ël Reflex

Reflex in Action:
Advancing Math Fluency and Proficiency in 2nd Grade

Study Sample:
- 547 2nd-grade students
- Moderate-size, suburban public school district in California
- Student Diversity: 50% white, 40% Hispanic, 20% economically disadvantaged

Research Methodology:
- 2023-2024 school year
- iReady math assessments completed in fall 2023 and spring 2024
- Comparison of growth for students who used Reflex for 40+ days (n = 481) compared to students with no Reflex usage (n = 66)

Main Findings:
Students who used Reflex:
- Demonstrated large growth in addition and subtraction math fact fluency
- Were 2x more likely to meet ambitious growth goals compared to students with no Reflex usage
- Moved toward grade-level proficiency, with greater growth in fluency predicting higher spring math assessment scores (regardless of baseline abilities)

ExploreLearning Reflex is an adaptive, online program that helps students develop math fact fluency—the automatic (quick and effortless) recall of basic math facts. The current study empirically tests the impact of the Reflex program on math fact fluency and student progress toward full achievement of grade-level standards in math for 2nd-grade students in a mid-size suburban school district during the 2023-2024 school year.

Digital Interventions and Math Fact Fluency

ExploreLearning Reflex is an adaptive, game-based platform designed to help students build fluency with basic math facts in a fun, engaging way. It focuses on developing automaticity—where students can recall math facts instantly—across four key operations: addition, subtraction, multiplication, and division. Reflex is used primarily in elementary and middle schools, but it can benefit students of all ages who need to strengthen their foundational math skills.

When students achieve automaticity, they can retrieve math facts from their long-term memory without conscious effort or attention. When they reach more advanced mathematics, like multi-digit arithmetic, fractions, and long division, they are able to focus working memory on more complex problem-solving instead of simple computations.

A number of recent meta-analyses have found support for the impact of math fact fluency interventions on improving general mathematics achievement, especially for students at-risk for mathematics disabilities (e.g., Burns et al., 2024; Stocker et al., 2021). Technology-based adaptive interventions for fact fluency can be particularly beneficial, as they can provide differentiated practice, immediate feedback, and engaging and game-like environments. This can also significantly improve student engagement and motivation, building self-confidence in math ability, enjoyment of the learning process, and overall helping more students be successful in mathematics.

Methodology: Reflex and Math Achievement

The current study tested the efficacy of Reflex for improving math fact fluency and overall progress towards achieving grade-level proficiency in math. The sample included nearly 550 students in 2nd grade during the 2023-2024 school year with no prior usage of Reflex. The students attended a mid-size suburban school district in southern California. The district's student demographics are 50% non-white, with 40% Hispanic population, and 20% of families are economically disadvantaged.
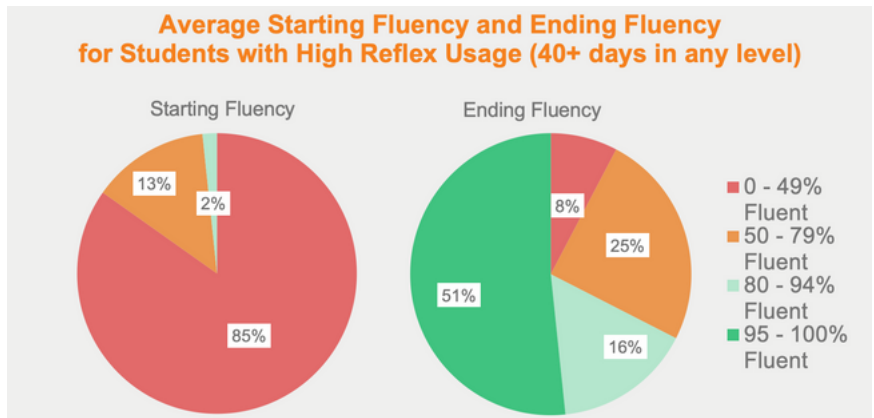
The district utilized the i-Ready Diagnostics to assess 2nd graders' current math abilities for instructional differentiation, as well as quantify growth over the course of the school year. The diagnostic tests provide an assessment of proficiency, as well as growth targets to help teachers put each 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 for groups of students is to aim for as many students as possible to reach their stretch growth target.

In the current sample, high usage of Reflex (n = 481 students) was defined 40 or more days of usage between fall and spring testing (mean = 86 days Reflex usage). Students with no Reflex usage (n = 66 students) used the program for less than 10 days between fall and spring testing. Student fluency was assessed in-app, with starting fluency and ending fluency used to calculate growth between each student's iReady testing dates.

Results

> ### Outcome 1: 2nd-grade students who used Reflex demonstrated large growth in addition and subtraction math fact fluency

Students with frequent usage of Reflex exhibited large increases in math fact fluency[1]. For instance, students with high Reflex usage went from an average of 28% fluency at the start of the school year to an average of 84% fluency by the end of the year, with 44% of those students reaching 100% fluency.

Average Starting Fluency and Ending Fluency for Students with High Reflex Usage (40+ days in any level)

Starting Fluency: 13%, 2%, 85%

Ending Fluency: 8%, 25%, 16%, 51%

- 0 - 49% Fluent
- 50 - 79% Fluent
- 80 - 94% Fluent
- 95 - 100% Fluent

Results (continued)

> **Outcome 2: Students who used Reflex were <u>2x</u> more likely to meet ambitious growth goals compared to students with no Reflex usage**

Reflex supported students in achieving high levels of growth in math achievement. The graphs below show (1) the percentage of students who met growth goals by Reflex usage and (2) the median percentage of typical growth scores achieved by students by Reflex usage. Reflex users were significantly more likely than non-users to fully meet both typical and stretch goals[2]. <u>Students who used Reflex were 1.7x more likely to meet typical growth goals and 2x as likely to reach stretch goals compared to non-users,</u> a critical benchmark for propelling students towards proficiency. Additionally, only students who used Reflex met the i-Ready progress goal for typical growth of 100% group median progress. They also significantly exceeded students without Reflex usage in the median amount of stretch growth achieved[3].


Percentage of Students Meeting or Exceeding Individual Growth Goals by Reflex Usage

Stretch Growth: 17%, 34%
Typical Growth: 41%, 69%
■ No Reflex Usage ■ Reflex Usage

Median Percentage of Individual Growth Goals Achieved by Reflex Usage

Stretch Growth: 51%, 83%
Typical Growth: 81%, 123%
■ No Reflex Usage ■ Reflex Usage
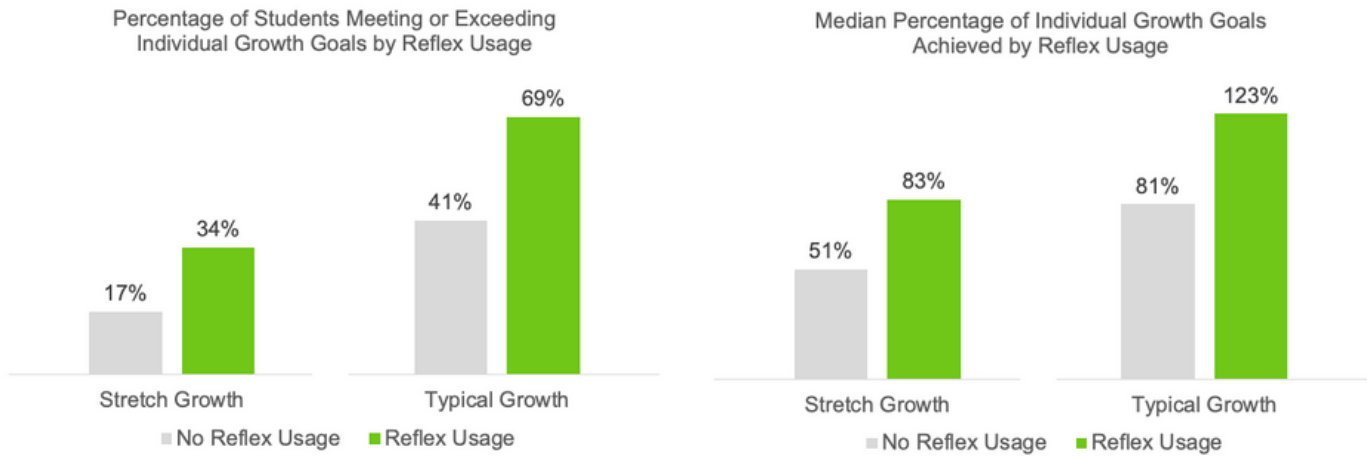
Results (continued)

> **Outcome 3: Reflex moved more students to grade-level proficiency, with greater growth in fluency predicting higher spring math assessment scores, regardless of baseline abilities**

Reflex users and non-users were similar in their baseline math achievement; 92% of non-users and 87% of Reflex users scored below grade-level proficiency on the fall math diagnostic test. However, on the spring math diagnostic test, Reflex users were 2.6x more likely to fully meet grade-level proficiency than non-users; 39% of Reflex users met grade-level proficiency in the spring, compared to only 15% of non-Reflex users[4].

Spring Math Relative Achievement Levels of Students by Reflex Usage

	On-grade level or above	Early-on grade level	Below-grade level
Reflex Users	39%	21%	39%
Non-Reflex Users	15%	18%	67%
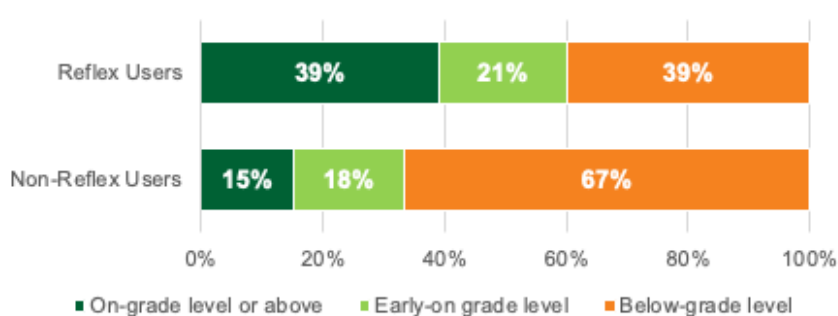
Additional data further supports the causal relationship between Reflex usage and overall math increases. When looking at fall-to-spring growth, we found a significant correlation between fluency improvements in Reflex and increases in math scale scores, even when controlling for baseline fluency and fall iReady math achievement[5].

Conclusions

Within this sample of 2nd-grade students using Reflex for the first time, we saw significant growth in math fact fluency in a short time period, with the average student achieving over 80% fluency. Across both users and non-users, nearly all students began the school year testing below grade-level proficiency. However, those who used Reflex were significantly more likely to end the year approaching or fully meeting grade-level proficiency standards in math. iReady diagnostic tests provides teachers and schools two important accountability measures: typical and stretch growth goals. We found that students who used Reflex were significantly more likely to meet or surpass both expected (typical) AND ambitious (stretch) growth goals compared to students with no Reflex usage. Furthermore, when we looked at score growth on the diagnostic math tests as a function of growth in Reflex, we found that the amount of growth in Reflex was predictive of the amount of growth on the test regardless of the student's baseline scores, providing even more evidence that Reflex was a driver and major supporter of their ability to succeed in math. Together, this evidence suggests Reflex 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.

Technical Notes

1. A Paired samples t-test was conducted to look at student growth in Addition/Subtraction 0-10 math fact fluency from fall to spring for students with 40+ days of usage. Students who used Reflex showed significantly higher fluency levels in the spring compared to the fall, $t(479) = -61.61$, $p < .001$; M (starting fluency) = 84.55, SD = 19.88, M (ending fluency) = 27.84, SD = 19.70.

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 (Reflex usage vs non-Reflex usage). Students who used Reflex were significantly more likely to reach their typical growth goals (69%) compared to students with no Reflex usage (41%), χ^2 (1, N = 547) = 20.34, $p < .001$. Similarly, students who used Reflex were significantly more likely to reach their stretch growth goals (34%) compared to students with no Reflex usage (17%), χ^2 (1, N = 547) = 8.10, $p < .005$.

3. Independent samples t-tests were conducted looking at the difference in median amounts of stretch and typical growth achieved by Reflex users and non-users. Students who used Reflex achieved significantly higher percentages of their typical growth goals (M = 128.64, SD = 60.12) compared to non-users (M = 87.53, SD = 67.60), $t(545) = 5.13$, $p < .001$. Similarly, students who used Reflex achieved significantly higher percentages of their stretch growth goals (M = 85.31, SD = 38.78) compared to non-users (M = 58.23, SD = 45.39), $t(545) = 5.21$, $p < .001$.

4. A 2x2 chi-square was conducted to analyze the numbers of students fully meeting grade-level proficiency within each usage group (Reflex usage vs non-Reflex usage). Students who used Reflex were significantly more likely to meet grade-level proficiency (39%) compared to students with no Reflex usage (15%), χ^2 (1, N = 547) = 14.39, $p < .001$.

5. A partial correlation was conducted looking at the relationship between increases in fact fluency from fall to spring and growth in i-Ready math scale scores from fall to spring, controlling for fall i-Ready overall scale scores and starting fluency percentage. The correlation was significant, $r(476) = .353$, $p < .001$.

References

1. Burns, M. K., Duesenberg-Marshall, M. D., Romero, M. E., Sussman-Dawson, K. J., & Singell, E. (2024). Meta-Analysis of the Effect of Technology-Based Mathematical Fact Practice on Mathematics Outcomes. Journal of Special Education Technology, 01626434241288199.
2. Stocker, J. D., Hughes, E. M., Wiesner, A., Woika, S., Parker, M., Cozad, L., & Morris, J. (2022). Investigating the effects of a fact family fluency intervention on math facts fluency and quantitative reasoning. Journal of Behavioral Education, 1-22.