Spring 5-12-2023

Effects of Small Group Instruction on Fact Fluency Progress

Kristi Gaida
ak6844pe@go.minnstate.edu

Effects of Small Group Instruction on Fact Fluency Progress

A Project Presented to
The Graduate Faculty of
Minnesota State University Moorhead

By

Kristi Gaida

In Partial Fulfillment of the
Requirements for the Degree of
Masters of Science in
Curriculum and Instruction

May 2023

Moorhead, Minnesota

Table of Contents

ABSTRACT

This study will focus on the impact small group and individual instruction has on fact fluency. The specific group of facts being multiplication facts 0-12. This study will be based in a 6th grade math classroom in rural, central Minnesota. Students will be given a pre-test to assess their base knowledge of multiplication facts 0-12. Over the course of the study, student progress will be monitored through different interventions along with progress monitoring through the use of FastBridge. At the end of the study, students will also receive a post-test to help solidify the validity of the results for the study.

During this study, students were divided into groups based upon which multiplication facts they needed more practice in. Students worked in small groups with the teacher-researcher with the main focus on skip counting and finding patterns. 1 day a week students participated in a whole group activity, 3 days a week they worked in selected small groups with the teacher researcher, and 1 day of the week students did progress monitoring. Through the process the researcher found that implementing small group and whole group instruction that focuses on number sense and fact fluency did improve students' overall multiplication fact fluency.

Chapter 1

Introduction

Introduction

A student's knowledge of their basic math facts is a crucial building block to a successful math career. However, many students still struggle with simple addition, subtraction, multiplication, and division well into high school. With fact fluency being the key to many other mathematical concepts, one can only wonder if students worked more on fact fluency would their overall math scores improve? "If automaticity with math facts operates as a cornerstone for ongoing skill development, students who fail to attain fluency may, in turn, struggle with more complex math skills" (Nelson, Peter M, 2016).

Educators are aware of the importance basic fact fluency plays for the future of our students and are also aware that students are still struggling with this. Despite this, the way fact fluency is being taught across the different operations, especially multiplication, has remained the same. More often than not, basic multiplication facts are taught as a memorization skill. "Rote memorization of basic facts has the added flaw that, if you forget the fact, you have no alternative for figuring it out efficiently." (Bay-Williams, Kling, 2019, p. 160). We also know that number sense plays a big role in the success of one's fact fluency. "Plain and simple, number sense is a person's ability to understand, relate, and connect numbers." (Hogan, 2017). The better one's number sense is, the better the fact fluency; the two go hand-in-hand.

Brief Literature Review

Fact fluency is a pivotal building block in a successful mathematics career. "If automaticity with math facts operates as a cornerstone for ongoing skill development, students

who fail to attain fluency may, in turn, struggle with more complex math skills" (Nelson, Peter M, 2016). For years the focus for teaching multiplication facts has been to force memorization to our students. As research has shown, this method may help in the short term, but has not proven to have a lasting effect. "Students subjected to such programs may appear to know the facts in the short term, but within weeks or months they are back to where they started: counting." (Bay-Williams, Kling, 2019, p. 5) Counting may get a student to the answer, however this is inefficient and would not promote fact fluency.

Number sense is another crucial part to one's mathematic success. "Plain and simple, number sense is a person's ability to understand, relate, and connect numbers." (Hogan, 2017). Number sense helps build strong fact fluency while fact fluency helps foster a strong number sense. These two work closely together to promote growth within mathematics. To build both of these, it's important to promote a variety of sound strategies. Having a candy bag of strategies to choose from will allow students the opportunity to solve a problem when what once was memorized is now lost.

Statement of the Problem

The research problem was to measure the improvement of student's multiplication fact fluency by spending time in small group instruction that focuses on number sense. Currently, students the researcher works with struggle to recall their basic multiplication facts. As several forms of research would suggest, along with the researcher's own observations, a lack of basic fact knowledge hinders a student's ability to perform other math skills. The district the researcher is currently at does spend ample time reviewing basic multiplication facts starting in the 3rd grade. However, what the researcher has found in their own investigating is that most forms of instruction provided at their school relies heavily on a memorization method.

Purpose of the Study

The purpose of this study is to help promote sound strategies for fact fluency for the researcher's sixth-grade students. By having a strong background of fact fluency and number sense, the researcher's goal is to help students' overall multiplication fact fluency. As proven in several research studies, having basic fact knowledge is the building blocks to all other mathematics skills. The researcher was concerned with their students' current ability to recall efficiently their basic multiplication facts. Less than 50% of the researcher's current students show proficiency in their fact fluency based on FastBridge data.

Research Question

Does small group instruction have a positive effect on fact fluency?

Definition of Variables

The following are the variables of the study:

Variable A: The progress students show in their weekly and bi-weekly progress monitoring will be the dependent variable.

Variable B: The progress students are making on their number sense in a small group and whole group setting will be the independent variable.

Significance of the Study

Math educators in middle school through high school are seeing how far behind students are in their current fact fluency. The repercussion of this is that students struggle to do any other mathematical operation in an effective and efficient way. This issue has created huge gaps in mathematics education that become more noticeable at the high school level courses. By

focusing on sound strategies for fact fluency and number sense, students will have a strong background of basic facts that will in-turn provide a stronger math career.

Research Ethics

Permission and IRB Approval. In order to conduct this study, I received approval from MSUM's Institutional Review Board (IRB) to ensure the ethical conduct of research involving human subjects (Mills & Gay, 2019). Likewise, authorization to conduct this study was sought from the school district where the research took place, at a rural school in Central Minnesota.

Informed Consent. Protection of human subjects participating in research were assured. Participant minors were informed of the purpose of the study via the Informed Consent Letter. I also read the method of assent to the participants before beginning the study. Participants were made aware that this study was conducted as part of the researcher's Master Degree Program and that it was intended to benefit the researcher's teaching practice. Informed consent means that the parents of participants were fully informed of the purpose and procedures of the study for which consent was sought, and the parents understood and agreed, in writing, to their child participating in the study (Rothstein & Johnson, 2014). Confidentiality was protected through the use of pseudonyms (e.g., Student 1) without the utilization of any identifying information. The choice to participate or withdraw at any time was outlined in both verbally and in writing.

Limitations

Limitations to this study would include students with specialized education needs that hinder their math comprehension. Examples of this would include students receiving services with ESL or Special Education. Students receiving such services will be participate in this study

when they are in the classroom like their peers. However, results from these students will not be part of this study as they are also receiving math intervention from an additional source.

Chapter 2

Literature Review

Introduction

The skill of knowing one's basic math facts is a crucial building block in the success of mathematics. Yet, many students still seem to struggle well in to their middle and high school years. "This is because there are two fundamental flaws in this type of instruction: {1} a lack of attention to strategies, falsely assuming students can go straight from counting {or skip counting} to just knowing the facts: and {2} a lack of effective assessment, falsely assuming that timed tests can provide meaningful data on student mastery of basic facts." (Bay-Williams, Kling, 2019, p. VII).

Educators are aware of the importance of basic multiplication facts for the future of each student, and as kids still seem to struggle we continue to keep moving on. With so much riding on these basic skills educators should place more of an emphasis on fact fluency. Sometimes the mere definition of fluency can be unclear. According to Figure 1.1 of *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention*, procedural fluency means you are computing with flexibility, accuracy, and efficiency (p. 2).

"If automaticity with math facts operates as a cornerstone for ongoing skill development, students who fail to attain fluency may, in turn, struggle with more complex math skills" (Nelson, Peter M, 2016). While proving your knowledge of multiplication facts may not continue to be a state standard or listed in your curriculum past the third grade, the proof of its significance should warrant supplementation into extended levels of mathematics.

Memorization

As we first teach students their multiplication facts, a phrase often heard is to memorize them. While memorizing items may help in the short term it will not help students' understanding of the concept. "Rote memorization of basic facts has the added flaw that, if you forget the fact, you have no alternative for figuring it out efficiently." (Bay-Williams, Kling, 2019, p. 160). However, the way multiplication facts have been taught has remained nearly the same for years.

It is time more of an emphasis be placed on sound strategies to help students comprehend the math at hand than to place such importance on rote memorization. By teaching students skills to go about solving facts fluently they are also able to solve similar problems applied in different situations. While this may take more time to achieve, the payoff will be great not only for the student, but for their future educators as well.

"Researchers indicate that students may struggle with the use and understanding of formal algorithms if their knowledge is dependent on memory, rather than anchored with a deep understanding of the foundational concepts (e.g. Battista, 2012; Carpenter, Franke, & Levi, 2003; Empson & Levi, 2011; Fosnot & Dolk, 2001; Kaput, 1989)" (Hulbert, 2017, p. 18). As found in a multitude of studies, memorization of facts does not contribute to fact fluency. The results show it is time to move on to a new way of instructing this consequential skill.

Number Sense

A topic often discussed and measured to show a students' success in math is number sense. "Plain and simple, number sense is a person's ability to understand, relate, and connect numbers." (Hogan, 2017). Children who have secure number sense posses the following: ability

to visualize and talk comfortably about numbers, take numbers apart and put them back together in different ways, compute mentally, and relate numbers to real-life problems by connecting them to their everyday world (Hogan, 2017).

As previously noted, there is great amounts of research to support the memorization of basic math facts does not support students and their math growth. The push for sound strategies would support and foster number sense greatly for our students. This is why it is so important to start this early on in a student's educational career. Building a sound platform of number sense will also strengthen and encourage math confidence, and in turn lowering cases of math anxiety. "Focusing on number sense in the younger grades helps build the foundation necessary to compute and solve more complex problems in older grades." (Hogan, 2017) It is very clear that fostering a strong number sense does not support the idea of memorization.

Fact Fluency

The entire goal of knowing basic multiplication facts is to have fact fluency. Too many students move on each year without having sound fact fluency and this hinders them in their success for future grades. As we previous learned, there are 3 parts to fact fluency: accuracy, efficiency, and flexibility (Bay-Williams, Kling, 2019). Efficiency and flexibility also include the ability to choose the appropriate strategy. To understand each of these better we will define all four as given by *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention* (Bay-Williams, Kling, 2019):

Accuracy: the ability to produce mathematically precise answers

Efficiency: the ability to produce answers relatively quickly and easily

Appropriate strategy use: the ability to select and apply a strategy that is appropriate for

solving the given problem efficiently

Flexibility: the ability to think about a problem in more than one way and to adapt or adjust thinking if necessary

Each of these abilities requires cognition and higher-leveled thinking. Again, the importance of number sense rather than memorization becomes a key topic in the promotion of fact fluency. If a student is unable to recall a specific number or strategy it is important for them to have the problem-solving skills to assess where they are and how they can move forward. This may mean trying a different strategy entirely to solve the problem at hand. Having a sound basis of fact fluency will assist with a strong fluency in math which is ultimately what we want for our students.

Research Question

Does small group instruction have a positive effect on fact fluency?

Conclusion

With such importance weighing on fact fluency, going back to refresh, even at the middle school age, is vital to the success of the student. It has become very clear through numerous studies that simply memorizing multiplication facts is not enough to promote number sense and math confidence. Until educators as a whole work to find a new solution to the initial introduction of multiplication facts, it is clear multiplication supplementation in the classroom through high school is necessary. While multiplication will not always be a standard listed each year, the emphasis fact fluency plays in the basic knowledge of mathematics will prove worth-while.

As a current math teacher, the researcher sees the struggle to recall basic facts daily. The researcher also sees how much this hinders the student to complete math tasks that should other wise be simple. Educators need to be aware of the importance basic facts of addition, subtraction, multiplication, and division are to the future success of the student. Without these building blocks students will continue to struggle and we will see confidence in math continue to dwindle. "Basic facts truly are the foundation on which all mathematical computation is based" (Bay-Williams, Kling, 2019, VII).

Chapter 3

Methods

Introduction

This study was conducted to help improve student's overall fact fluency while focusing on number sense in a small group setting. As several research studies have shown, sound fact fluency is the building block to a successful math career. Educators are seeing a rise in the number of students who struggle to recall their basic math facts. This creates challenges further in a student's math career when trying to solve rigorous math problems.

"Rote memorization of basic facts has the added flaw that, if you forget the fact, you have no alternative for figuring it out efficiently." (Bay-Williams, Kling, 2019, p. 160). Research shows that just memorizing multiplication facts is simply not enough. While memorization may work in the short term, without having sound strategies to fall back on, long term recall can be a struggle. By having sound strategies to rely on, when students can not recall a fact from memory they still have a way that's efficient to complete the problem at hand.

Research Question(s)

Does small group instruction have a positive effect on fact fluency?

Research Design

Students will participate in whole group and small-group multiplication fact fluency activities and interventions. Activities used will be evidence based to promote sound strategies for number sense rather than memorization tactics. Small-group activities will be based upon different facts students need to focus on. One-on-one instruction maybe implemented as intervention for a student as needed. Weekly progress will be tracked by fluency assessments.

Students will also participate in bi-weekly FastBridge progress monitoring to assess their automaticity.

Setting

The setting of this study was a rural elementary school located in central Minnesota with a population of just over 3,000 people. The district also has several students who live outside the district limits that choose to open enroll. The district has 52% of students receiving free and reduced lunch and a very diverse population with 50% of the students identifying as Hispanic or Latino race (*Long Prairie-Grey Eagle School District - U.S. News Education*, 2022). It's a farming community that also houses several packaging plants. School enrollment was 930 students in K-12th grade. 65 of them in sixth grade at the elementary building. Of the students enrolled in district, 46.1% were Caucasian, 49.5% Hispanic or Latino, 0.2% were Black or African American, and 0.4% American Indian. Within the district, 37% receive ESL (English as a Second Language) services and 59.2% qualified for free or reduced breakfast and lunch.

Participants

The participants of the researcher's action research were students randomly selected from their sixth-grade students from the 2022-2023 school year. There were 65 students in the grade with 32 boys and 33 girls. There were 28 students in the grade that were Caucasian, 37 Hispanic or Latino, 0 were Black or African American, and 0 American Indian. Within the grade, 17 receive ESL (English as a Second Language) services.

Sampling

The sample for this research were randomly selected students from the researcher's sixth-grade math classes. All students present in the classroom did participate in the small group instruction and the group activities, but only the 4 randomly selected students had data collected

for the purpose of this study. Students receiving specialized education accommodations participated in the activities of the study, but their data is not included with the whole group data as their accommodations could hinder the validity of the results. These students do have a background knowledge of multiplication facts, but most have received their instruction through the use of memorization.

Instrumentation

Data will be collected through the use of formal and informal assessments in the classroom. Most assessments will come from the book *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention.* This book provides several research-based fact fluency instruction techniques along with valid assessment tools to support this study.

FastBridge will also be used to collect bi-weekly data on students' fact automaticity. FastBridge is a current program utilized in the school for tracking data. The students are already familiar with this assessment and there will not be a learning curve for them in order to take the assessment correctly.

Data Collection

Base-line data will be collected from FastBridge and a multiplication quiz before implementing the study. The information from this data will be used to help form solid small groups based upon which multiplication facts the students need the most assistance with. Data will be collected on a weekly basis through formal and informal assessments.

Data Analysis

To assess the success of the study, data will be organized into a spreadsheet. Data from the student's baseline data will be compared to their progress with multiplication fact fluency.

Student's overall fact fluency will be tracked to see if they have any noticeable improvement. Both sets of data will be compared with FastBridge automaticity and computation data.

Research Question(s) and System Alignment

Table 3.1

Research Question(s) Alignment

Research Question	Variables	Design	Instrument	Validity & Reliability	Technique	Source
Does small group instruction have a positive effect on fact fluency?	The progress students show in their weekly and bi-weekly progress monitoring will be the dependent variable The progress students are making on their number sense in a small group and whole group setting will be the independent variable	Small Group Instruction Whole Group Instruction One-on-one intervention Action Research	Formal Assessment Informal Assessment FastBridge	The researcher will be gathering data on a weekly and bi weekly basis. The scripted assessments and interventions will allow the researcher to provide an equal learning opportunity.	Students will be given baseline assessments and then given whole group, small group, and one-to-one multiplication fluency instruction	Sixth-Grade students

Procedures

Students will spend 10-15 minutes during their regular scheduled math block on that day's multiplication activity. Students are seen for math class five days a week. One day will be spent doing a whole group multiplication activity, 3 days will consist of small group instruction (or one-to-one intervention as needed), and one day will have a formal assessment of their current ability in multiplication fact fluency. Whole group activities will consist of a whole

group game model to practice basic multiplication facts. Small group and one-on-one intervention will consist of activities from *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention.* Assessment will also be taken from *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention.* Students will also continue to receive their bi-weekly FastBridge assessment as according to the district's testing schedule. Progress will be continuously monitored on all described platforms through the entirety of the study.

Ethical Considerations

The researcher sent home an informed consent letter in both English and Spanish to the students the researcher sees for sixth grade math. Parents or guardians were informed of the activities and assessments their student would be taking part in by agreeing to the informed letter of consent. By receiving this information ahead of time, parents or guardians were given the option whether or not they would like their student to participate in this study. All data was kept confidential and names were changed to a pseudonym. Students who participated in the study were not exposed to anything additional they would not already receive in a regular sixth grade math class, therefore no additional harm was presented to the student.

Conclusions

The school in which this study was conducted has a low socioeconomic status and is culturally diverse. The researcher used the students already present in their sixth-grade math classes while considering that students receiving any sort of specialized classroom accommodations could challenge the validity of the data collected. The researcher will provide weekly and bi-weekly assessments to assess the improvement of multiplication fact fluency.

Chapter 4

Data Analysis and Interpretation

The purpose of this study is to build number sense and fact fluency amongst student participants to help improve their overall basic multiplication fact fluency. "If automaticity with math facts operates as a cornerstone for ongoing skill development, students who fail to attain fluency may, in turn, struggle with more complex math skills" (Nelson, Peter M, 2016). There is great importance in the number sense and fact fluency of multiplication which is why the action researcher felt so strongly to dig into this area further.

Data Collection

For this study, the researcher used a variety of items to collect data on the students that the researcher worked with. Each week the students took at multiplication quiz that included 145 multiplication problems (0 to 12) in a random order and the students were given 5 minutes to complete this. In addition to the multiplication quiz, the researcher would also have the students take the automaticity quiz provided by the building wide progress monitoring program, FastBridge. This assessment was also given once a week during the duration of the study. This was another timed test that focused on multiplication facts 0 to 12.

As well as collecting data from assessments, the researcher started their study with a multiplication inventory. These involved students completing every multiplication fact in order starting with their 1's all the way to their 12's. Students were not timed on this, but were asked that if they couldn't think of the answer quickly to leave it blank and move on. To ensure students were moving quickly and not trying to work out problems on the side of their paper or

counting on their fingers, the researcher called back small groups of 4 to 5 students to sit by teacher-researcher at the group table for close monitoring. The data collected from this specific item was used to create small groups based on their fact needs. The researcher was also able to observe students for understanding during the small group and whole group time.

Results

RQ 1: Effects of Small Group Instruction on Fact Fluency Progress

Small group multiplication fact fluency practice took place over a span of 4.5 weeks. During each week, students would spend 15 minutes per day for 3 days working on multiplication facts that were flagged as high risk in a small group setting. One day a week, students would participate in a whole group activity that promoted the use of multiplication facts. The fifth day of the week was used for progress monitoring assessments.

During small group time, the researcher would spend the 15 minutes working on 1-2 multiplication fact families in a group of 3-6 students. The focused skill during this time was skip counting and students were asked to recognize any patterns that they saw while doing this.

Table 4.1

Multiplication (0 to 12) Progress Monitoring

Student:	Week 1	Week 2	Week 3	Week 4	Week 5
	Baseline				Final
A	47	51	41	55	62
B	46	51	62	60	53
I	49	56	57	67	65
M	40	X	46	37	37
Average	45.5	52.7	51.5	54.8	54.3

Note: Student scores are based on how many correct out of 145 presented questions in a time limit of 5 minutes. Students were given this assessment at the beginning of each week during the course of the study. An "X" indicates that a student was not present the day of that assessment and was not able to take it before proceeding with continued intervention.

Table 4.2

Multiplication (0 to 12) Progress Monitoring Breakdown

Student:	Mean	Median	Range	SD
A	51.2	51	21	7.11
B	54.4	53	16	5.89
I	58.8	57	18	6.52
M	40	38.5	9	3.67
Average	51.1	49.9	16	5.80

Note: Student data analysis is based off of their weekly multiplication progress monitoring. This includes baseline and final scores. Refer to Table 4.1 for individual data that was used to comprise this table.

Data collected by FastBridge was determined by the researcher as unusable for the purpose of this research study. Scores accumulated weekly by FastBridge were put into a full year data assessment that did not allow for the analysis of each week's breakdown according to the researcher's knowledge.

Data Analysis.

Overall, the researcher was able to see improvement in the student participant's multiplication facts. The researcher anticipated to see more gradual improvement of the course of the 4.5 weeks. However, each student had a moment of descend in their overall participation of

the study. As many previous studies have shown, having sound number sense does help improve overall multiplication fact fluency. The researcher focused on this skill during small group interventions by having students work with basic skip counting and looking for patterns while doing so. This strategy proved efficient in the goal of the study by the data provided in Table 4.1 and Table 4.2.

One problem that came up while conducting the study was if a student missed progress monitoring or a day of intervention. Of the student sample, there was a total of 5 absences over the course of 4.5 weeks. Another problem the researcher faced was the inability to get an accurate data analysis of the FastBridge data. While the collection of data from the Multiplication (0 to 12) Progress Monitoring proved to work, having another form of comparison would have been nice for stronger reliability in the results.

Conclusion

Before beginning this study, the action researcher understood the importance of fact fluency for students: not only for the sake of being able to quickly and efficiently being able to recall basic facts, but to help with future math that would require more steps. Having sound background of fact fluency helps move through multi-step problems much more fluidly. The growth the students in this study have shown prove that working to solidify fact fluency while building number sense does help improve basic multiplication fact fluency. Not only were students able to work on number sense in a small group setting, students were also able to participate in group game-like activities that help with the practice of their multiplication facts that they had been working on. These items together allowed for a fun, engaging, and interactive way to work with the student participants while also improving their basic multiplication fact fluency.

Chapter 5

Implications for Practice

The purpose of this study was to look more closely at the benefits of continued practice with number sense and fact fluency to help with the improvement of overall basic multiplication facts. Several studies overtime have proven the importance of basic fact fluency and having a solid understanding of number sense. With a background of teaching middle school math, the researcher found great importance in having a sound foundation of multiplication facts in order to have a successful math career. That is why the researcher chose to look more closely at this topic.

This study has shown that focusing on number sense of math facts that a student is struggling with does help improve their basic multiplication fact fluency. Over the course of 4.5 weeks, students were able to work in small groups along with group activities to help deepen their knowledge and understanding of number sense. This in turn proved, through the collection of data in weekly progress monitoring, that number sense does help strengthen multiplication fact fluency amongst the student participants.

Action Plan

The researcher plans to use the information found in the study to better help their teaching practice in their classroom. From this study the researcher found how beneficial the implementation of small groups can be to focus on fundamental skills needed to help be successful for current and future math concepts.

The researcher plans to continue with small group interventions in the classroom: not only will the focus be on multiplication, but other base skills that are important for life-long math

success. Before this process, the researcher had felt lost as to where to start with small groups and the best way to keep track of data during this time. Over the course of this study, the action researcher has learned better practices for small group intervention that has helped build confidence and will aid in the continuation of implementing small groups in the classroom.

Plan for Sharing

The action researcher plans to share this information with their colleagues, instructional coach, and administration. In sharing, the researcher hopes to inform and inspire others to focus on number sense while providing multiplication fact instruction. Not only is number sense an important topic of this study, but also how small group instruction is important to students who need intervention in building block skills to become successful at math.

References

Avitia, Maria, et al. "Achievement Error Differences of Students with Reading versus Math Disorders." *Journal of Psychoeducational Assessment*, vol. 35, no. 1-2, 2016, pp. 111–123., https://doi.org/10.1177/0734282916669209.

Balhinez, Reut, and Shelley Shaul. "The Relationship between Reading Fluency and Arithmetic Fact Fluency and Their Shared Cognitive Skills: A Developmental Perspective." *Frontiers in Psychology*, vol. 10, 2019, https://doi.org/10.3389/fpsyg.2019.01281.

Bay-Williams, Jennifer M., and Gina Kling. *Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention*. ASCD, 2019.

Bender, William N., and William N. Bender. *Differentiating Math Instruction, K-8: Common Core Mathematics in the 21st Century Classroom*. Corwin, 2013.

Berrett, Andrew N., and Nari J. Carter. "Imagine Math Facts Improves Multiplication Fact Fluency in Third-Grade Students." *Journal of Behavioral Education*, vol. 27, no. 2, 2017, pp. 223–239., https://doi.org/10.1007/s10864-017-9288-1.

Boyles, Nancy N. *Rethinking Small-Group Instruction in the Intermediate Grades: Differentiation That Makes a Difference*. Maupin House, 2011.

Codding, Robin S., et al. "Meta-Analysis of Mathematic BASIC-Fact Fluency Interventions: A Component Analysis." *Learning Disabilities Research & Practice*, vol. 26, no. 1, 2011, pp. 36–47., https://doi.org/10.1111/j.1540-5826.2010.00323.x.

De Visscher, Alice, and Marie-Pascale Noël. “Arithmetic Facts Storage Deficit: The Hypersensitivity-to-Interference in Memory Hypothesis.” *Developmental Science*, vol. 17, no. 3, 2014, pp. 434–442., https://doi.org/10.1111/desc.12135.

Emerson, Jane, and Patricia Babtie. *The Dyscalculia Solution: Teaching Number Sense*. Bloomsbury Education, 2014.

Erbeli, Florina, et al. “Developmental Dynamics between Reading and Math in Elementary School.” *Developmental Science*, vol. 24, no. 1, 2020, https://doi.org/10.1111/desc.13004.

Espinas, Daniel R., and Lynn S. Fuchs. “The Effects of Language Instruction on Math Development.” *Child Development Perspectives*, vol. 16, no. 2, 2022, pp. 69–75., https://doi.org/10.1111/cdep.12444.

Hogan, Jennifer. “Demystifying Math: What Is Number Sense?” *Scholastic*, 2017, https://www.scholastic.com/parents/school-success/learning-toolkit-blog/demystifying-math-what-number-sense.html.

Hulbert, Elizabeth T., et al. *A Focus on Multiplication and Division Bringing Research to the Classroom*. Taylor and Francis, 2017.

Kromminga, Kourtney R., and Robin S. Codding. “A Comparison of 1:1 Flashcards and a Tablet App on Student Mathematics Proficiency.” *Journal of Behavioral Education*, vol. 30, no. 4, 2020, pp. 578–603., https://doi.org/10.1007/s10864-020-09392-4.

Long Prairie-Grey Eagle School District - U.S. News Education. 2022, https://www.usnews.com/education/k12/minnesota/districts/long-prairie-grey-eagle-school-dist-100887.

Nelson, Peter M., et al. "The Relative Value of Growth in Math Fact Skills across Late Elementary and Middle School." *Assessment for Effective Intervention*, vol. 41, no. 3, 2016, pp. 184–192., https://doi.org/10.1177/1534508416634613.

Newton, Nicki. *Guided Math in Action: Building Each Student's Mathematical Proficiency with Small-Group Instruction*. Routledge, 2022.

Root, Jenny, et al. "Essential Components for Math Instruction: Considerations for Students with Extensive Support Needs." *TEACHING Exceptional Children*, 2022, p. 004005992211208., https://doi.org/10.1177/00400599221120882.

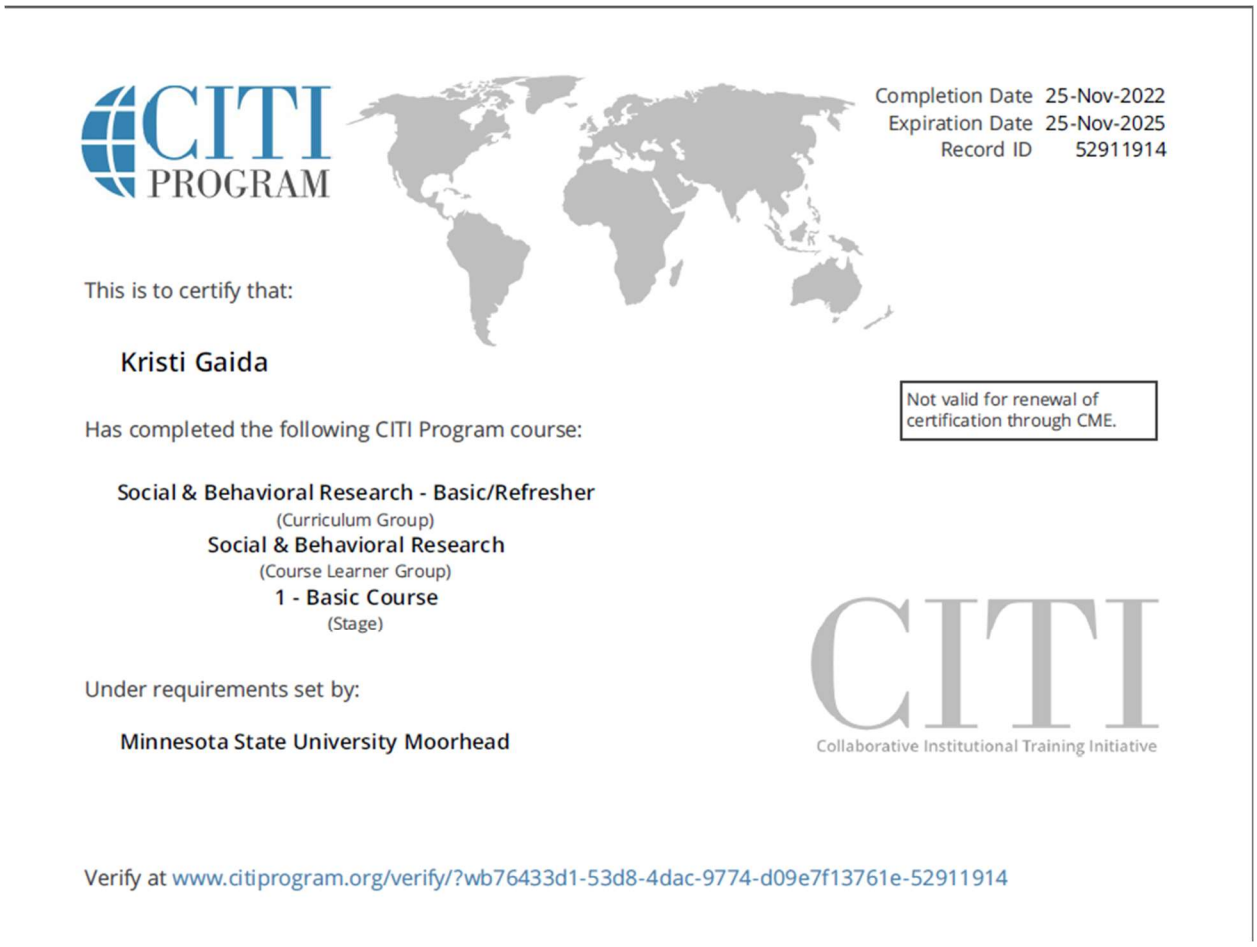
Rotem, Avital, and Avishai Henik. "Multiplication Facts and Number Sense in Children with Mathematics Learning Disabilities and Typical Achievers." *Cognitive Development*, vol. 54, 2020, p. 100866., https://doi.org/10.1016/j.cogdev.2020.100866.

Taylor-Cox, Jennifer. *Math Intervention: Building Number Power with Formative Assessments, Differentiation, and Games: Grades 3-5*. Routledge, Taylor & Francis Group, 2016.

Vukovic, Rose K., et al. "The Mathematics Skills of Children with Reading Difficulties." *Learning and Individual Differences*, vol. 20, no. 6, 2010, pp. 639–643., https://doi.org/10.1016/j.lindif.2010.08.004.

Whitney, Todd, et al. “Effects of a Mathematics Fluency Program on Mathematics Performance of Students with Challenging Behaviors.” *Preventing School Failure: Alternative Education for Children and Youth*, vol. 60, no. 2, 2015, pp. 133–142., https://doi.org/10.1080/1045988x.2015.1040984.

Appendix A



CITI PROGRAM

Completion Date 25-Nov-2022
Expiration Date 25-Nov-2025
Record ID 52911914

This is to certify that:

Kristi Gaida

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Social & Behavioral Research - Basic/Refresher
(Curriculum Group)
Social & Behavioral Research
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Minnesota State University Moorhead

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wb76433d1-53d8-4dac-9774-d09e7f13761e-52911914

November 25, 2022

205 2nd St. S
Long Prairie, MN 56347

Dear Parent or Guardian,

Your child has been invited to participate in a study to see if working more closely with multiplication fact fluency will help with the improvement of their overall math ability.

Your child was selected to participate because he/she is in my math classroom. If you do allow your child to participate, your child will be asked to complete the following activities that are typical in a sixth-grade classroom and involve no risk to your child.

1. Your child will be participating in a small group/whole group/one-on-one multiplication intervention with their regular math teacher
2. Your child's progress on multiplication fact fluency will be assessed weekly through the use of in class assessments and FastBridge data.

Mrs. Tammy Cebulla has given permission to conduct this study. The information gathered will help me complete my master's degree at Minnesota State University of Moorhead. With parental consent, I am able to use the information gathered from small groups/whole group/one-on-one instruction to write my final paper. It is important to know that the tasks your child will be completing are part of normal sixth-grade instruction and will not take from time from their regular math class. If you sign this form, you are giving me permission to use the information I gather from your child. All information will be kept confidential and no names will be used. Your child may also opt out of participation at any time with no consequences.

Please feel free to contact me with any questions you may have about this study.
kgaida@lpge.org or (320) 732-4635.

You will be offered a copy of this form to keep. You are making a voluntary decision whether or not your child may participate. Your signature indicates that you have read and understand the information above and are allowing your child to participate in the study. You may withdraw your child from the study at any time.

_____
Student's Name

_____ _____
Signature of Parent or Guardian Date

_____ _____
Signature of Investigator (Teacher) Date

PRESS Int. Manual Pgs 24-25