressive Sectors aligned to 3rd - 5th grade standards, Frax uses evidence-based practices—such as number line reasoning and treating fractions as numbers—to develop deep conceptual understanding. Its adaptive scaffolding and structured progression support differentiated learning, making Frax a powerful supplement to core instruction while reducing the burden on teachers to individualize fraction teaching on their own.

Current Study

This study evaluates the impact of Frax usage on students' year-over-year mathematics growth by comparing Frax users with **baseline-matched peers** on a common benchmark diagnostic. We conducted a rigorous comparison of three strictly matched groups of students representing high Frax usage, moderate Frax usage, and no Frax usage. This design allowed examination of whether **deeper Frax engagement**—particularly completion of Sector 2—**was associated with greater growth in math achievement** relative to students with just Sector 1 completion or no usage. By using strict statistical methods to create 1:1 student matching based on prior math achievement, we can be confident that the growth observed in the current study is directly related to differences in classroom experiences.

Methodology

Frax usage: All teachers in the district had access to **Frax** (Sectors 1 and 2), and some teachers chose to implement it with their students. Frax Sector 1 consists of 27 missions broadly aligned to 3rd-grade fractions standards. Sector 2 consists of 30 missions broadly aligned to 4th-grade fractions standards. Each mission takes, on average, 20 to 30 minutes to complete, and must be completed in order, with usage limited to one mission per day to encourage spaced learning. Usage groups were defined as the following based on Frax usage between pre-test and post-test dates:

- **Sector 2 completion (G2)**
- **Sector 1 completion (G1)**
- **No/Low usage (G0)** is defined as completing 5 or fewer missions in Sector 1

Math achievement: Student math achievement was measured using the *i-Ready* mathematics diagnostic assessment, a widely used and validated benchmark of mathematics proficiency. Assessments analyzed here were administered at the beginning of second and third grade (Fall 2023) and at the end of fourth and fifth grade (Spring 2025).

- **Baseline Equivalence.** To ensure equivalence across user and non-user groups, the current sample was restricted to students who were performing **below grade level** on their Fall 2022 benchmark test. This category represents students who likely require targeted support to close skill gaps to reach grade-level expectations. This included a study population of 1,095 students. Strict 1:1 matching was conducted using the MatchIt package in R to create statistically equivalent comparison groups. The final matched samples included 186 matched students for the G1–G0 comparison, 134 for the G2–G0 comparison, and 210 for the G2–G1 comparison. Post-match standardized mean differences (SMDs) indicated strong baseline equivalence across all comparisons - G1 vs G0 (SMD = 0.058), G2 vs G0 (SMD = 0.028), and G2 vs G1 (SMD = −0.006)- all well within WWC thresholds for equivalence.
- **Student Growth**: Student's individual progress towards on-grade-level math proficiency was also assessed by comparing scale score growth for individual students from the beginning of second or third grade (Fall 2023) to the end of fourth or fifth grade (Spring 2025). *i-Ready* defined placement levels (below grade level, early-on grade level, mid-above grade level) were also used to assess growth towards proficiency.

Results

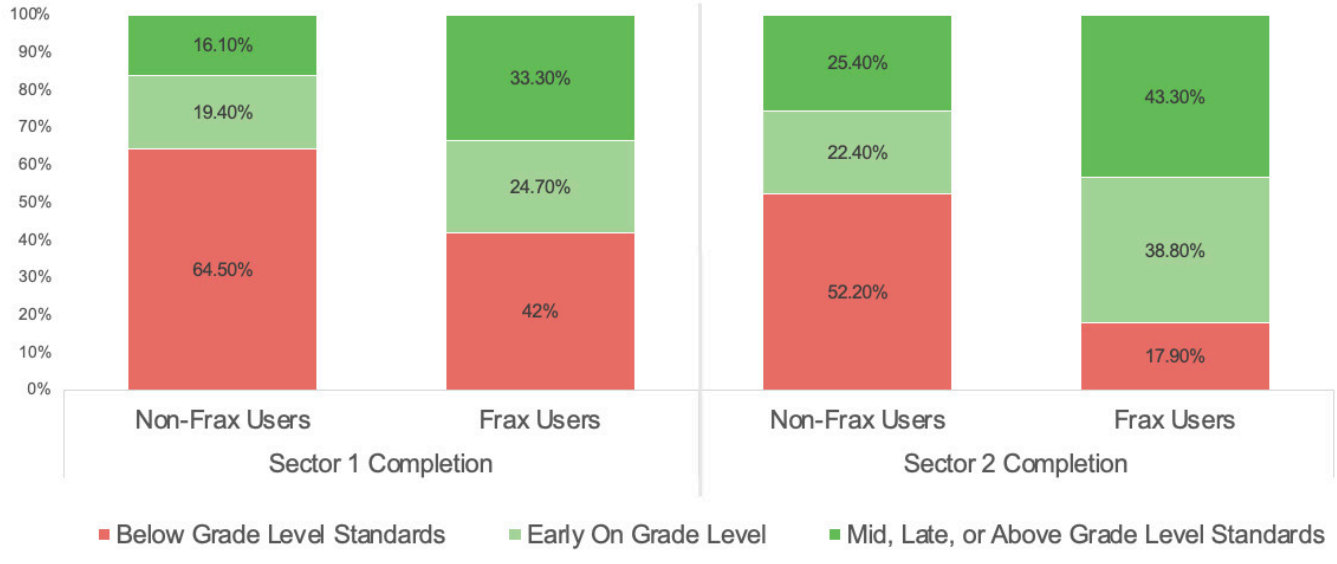
FINDING 1: Students completing Frax Sectors 1 or 2 were more likely to meet or exceed grade-level standards compared to matched students with low/no use

The first analysis compared likelihood of meeting grade-level standards at post-test for matched students across levels of Frax usage (no usage, Sector 1 completion, Sector 2 completion). The results show a stepwise pattern: **even though all students began below grade level at pre-test, students who completed more Frax were significantly more likely to reach grade-level proficiency in math at post-test compared to baseline matched peers.**

- **Sector 1 completion vs no usage:** Students who completed Sector 1 were significantly more likely to meet or exceed grade-level standards than matched peers with little or no usage (**58% vs. 35.5%**), demonstrating meaningful gains after initial program engagement.
- **Sector 2 completion vs no usage:** Students who completed Sector 2 showed even greater benefits. They were significantly more likely to meet or exceed standards than low/no-use peers (**82% vs. 47%**), highlighting the added value of progressing into deeper fraction concepts.

Data illustrates a clear return on investment for students who advance through more of the Frax sequence: proficiency rates rose from 58% for Sector 1 completers (vs. 35.5% for non-users) to 82% for Sector 2 completers (vs. 47% for non-users), demonstrating that deeper engagement with program drives higher standards attainment.

Students who used **Frax** were significantly more likely to meet grade level standards on spring 2025 math assessments compared to fall 2023 baseline **matched students** with no Frax usage. Achievement gains increased progressively with more program usage.



Results

FINDING 2: Students who completed Frax Sector 2 experienced greater scale score growth compared to matched students who only completed Sector 1.

The second analysis analyzed scale score gains from pre-test to post-test for a more fine-grained look at student growth. Three ANCOVA models were conducted to examine the impact of Frax usage on mathematics achievement (spring 2025 scale scores), controlling for baseline performance (fall 2023). Across all comparisons, results demonstrated a stepwise relationship between depth of Frax engagement and math achievement gains. **Students who completed 1 or more Sectors in Frax outperformed low/no users, with those who completed Sector 2 achieving the highest overall scores.**

For instance, Grade 4 students who completed Sector 2 demonstrated a statistically significant average gain of +6.7 points compared to matched Grade 4 Sector 1 completers. Given the typical i-Ready growth rate of roughly one point per instructional week, **the advantage of Sector 2 represents the equivalent of nearly seven weeks of additional learning.**

Overall, Frax Sector 2 instruction accelerates growth for academically at-risk students, helping them progress faster than matched peers with low or no Frax usage, and saving instructional time by reducing remediation needs.

4th and 5th grade students who used **Frax** significantly outperformed fall 2023 baseline **matched students** with no Frax usage or lower Frax usage on spring 2025 math assessments.

Note: Data points (purple and gray circles) represent average math scale scores in spring 2025 for matched groups. Purple circles represent students with higher Frax usage compared to matched gray circles (no or lower usage). Light green shaded area represents early on-grade level category. Dark green shaded area represents mid-grade level and above.

Conclusions

Prior research has consistently shown that early challenges in fractions tend to persist without targeted, conceptually grounded interventions. Fractions represent a critical juncture in math learning: they bridge whole-number reasoning and algebraic thinking, and difficulties in this area often hinder students' progress in later grades. Strengthening fraction understanding during the upper elementary years is therefore essential for building strong foundations required for middle and high school mathematics success.

The results of this study demonstrate that Frax effectively supports this goal by providing structured, adaptive instruction aligned to grade-level fraction standards. Students who completed Sector 2 showed clear, measurable gains over peers who completed only Sector 1 or had little to no usage. Sector 2 completers were over 1.5 times more likely to meet or exceed grade-level standards on the i-Ready Math assessment. Critically, Grade 4 Sector 2 completers noted an average of +6.7 points higher than their Sector 1 peers highlighting nearly seven weeks of additional learning. These improvements not only accelerated students' readiness for on-grade content but also moved many closer to or beyond the benchmark for Mid, Late, or Above Grade Level placement.

These findings underscore the importance of ensuring students' progress through the full Frax sequence aligned with their grade levels, particularly into Sector 2, where conceptual understanding deepens and achievement gains compound. For districts seeking scalable, evidence-based tools to strengthen math foundations, Frax offers a proven solution—helping students overcome persistent barriers to fractions learning, close skill gaps earlier, and build the mathematical readiness needed for long-term success in secondary math and beyond.

IMPLICATIONS FOR PRACTICE

- **Prioritize early fraction intervention.** Students who begin behind in fractions often stay behind—targeted support in Grades 3–5 can prevent widening gaps in middle school.
- **Encourage progression through the full Frax sequence.** Students who completed Sector 2 were more likely to meet grade-level expectations and showed grater growth than baseline matched peers with low or no usage.
- **Leverage Frax to accelerate learning for academically at-risk students.** Sector 2 completers demonstrated increased growth equivalent to nearly seven weeks of additional instruction—an important strategy for catching students up more quickly.
- **Combine Frax with grade-level instruction to reduce remediation time.** As students strengthen foundational fraction understanding, they are better prepared for on-grade content, reducing long-term reteaching demands.
- **Support teachers with structures that make Frax implementation simple.** Regular routines (e.g., daily or twice-weekly sessions) can help students progress through missions efficiently and complete Frax prior to beginning in-class fractions units.

Statistical Analyses and Technical Notes

		Comparison 1		Comparison 2		Comparison 3	
		No/Low Frax Usage	Sector 1 Completion	No/Low Frax Usage	Sector 2 Completion	Sector 1 Completion	Sector 2 Completion
Grade 4	Sample Size	59	59	38	38	60	60
	Baseline scale score M(SD)	389 (21.5)	390 (20.6)	397 (18.9)	397 (18.9)	408 (13.5)	408 (13.2)
Grade 5	Sample Size	34	34	29	29	45	45
	Baseline scale score M(SD)	422 (17.9)	423 (18.3)	428 (14.4)	429	430 (15.3)	430 (15.2)

FINDING 1:

A series of 2×5 chi-square tests were conducted to examine the relationship between Frax usage level and students' grade-level placement on the i-Ready Math assessment.

- The first analysis compared Sector 1 completers (G1) to students with low or no Frax usage (G0). The chi-square test revealed significant group differences, $X^2(4, N = 93) = 10.83$, $p = .029$. Among low/no users, only 35% met or exceeded grade-level standards (Early On + Mid/Above), compared to 58% of Sector 1 completers, demonstrating that initial engagement with Frax meaningfully improves math outcomes.
- The second analysis compared Sector 2 completers (G2) to low/no users (G0) and also yielded a significant effect, $X^2(4, N = 93) = 18.17$, $p = .001$. Students who completed Sector 2 achieved substantially higher rates of grade-level proficiency, with 82% meeting or exceeding standards compared to 48% of low/no users. No Sector 2 students scored Two Below or Three Below grade level, indicating strong remediation effects for struggling learners.
- Finally, the comparison between Sector 2 completers (G2) and Sector 1 completers (G1), while not statistically stable (X^2 = NaN, p = NA) due to small cell counts, showed a positive descriptive pattern. Ninety percent of Sector 2 students scored at Early On or Mid/Above placement levels compared to 82% of Sector 1 students, suggesting a benefit associated with completing the higher-level sector.

FINDING 2:

Three ANCOVA models were conducted to examine the impact of Frax usage levels on mathematics achievement (i-Ready Spring 2025 scale scores), controlling for baseline performance (Fall 2023). Across all comparisons, results demonstrated a clear, stepwise relationship between depth of Frax engagement and math achievement gains. Students with any Frax completion outperformed low/no users, and those who progressed through Sector 2 achieved the highest overall scores.

Comparison	Group Means (Adjusted)	Mean Difference	$F(df_1, df_2)$	*p*-value	Partial η^2	Interpretation
Low/No Use (G0) vs. Sector 1 (G1)	G0 = 462 G1 = 473	**+10.2**	$F(1, 182) = 19.32$	< .001	.11	Significant; medium–large effect
Sector 1 (G1) vs. Sector 2 (G2)	G1 = 487 G2 = 491	**+4.47**	$F(1, 206) = 4.94$	.027	.02	Significant; small–medium effect
Low/No Use (G0) vs. Sector 2 (G2)	G0 = 472 G2 = 486	**+14.5**	$F(1, 130) = 26.94$	< .001	.18	Significant; large effect