2026

Ten Minutes to Mastery: Evaluating a Tier 1 Fluency Program

Northern Alberta:

Fort Vermilion, Peace River, and Peace Wapiti Public School Divisions

Fort Vermilion School Division

Peace River School Division
Learning Together - Success for All

PEACE WAPITI PUBLIC SCHOOL DIVISION

AIM COLLECTIVE

Executive Summary

The Project

In Fall 2024, four Northern Alberta school divisions (i.e., Zone 1) and researchers from Carleton University collaborated to evaluate the effectiveness of a Tier 1 classroom intervention, **Ten Minutes to Mastery**. The purpose of the intervention was to improve the arithmetic fluency skills of students in Grade 2 through 6. In this report, we examined the growth in arithmetic fluency of students in Fort Vermilion, Peace River, and Peace Wapiti School Divisions. We examined change in fluency scores over two intervention cycles across three time points, using pre- and post-intervention assessments from the Provincial Numeracy Screening Assessment (PNSA; Douglas & LeFevre, 2023).

Results

1. Students in grades 2 and 4 who received the intervention showed significantly greater growth in their **addition and subtraction fluency** scores than students who did not receive intervention (i.e., control students).
2. Students in grade 3 who received the intervention showed significantly greater growth in their **subtraction fluency** compared to control students.
3. Students in grades 5 and 6 who received the intervention showed greater growth in their **addition/ subtraction fluency** and their **multiplication/division fluency** compared to control students.
4. Students in grade 4 who received the intervention showed greater growth in their multi-digit **addition calculation** skills compared to control students.
5. The frequency of the intervention, as reported by teachers, was related to growth of students' fluency skills.

Conclusions

1. This Tier 1 fluency intervention was effective. Students' fluency skills improved more in response to the full-class instruction than those of similar students who did not receive the intervention.
2. The PNSA is an effective tool for tracking student progress and response to intervention.

Acknowledgements

This report describes the results of a research collaboration between researchers from the Math Lab at Carleton University and three Alberta Zone 1 school divisions: Fort Vermilion (FVSD), Peace River (PRSD) and Peace Wapiti Public (PWPSD). A fourth division, Grande Prairie Public (GPPSD), also participated but because they used a modified protocol, their results are described in a separate report. The divisional math leads on the project included Gilbert Morris (FVSD), Sandra Scott-Wilkes (PRSD), Rhonda Giesbrecht and Nicki Nightingale (PWPSD). The project was supported by division Superintendent Mike McMann (FVSD), Deputy Superintendent Jeff Thompson (PRSD) and Assistant Superintendent Penny Rose (PWPSD). The analyses described in this report were done with de-identified data provided to the Carleton team. The report was written by Heather Douglas, Jo-Anne LeFevre, Rebecca Merkley, and Ayushi Chitranshi.

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Background

Arithmetic fluency is the quick and efficient solution of simple problems such as 3 + 4, 14 – 5, 6 x 8 or 12 ÷ 2, through retrieval of number facts or application of efficient strategies (Codding et al., 2023). Fluency supports the acquisition of other mathematical skills (Price et al., 2013), including word-problem solving (Lin, 2020), fractions (Namkung & Fuchs, 2016) and algebra (Siegler et al., 2012). Fluent access to basic arithmetic facts reduces demands on students' working memory (Frigitta et al., 2023) and therefore makes more advanced math easier (Price et al., 2013). Students with high fluency are also confident in their mathematical skills (Maki et al., 2024). In short, fact fluency is a foundational skill that students need to succeed in mathematics.

In the 2024-25 school year, four Northern Alberta School Divisions came together to share best practices to improve students' fact fluency skills. The group implemented a full class (Tier 1) intervention for students in grades 2 through 6 across their divisions. The intervention resources were prepared by the Peace Wapiti math leads and edited in consultation with the Zone 1 team. To evaluate the results of the intervention, students completed the Provincial Numeracy Screening Assessment (PNSA) three times during the year. In this report, we discuss the findings from Fort Vermilion, Peace River, and Peace Wapiti School Divisions.

The Intervention

Overview

Ten Minutes to Mastery was designed by Peace Wapiti math leads Giesbrecht and Nightingale to build students' arithmetic fact fluency skills. For students in grades 2 through 4, the focus was on addition and subtraction fluency. For students in grades 5 and 6, the focus was on multiplication and division fact fluency.

The intervention protocol is grounded in the research on building fact fluency (Codding et al., 2011; VanDerHeyden & Peltier, 2023). Specifically, the intervention builds skill acquisition through strategy instruction and builds mastery through fluency practice. The strategy instruction in the intervention followed the sequence and lessons recommended by the National Centre for Excellence in the Teaching of Mathematics (2018, 2019). The recommended topics of each lesson are listed in Appendix A.

Delivery

The delivery of the intervention was based on the pedagogy of effective instruction (Fuchs et al., 2021; Powell et al., 2023). Specifically, the intervention involves:

a) systematic and explicit instruction to develop students' understanding of math ideas (Doabler et al., 2015; Doabler & Fien, 2013; Stockard et al., 2018),

b) the use of multiple representations (e.g., rekenreks, number lines, and ten frames) to build students' conceptual knowledge (Heinze et al., 2009), and
c) fact retrieval practice to help support students' fluency (Codding et al., 2011; Nelson et al., 2013; Stocker & Kubina, 2017).

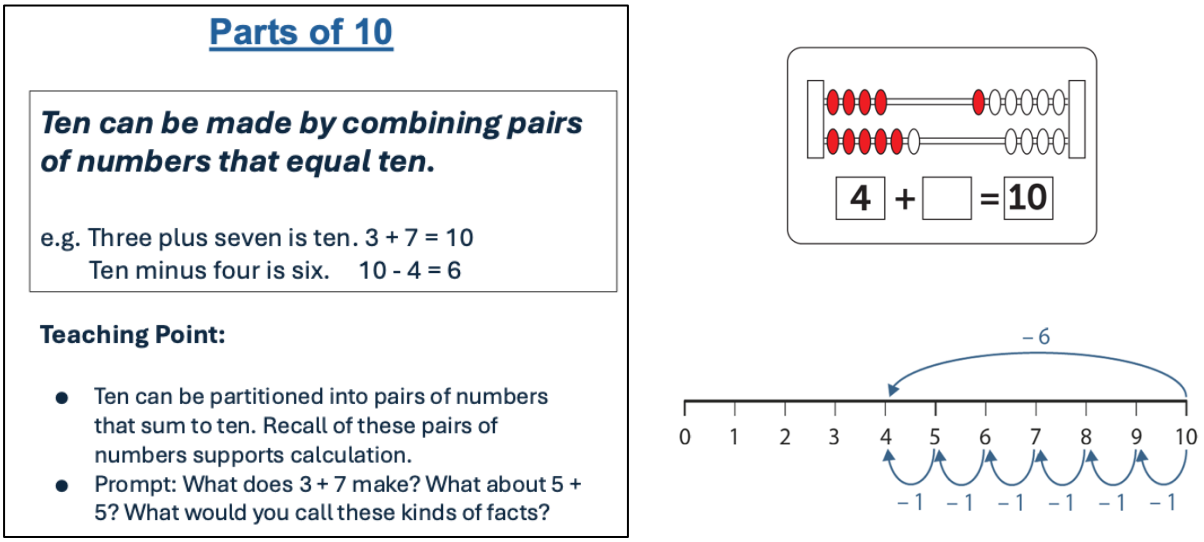
Implementation of the Intervention

Teacher Training and Support. Prior to starting the intervention, teachers received training on the intervention from the project leads. The training varied by school division.

- In Peace Wapiti, training was a mix of large-group half-day sessions, 1-hour single sessions, and in-class modelling. Many teachers had been using the intervention in prior years, so had previously been trained and received refreshers as needed.
- In Peace River, teachers started with a full day of in-person training. This training included an introduction to the research project, a review of the program and materials, and hands-on practice with the materials. Scott-Wilkes conducted teacher follow-up and in-class observation during the first 6 weeks. She did monthly follow-ups and hosted a mid-year 1-hour virtual check-in which gave teachers the opportunity to share best practices and challenges.
- Fort Vermilion is a geographically large school division. A train-the-trainer model was used. Morris conducted a half-day in-person training for the schools' numeracy coaches. The coaches then trained participating teachers within their schools. Coaches did in-class observations monthly and in-class modelling as needed. Morris did in-class observation following the first intervention cycle, followed up with coaches regularly, and addressed concerns as they arose.
- In all school divisions, project leads followed up with teachers who experienced difficulties or requested extra support.

Resources. All teachers received an instructional slide deck that described each strategy and showed multiple representations to illustrate the strategy and help support students' practice. Figure 1 shows the description of the "parts of 10" strategy and visual examples of rekenreks and number lines that teachers used to teach and reinforce the strategy. Teachers received classroom sets of flash cards for student practice. Morris also provided a teacher instruction summary sheet (see Appendix B).

Figure 1. *Parts of 10 and Supporting Representations (i.e., rekenreks and number lines).*



Daily Lessons

The 10-minute sequence of instruction used each day is shown in Figure 2. In the s*trategy instruction* phase, teachers were expected to demonstrate "efficient methods for deriving facts and highlight patterns to help students generalize their fact knowledge" (Morano et al., 2020, p. 61). Examples of instructional strategies include focusing on arithmetic concepts such as the commutative property (e.g., 3 + 4 = 4 + 3; 3 x 4 = 4 x 3) which minimizes the number of facts students need to remember, or adding or subtracting one (e.g., 6 + 1 = 7; 6 – 1 = 5) which builds on students' knowledge of the count sequence (Purpura et al., 2016). Strategies can also focus on known patterns such as making 10 (e.g., 8 + 6 = 8 + 2 + 4) or on recognizing doubles, which are inherently easier to memorize (Bagnoud et al., 2025). Training students on the use of efficient strategies helps them build their fact fluency (Powell et al., 2023).

Figure 2. *Intervention Lesson Sequence.*

Mastery "is characterized by fluent, facile, adaptable, and flexible skill" (Codding et al., 2023, p. 2). Once students respond consistently and accurately to specific items, retrieval practice and repetition help build mastery. The retrieval practice in the intervention builds mastery through partner practice and individual practice.

In the *partner practice* phase students worked together using specially designed flash cards to practice facts that aligned with the strategies they have been taught. For example, if students were taught the "parts of ten" strategy (see Figure 1) the flash cards would include a mix of "parts of ten" facts along with previously practiced facts. Student pairs work together to support each other.

In the *individual practice* phase students completed practice sheets that reflected the strategies they had been practicing. Students graphed their results each week so they could easily see growth in their fluency as the weeks progressed.

Next Steps

In the grade 4 classes, once teachers felt that most of the students had developed fluency in addition and subtraction facts (i.e., 20 facts per minute), the instructional focus shifted to multiplication and division facts. Multiplication builds on students' existing knowledge directly through use of repeated addition (e.g., 3 x 5 = 5 + 5 + 5) or structured counting (e.g., 3 x 5 = 5, 10, 15), using familiar sequences such as counting by 2s, 5s, and 10s. Conceptual information supports the use of strategies such as inverse operations (3 x 4 =12, 12÷3=4, 12÷4=3) and the distributive property, for example, 8 x 7 = (4 x 7) + (4 x 7), to reduce the number of facts students need to remember. Conceptual knowledge remains key to developing persistent, long-term fluency (Robinson, 2017; Robinson & LeFevre, 2011; Robinson & Sander, 2024).

The Assessment Tool

The Alberta Provincial Numeracy Screening Assessment (PNSA) is classroom-based numeracy screener developed by researchers at Carleton University (Douglas & LeFevre, 2023). The screener is designed for students in kindergarten to Grade 4 and includes a battery of subtests that measure students' foundational numeracy skills. These skills include students' understanding of symbols (e.g., number writing, place value), relations (e.g., number line estimation), and operations (e.g., fact fluency). For this study, students in Grades 4, 5 and 6 completed the Grade 4 version of the PNSA. In this report we focus on students' performance on the fluency subtests. For students in grades 2 and 3 we analyzed single-digit addition and subtraction fluency. For students in grades 4 to 6, we analyzed their combined single-digit addition and subtraction fluency, their combined multiplication and division fluency, and their multi-digit addition and subtraction calculation skills.

Study Design

Students in both intervention and control groups were tested with the PNSA in September 2024. Following the baseline testing, teachers delivered the first round of intervention approximately three times per week. As part of the intervention, teachers also completed a weekly progress report. All students were re-tested with the PNSA in January 2025. The intervention continued through the rest of the winter. Students were tested on the PNSA for a third time in May of 2025.

Dosage and Alignment

Optimizing dosage and ensuring the intervention is aligned with the student's skill level are two ways to improve the quality of the intervention (Fuchs et al., 2017). To quantify the dosage of intervention and alignment with student skills, teachers completed weekly progress reports where they recorded the number of strategy lessons they taught (i.e., frequency) and the strategies students practiced during the week. Teachers also rated student engagement on a five-point scales, where 1=not at all engaged and 5=very engaged. Progress reports were completed in the first (September to January) and second (February to May) round of intervention. However, due to problems matching the second term scores with the progress reports, we only discuss the first round reports.

Research Questions

1 Did the intervention affect growth of students' fact fluency?

2 Did the intervention affect growth of students' multi-digit calculation skill?

3 Did intervention frequency relate to growth of students' fact fluency?

Method

Participants

One hundred and fifty-five teachers participated in the study, 119 were in the intervention condition. Participating students ranged from grades 2 to 6 ($N = 2823$, 1490 boys) and of these students, 2090 completed all three rounds of PNSA testing. The breakdown of students by grade and group is shown in Table 1.

Table 1. *Number of Students by Group and Grade*

Grade	Students per Group (*n*)		Total
	Control	Intervention	
2	156	342	498
3	248	364	613
4	197	442	639
5	269	457	726
6	195	153	348
total	1065	1758	2823

Analyses

To determine the effectiveness of the intervention, we compared pre- and post-intervention fluency scores for the intervention and control groups. Analyses were done separately for addition/subtraction and multiplication/division.

Scores for addition and subtraction fluency were analyzed in a series of 3 (PNSA Testing: Time 1, Time 2, Time 3) by 2(Group: Intervention, Control) by 2 (Grade: 2, 3) mixed ANOVAs.

Scores for combined addition/subtraction, multiplication/division fluency, and calculation tasks were analyzed in a series of 3 (PNSA Testing: Time 1, Time 2, Time 3) by 2 (Group: Intervention, Control) by 3 (Grade: 4, 5, 6) mixed ANOVAs. For these analyses, we expected to find significant interactions between time and group indicating that students participating in the intervention correctly solved more math facts per minute after the intervention, compared to students who did not participate in the intervention. For the calculation tasks specifically, we expected to find transfer of the addition and subtraction fluency practice to greater gains in multi-digit calculation for Grade 4 intervention students compared to Grade 4 control students (note: students in Grades 5 and 6 only practiced multiplication and division).

To evaluate changes that varied by grade across the school year, ANCOVAs were used to test whether Time 3 performance differed for the intervention and control groups, using Time 1 performance as the covariate. For these analyses, we expected to find main effects of group if the students in the intervention improved more, relative to their Time 1 performance, compared to those in the control group.

Results

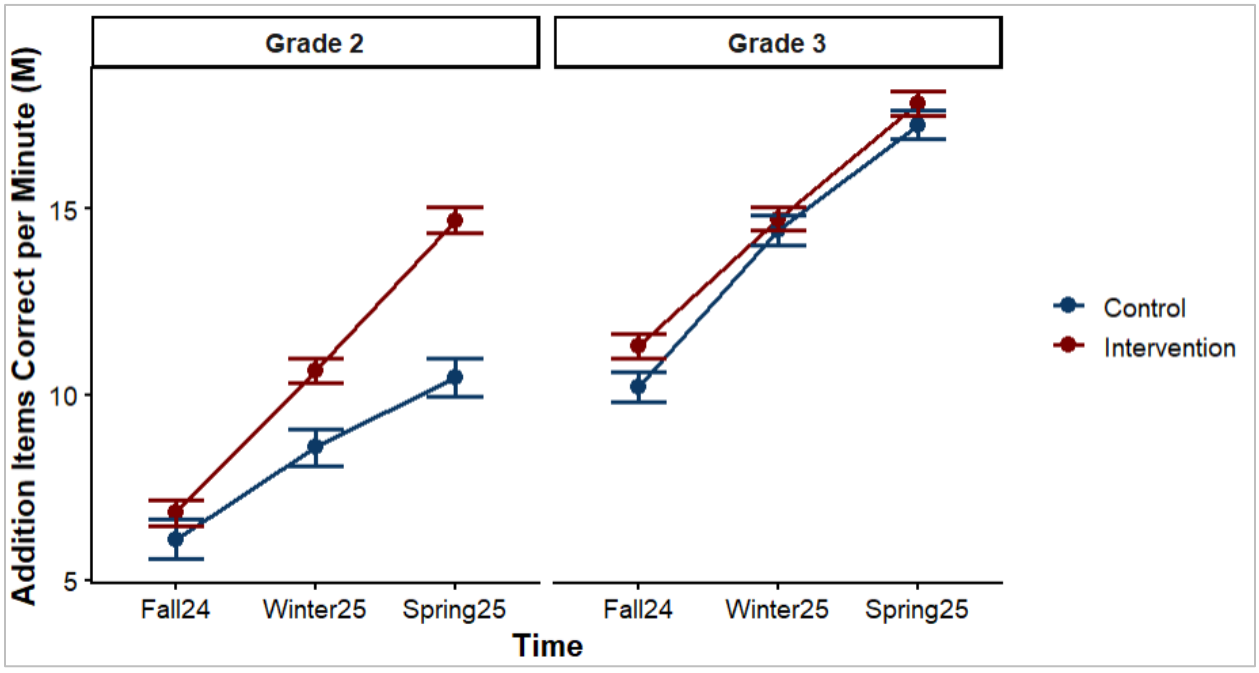
1 Did the intervention affect growth of students' fact fluency?

Addition and Subtraction Fluency

Grades 2 and 3

Students' performance on the PNSA addition test are shown in Figure 3. As expected, both groups of students (i.e., intervention and control) in both grades 2 and 3 improved dramatically across the school year in response to their regular instruction. Did the students in the intervention group improve more? Statistically, there was a significant interaction between time and group, $F(2, 895) = 8.97$, $p < .001$, indicating different patterns of change for the two groups of students. However, this pattern varied with grade, $F(2, 895) = 12.59$, $p < .001$ indicating there were differences for students in grade 2 compared to those in grade 3. Specifically, for students in grade 2, addition fluency skills changed more for intervention students compared to control students. In summary, the intervention was effective at differentially improving addition fluency for students in Grade 2 but not in Grade 3. As shown in Figure 3, by the end of the year, grade 2 students who had received the intervention solved about five more items correctly in one minute compared to their peers who had not participated in the intervention.

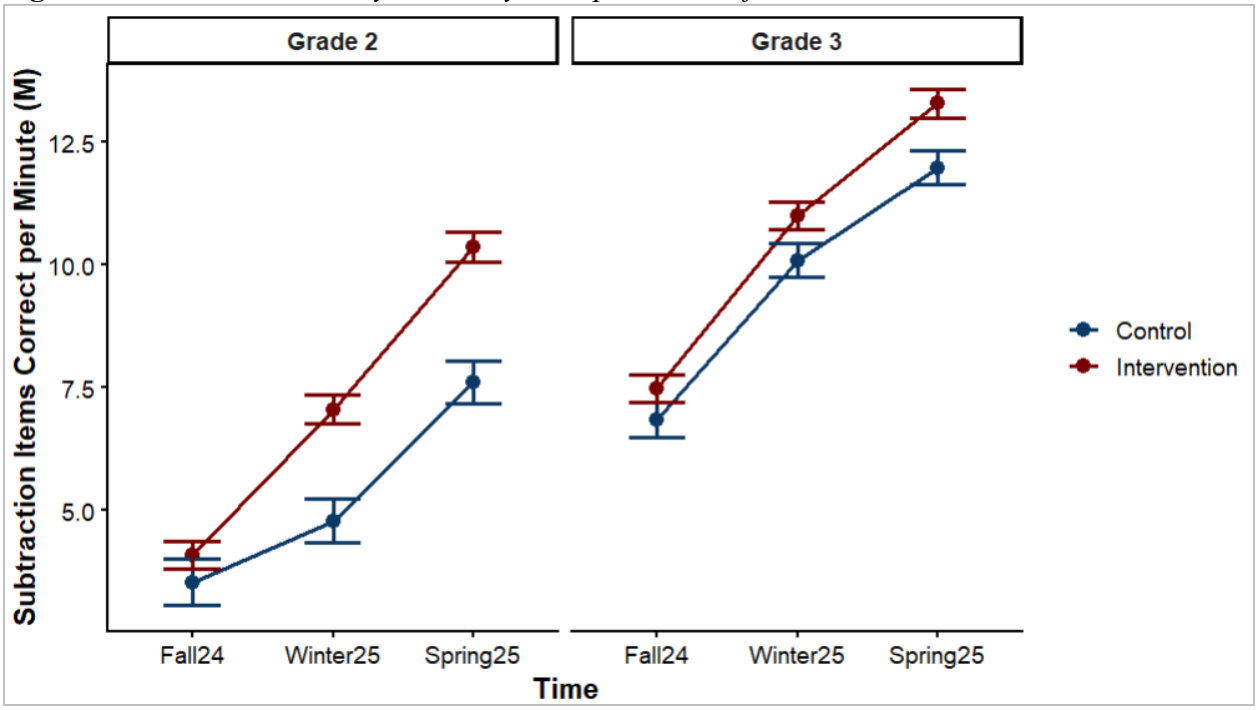
Figure 3. *Addition Fluency Scores by Group over time for Grade 2 and Grade 3 Students*



Note. The error bars represent 95% confidence intervals.

The results for subtraction are shown in Figure 4. The results are similar to those for addition. All students improved, but grade 2 students in the intervention group improved more than their peers in the control group, as supported by the interaction between test time and group, $F(2, 909) = 11.83$, $p < .001$. In contrast to addition, there was no interaction with grade – intervention students in both grades showed greater improvement than those in the control group. Thus, the intervention was effective at improving subtraction fluency for students in Grades 2 and 3. Note, however, that students in Grade 2 benefited more from the intervention than those in Grade 3, which is consistent with the results for addition.

Figure 4. *Subtraction Fluency Scores by Group over time for Grade 2 and Grade 3 Students*



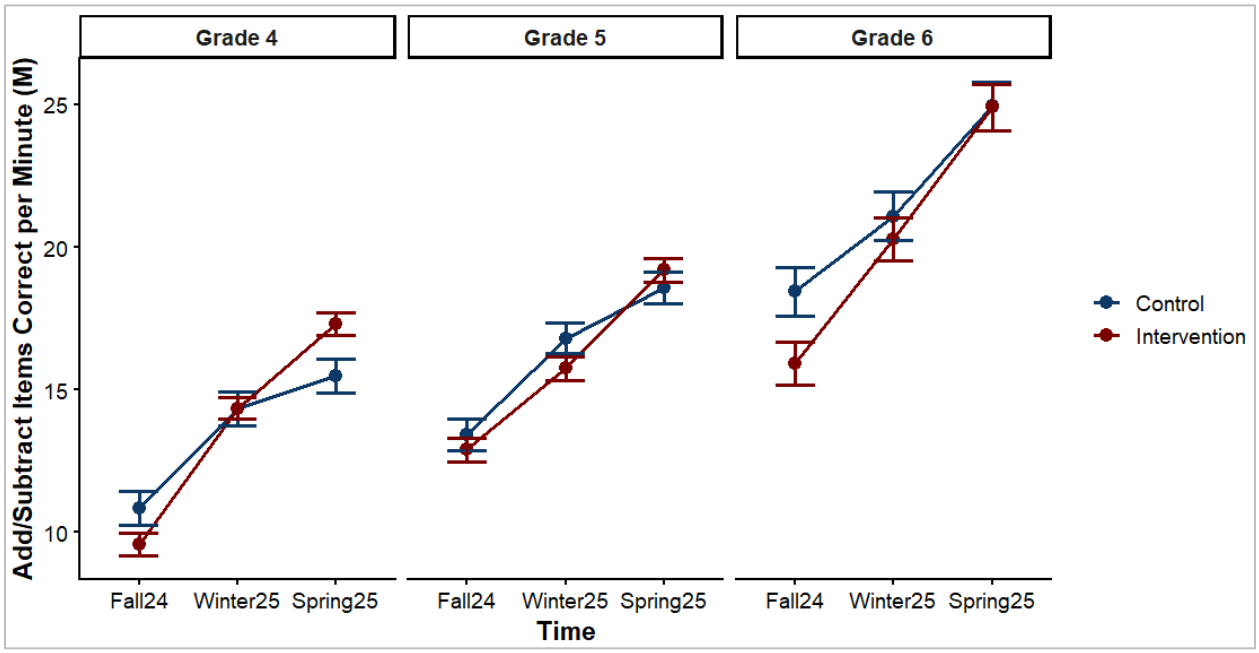
Note. The error bars represent 95% confidence intervals.

Grades 4 to 6

In grades 4 to 6, addition and subtraction fluency in the PNSA are combined into one subtest. Figure 5 shows the mean scores for PNSA addition/subtraction fluency for students in Grades 4, 5 and 6. There was a significant interaction between time and group, $F(2, 1139) = 18.519$, $p < .001$, and as shown in Figure 5, the pattern varied across grades, $F(4, 2278) = 3.472$, $p = .008$. To test whether the improvement in students' scores from Time 1 to Time 3 was greater for students in the intervention group compared to the control group, Time 3 scores were analyzed in a 3 (Grade: 4, 5, 6) ANCOVA, controlling for Time 1 scores. At Time 3, intervention students' fluency scores were significantly greater than those of control students in all grades: $F(1, 503) = 26.76$, $p < .001$, $F(1, 507) = 4.57$, $p = .033$, and $F(1, 161) = 7.03$, $p = .009$, for grades 4, 5, and 6, respectively. The intervention was effective but it took the whole year to see the impact of the intervention. Moreover, the pattern of change depended on the grade. In grade 4, intervention students started lower than control students, but ended up with higher scores. In grade 5 the pattern was similar, but the amount of the change was smaller. In grade 6, intervention students

started lower than control students but caught up. Notably, students in grades 5 and 6 did not practice addition and subtraction facts directly so any improvement is presumably related to their increased use of these skills during multiplication and division practice (relative to students in the control group).

Figure 5. *Addition and Subtraction Fluency Scores by Group over Time for Grades 4 to 6*



Note. The error bars represent 95% confidence intervals.

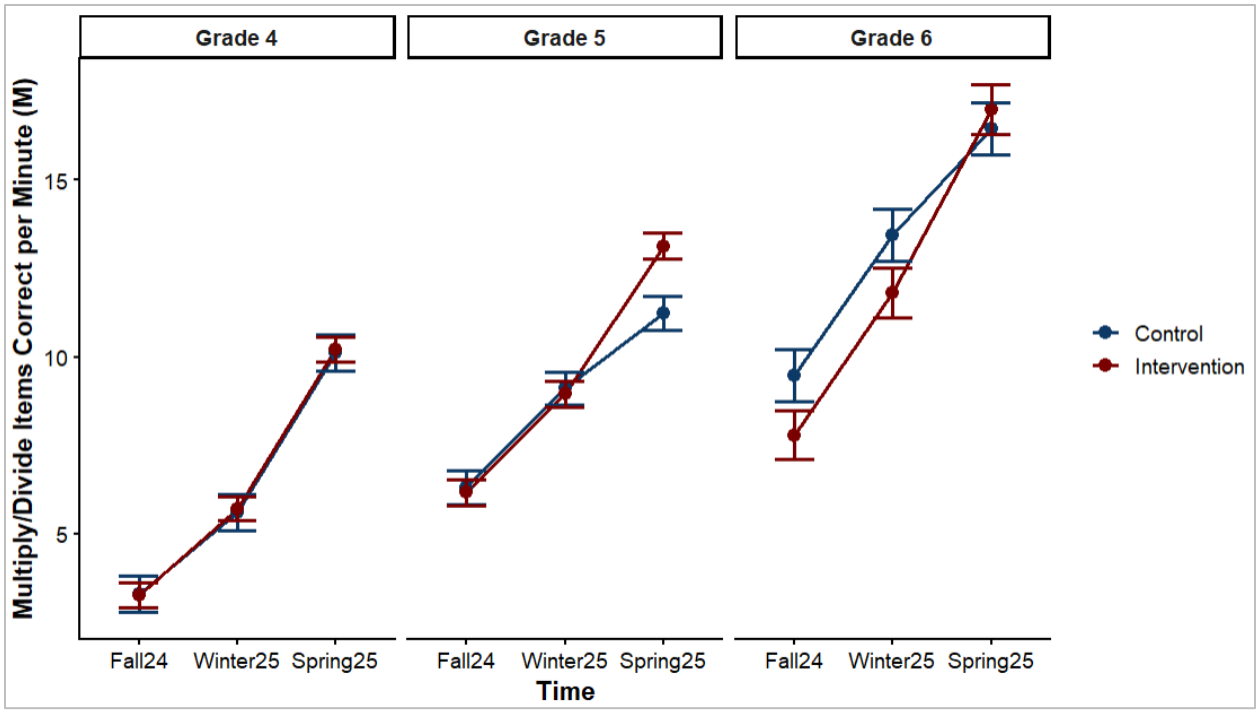
Multiplication and Division Fluency

Grades 4 to 6

Students' multiplication/division scores on the PNSA are shown in Figure 6. There was a significant interaction between time and group, $F(2, 1121) = 9.77$, $p < .001$, and the pattern varied with grade, $F(4, 2244) = 3.03$, $p = .022$.

To test whether the improvement in students' scores from Time 1 to Time 3 was greater for students in the intervention group compared to the control group, Time 3 scores were analyzed in an ANCOVA for each grade controlling for Time 1 scores. There was no effect of the intervention on Grade 4 students' fluency scores. For grades 5 and 6 students, however, multiplication/division fluency scores for intervention students in grades 5 and 6 were higher than those of control students, $F(1, 491) = 18.13$, $p < .001$, and $F(1, 161) = 4.15$, $p = .043$, respectively. In summary, the intervention had a positive effect on multiplication and division fluency scores for students in Grades 5 and 6.

Figure 6. *Multiplication and Division Fluency Scores by Group over Time for Students in Grades 4 to 6*



Note. The error bars represent 95% confidence intervals.

Summary

For students in Grade 2, the intervention led to more gains in both addition and subtraction fluency compared to students in control classes. For students in Grade 3, the intervention led to more gains in subtraction fluency compared to control students. For students in Grades 4 to 6, the intervention led to more gains in combined addition/subtraction fluency and for students in Grades 5 and 6, the intervention led to more gains in combined multiplication/division fluency compared to control students. These results are summarized in Table 2.

Table 2. *Summary of the Effects of the Intervention on Growth in Students' Arithmetic Skills on PNSA Arithmetic and Calculation Subtests*

Grade	Single Operations		Combined Operations		Multi-digit Calculation	
	Addition	Subtraction	Addition/ Subtraction	Multiplication/ Division	Addition	Subtraction
2	✓	✓				
3	x	✓				
4			✓	x	✓	x
5			✓	✓	x	x
6			✓	✓	x	x

Notes: ✓ = intervention students' skills grew more than control students' skills, the intervention worked; x = the intervention did not have a significant effect on the indicated skills

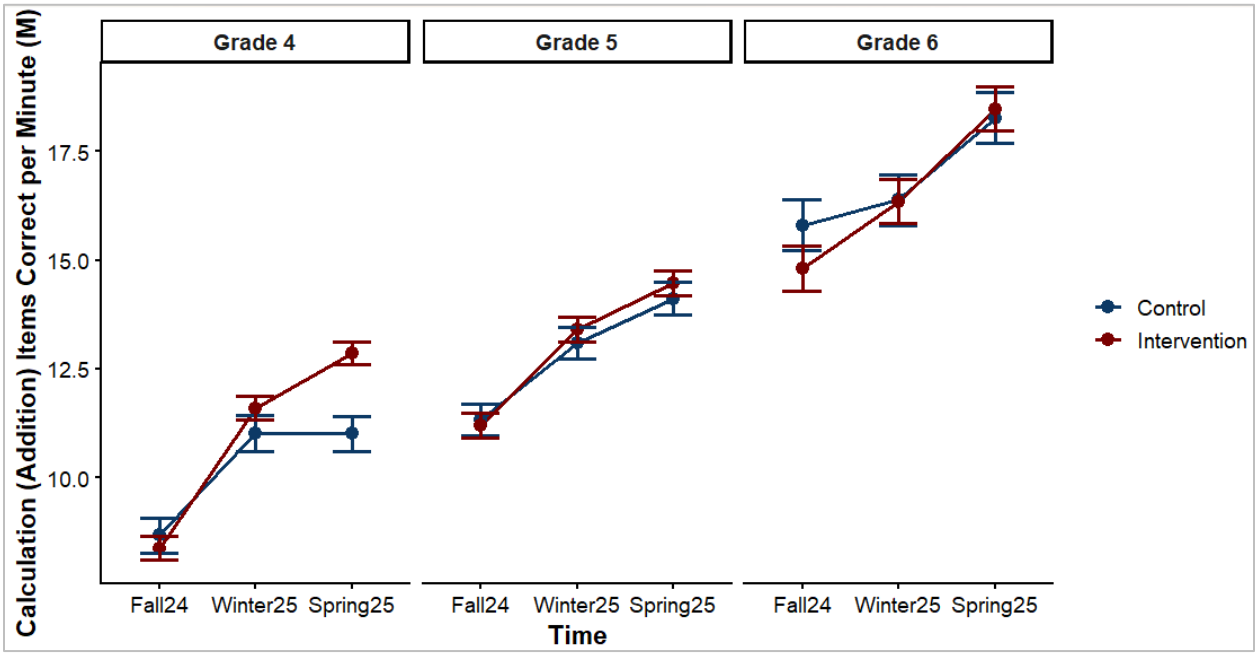
2 Did the intervention affect growth in students' multi-digit calculation skill?

Multi-Digit Calculation - Addition

The data for PNSA multi-digit calculation (addition) scores are shown in Figure 5. There were significant interactions between time and group, $F(2, 1208) = 18.52$, $p < .001$, time and grade, $F(4, 2418) = 6.83$, $p < .001$, and time by group by grade, $F(4, 2418) = 3.47$, $p = .008$. Thus, the pattern of change by group differed by grade as shown in Figure 5.

To better understand if the different patterns reflected greater growth in calculation addition scores for intervention students compared to control students, Time 3 performance was analyzed in an ANCOVA controlling for Time 1 scores. As predicted, intervention students in Grade 4 had significantly higher calculation addition scores compared to control students, $F(1, 531) = 26.32$, $p < .001$. The growth in scores for intervention students in grades 5 and 6 was not significantly greater than those for control students ($p = .217$ and .164, respectively). This result is not surprising given the intervention for these grades was focussed on multiplication and division, not on addition.

Figure 7. *Calculation (Addition) scores by group over time for students in Grades 4 to 6.*

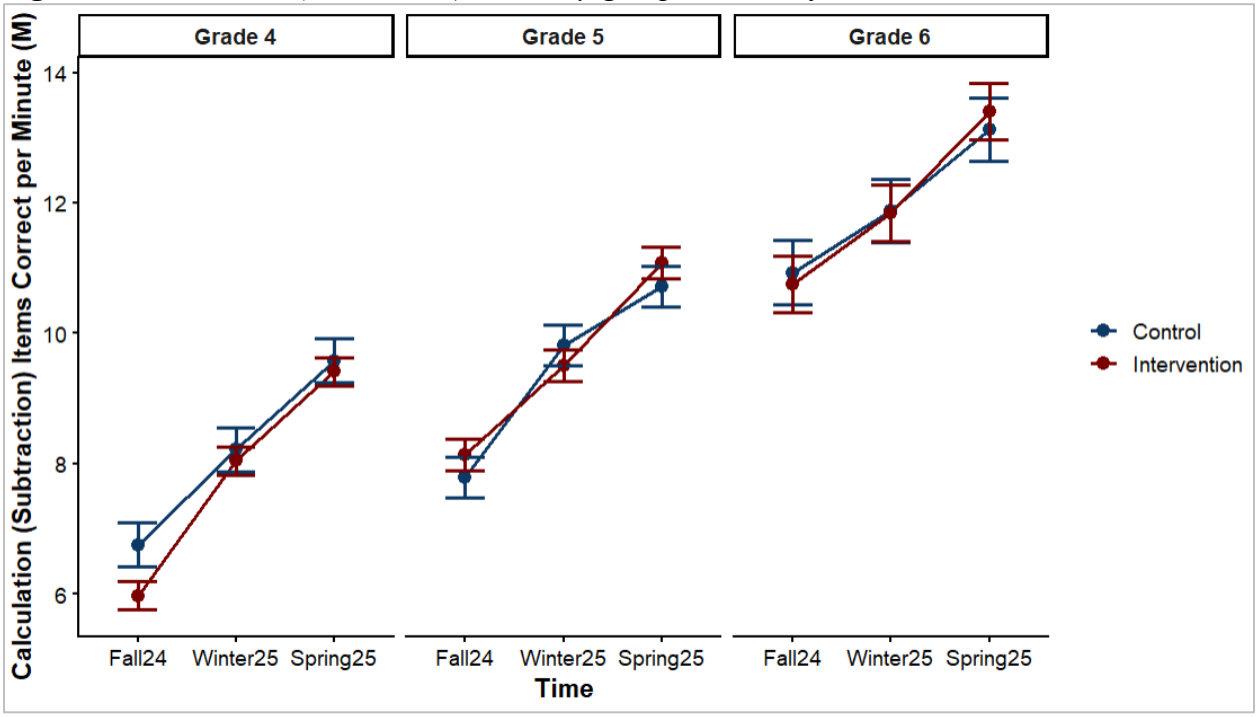


Note. The error bars represent 95% confidence intervals.

Calculation - Subtraction

Figure 6 shows the mean scores over time for PNSA Calculation (Subtraction). As shown in Figure 8, the only differences between groups were for grade 4 students in the Fall. Consistent with this pattern, the interaction of time by group was not significant, $F(2, 1194) = 8.25$, $p = .332$. However, intervention students in Grade 4 started the year lower than the control students ($p = .025$), suggesting differential improvement for this grade. Accordingly, the Time 3 scores for grade 4 were analyzed in a 2 (Group: Intervention, Control) ANCOVA, controlling for Time 1 scores. The growth in skills among Grade 4 students was not significantly different between intervention and control students, $F(1, 529) = 0.589$, $p = .445$. The intervention did not have an effect on students' calculation subtraction scores.

Figure 8. *Calculation (Subtraction) scores by group over time for students in Grades 4 to 6.*



Note. The error bars represent 95% confidence intervals.

To summarize, the fact fluency intervention had a positive effect on Grade 4 students' calculation addition skills. We did not find an effect of the intervention on calculation skills for students in grades 5 and 6 or for subtraction calculation skills in any of the three grades.

3 Did the intervention frequency relate to growth of students' fact fluency?

One hundred and nineteen teachers administered the intervention in their classrooms. Most of these teachers (N=104) completed progress reports. Teacher-reported intervention frequency was assigned equally to all students in the teacher's class; thus, student's absences were not considered in the frequency data.

On average, teachers reported doing the intervention three times per week (M = 3.04, SD =1.03) as recommended (see Appendix C). We examined the correlations between teacher-reported frequency and growth in students' fluency performance. Positive correlations indicate that students whose teachers reported a higher frequency of intervention sessions had greater growth in fluency than students whose teachers reported a lower frequency of intervention sessions. This pattern is shown in the green-filled cells in Table 3 and was observed in all fluency measures for students in grades 2 and 3. Interestingly, for students in Grade 4, more addition/fluency lessons did not influence growth addition fluency whereas more multiplication lessons related to greater

growth in both addition and multiplication fluency. This pattern suggests that for the teachers who completed the weekly surveys the addition practice may not have aligned with their students' needs, suggesting that students were ready to move on to multiplication practice sooner than anticipated. Anecdotal reports from the math leads support this conclusion. Finally, as expected, for students in grades 5 and 6 more multiplication practice led to greater gains in multiplication fluency. In general, groups of students whose teachers reported more practice showed greater growth in skills for many of the arithmetic measures.

Table 4. *Correlations Between Winter Fluency Gains Scores and Intervention Frequency*

Grade	N	Fluency Practice	PNSA Outcome Measure at Time 2			
			Addition	Subtraction	Combined Add/Sub	Combined Mul/Div
2	347	Add/Sub	.116*	.186***		
3	399	Add/Sub	.138**	.375***		
		Mul/Div	.155**	.191***		
4	393	Add/Sub			-.044	-.189***
		Mul/Div			.146***	.194***
5	450	Mul/Div			-.207***	.103*
6	199	Mul/Div			-.032	.209**

Notes: Green-filled cells indicate significant positive correlations and orange-filled cells indicate significant negative correlations. *$p < .05$, **$p < .01$, ***$p < .001$. Extreme outliers on fluency gains (SD>|3|) were excluded from correlational analyses

Discussion

The main purpose of this study was to determine if the **Ten Minutes to Mastery** full-class intervention implemented in Northern Alberta school divisions was effective at improving fact fluency skills of students in Grades 2 through 6. The intervention was designed to support improvements in addition and subtraction fluency in grades 2 through 4 and in multiplication and division fluency in grades 4 through 6.

As expected, the intervention was successful. Addition and subtraction fluency of students who participated in the intervention improved more than that of their peers who did not receive the intervention. Specifically, intervention students in Grades 2, 4, 5 and 6 showed greater growth in single-digit addition and subtraction fluency than control students whereas Grade 3 students showed greater growth than control students only in single-digit subtraction fluency. Students in Grade 4 also experienced some transfer of skills as evidenced by the positive effect of the intervention on their multi-digit addition calculation skills.

For multiplication and division fluency, we did not see the expected effect of the intervention in the Grade 4 students. Although their skills improved, they did not improve significantly more than those of the control students. We did however see an effect of the intervention on multiplication/division fluency for intervention students in Grades 5 and 6 who experienced significantly greater growth in these fluency skills compared to control students.

We were also interested to see if the frequency of the intervention related to growth in students' fluency skills. Teachers were asked to practice with the students three times per week. Based on first term weekly progress reports, on average, teachers reported successfully following the intervention recommendations. As expected, students whose teachers did the intervention more frequently generally had greater gains in their fluency skills than students whose teachers did the intervention less frequently. Importantly, doing the intervention on average 3 times per week led to greater fluency gains for students receiving the intervention compared to students who did not receive intervention.

In summary, these analyses tell us that the intervention was a success. Importantly, teachers' observations were consistent with the data. Many teachers shared insights about the intervention and its effect on their students. For example, one teacher commented that "…the students are engaged and self-competitive while being kind and encouraging of classmates." Another noted that she "…never had a class get subtraction so quickly and <now> they see the relationship between the addition and subtraction". Finally, one teacher shared how the intervention informed her understanding of her students' skills, "I learned how many students struggle with math facts." Looking at the data and recognizing the impact of the intervention on teachers and students we conclude that the intervention was a success. Ten Minutes to Math Mastery is an effective, low-cost enhancement of Tier 1 instruction in arithmetic.

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Appendix A

Strategy Sequence and Lesson Links from the website maintained by the National Centre for Excellence in Teaching Math in the United Kingdom

Addition and Subtraction

1. Adding 1 and 2
2. Adding and subtracting 1 and 2
3. Anchor to 5
4. Parts of 10
5. Adding doubles
6. Halving (inverse of doubles)
7. Adding near doubles
8. Adding and subtracting near doubles
9. Adding 10 (teens)
10. Adding and subtracting 10 from teens
11. Adding and subtracting 1 from teens
12. Adding 9
13. Adding and subtracting 9
14. Adding and subtracting 0
15. Derived facts

https://www.ncetm.org.uk/teaching-for-mastery/mastery-materials/primary-mastery-professional-development/number-addition-and-subtraction/

Multiplication and Division

1. Multiples and factors of 2, Divisors and quotients of 2
2. Multiples and factors of 10, Divisors and quotients of 10
3. Multiples and factors of 5, Divisors and quotients of 10
4. Multiplication by 0, Divisors and quotients of 0
5. Multiples and factors of 1, Divisors and quotients of 1
6. Multiples and factors of 4, Divisors and quotients of 4
7. Multiples and factors of 8, Divisors and quotients of 8
8. Multiples and factors of 3, Divisors and quotients of 3
9. Multiples and factors of 6, Divisors and quotients of 6
10. Multiples and factors of 9, Divisors and quotients of 9
11. Multiples and factors of 7, Divisors and quotients of 7

https://www.ncetm.org.uk/teaching-for-mastery/mastery-materials/primary-mastery-professional-development/multiplication-and-division/

Appendix B

Teacher Instruction Sheet – Addition/Subtraction

Preparation for each Practice Session:
Use a visual strategy for each day of practice. Select a *number line visual* for strategies +1/+2, -1/-2 and difference of ½, use *ten frames visual* for anchor to 5, parts of ten, doubles, near doubles, and a number line visual for all other strategies (e.g. adding zero, teens, and derived facts). See the ones provided in the package.
Copy one progress monitoring page (PM) per student for independent practice at the end of each practice session.
Identify the first "Worker," which should be the higher-performing student. This student will always work first.
Strategy Instruction for each Session:
Keep the strategy instructions to a minute or less. Provide students with the visual representation (see above) along with a "think aloud" to explain the strategy used to solve the fact.
Fluency Card Practice for each Session:
Say: *It's time for our FACT Fluency practice. Please get together with your math partner. Please take out your sorted deck of fluency cards and show me that you are ready.*
Say: *Workers, your job is to work as many problems correctly as you can. As you work, say the complete equation aloud and explain how you know the answer so your partner can HEAR you solve the problem and know the strategy you are using. Use a quiet voice while you work.*
Say: *Helpers, your job is to follow along, listen, and watch as the worker is solving problems. If your partner solves the problem correctly, place the known fact at the back of the deck. If you hear an error, speak up!* **Say:** *"Stop, Let's check this one." You should give the worker a hint about the strategy, but don't give them the answer. If the worker is stuck, solve it aloud so the worker knows how you got that answer. Put the unknown fact a few cards back in the deck. If you get really stuck as the Helper, put the card to the side and ask me for help.*
Set the timer for 3 minutes.
Say: *Remember, your goal is to work as many problems as possible with 100% accuracy. Ready? Begin!*
Start the timer when you say "Begin". The Helper will begin presenting flashcards to the Worker. Monitor students to ensure they are actively engaged in their roles.
When the timer rings, **Say:** *Stop practicing and switch roles. Pass the cards to your partner. They will start solving problems where you left off.*
Set the timer for 3 minutes.
Say: *Remember, good Workers solve problems by thinking out loud and explaining how they got the right answer. Good Helpers listen carefully, following along to catch any errors, and help the worker get the right answers by giving a strategy hint when needed. Ready? Begin!*
Start the timer when you say "Begin".
Provide the student with an independent practice sheet upside down.
Independent Practice for each Session:
When the timer rings, **Say:** *It's time for independent practice. Please put fluency cards away and show me you're ready by putting your name on your practice paper and then eyes on me.*

Say: *Remember your score from last time. Your goal today is to beat your score! Remember, your brain is like a muscle. You just worked your math muscle. Now let's see how much stronger you are getting!*
Set the timer for 2 minutes and **Say:** *Start on the first problem, work from left to right, and try to work every problem. If you don't know an answer, make your best guess and move on. Ready? Begin!*
Start the 2-minute timer. Encourage students to keep working where needed.
After the timer rings, **Say:** *Stop, put your pencils down and hold your paper in the air. Take out a correcting pen and show me you are ready. As I read the problem aloud, we will all say the answer aloud together. If your partner got it incorrect, put a slash through the incorrect answer. When your partner has no more answers on the paper, begin writing the answers to the problems using your scoring pen.*
Briskly read each problem while the whole class reads the answers aloud. You may consider writing the answers on an answer key displayed on your smartboard.
Optional Practice: Say: Get your own paper back and find the errors that have been marked with as slash through the answer. Correct your errors while explaining in a quiet voice out loud how you fixed them. If you do not have any errors, review the problems that have been answered for you, and then create your own problems just like the ones we are working on.
Graphing Results for each Session:
Say: *Now record your score on your graphing chart.*
Remember to celebrate students who have beaten their score from the day before! If you have met the goal for moving on or have closed the gap, celebrate these goals as well. In addition to building math confidence, goals like this help develop a growth mindset.

Appendix C

Teachers' Weekly Progress Reports (September to January)

Each week teachers were asked to report how many days (0 to 5) their class participated in the intervention, the focus of the lessons (i.e., addition/subtraction or multiplication/division) and the strategy they were teaching. Teachers rated how engaged they felt the students were during the weekly sessions; 1 = not at all engaged, 2 = somewhat engaged, 3 = engaged, 4 = very engaged and 5 = extremely engaged. The values shown in Table C1 are averaged across teachers. On average, teachers submitted just under 12 weekly reports. They did approximately three intervention lessons per week and felt their students were engaged during the intervention.

Table C1. *Teacher-reported lesson frequency ($n_{teachers}$ = 104)*

	N	*M*	*SD*	*Min*	*Max*
Weeks Reported	104	11.01	2.84	2.00	16.00
Student Engagement	104	3.70	0.61	1.00	5.00
Total Frequency	104	30.56	14.72	0.00	62.00
Average lessons per week	104	3.04	1.03	0.00	4.75