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Robust Math Fluency Routines to Support and Develop Students' Emerging Skills of Fluency:

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Robust Math Fluency Routines to Support and Develop Students' Emerging Skills of Fluency: School Improvement Plan

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Capstone Project: A School Improvement Plan

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Abstract

In elementary school, students are gaining a mathematical foundation that propels their procedural fluency. The problem is the current mathematical systems and routines do not lend themselves to fostering an environment that enables procedural fluency skills to be built. A review of literature focused on procedural math fluency systems and routines are needed to be structured in order for students to receive an equitable, enriching, and conceptual approach to learning mathematical concepts. Located in Ames, Iowa, Abbie Sawyer Elementary's 2022-2023 math proficiency data indicates the need for thoughtful and intentional professional learning on math fluency terminology, practices, and strategies. In response to the results, this school improvement plan looks at how the implementation of mathematical fluency structures, routines, and practices can improve students' understanding and benchmark proficiency scores. Additionally, teachers' professional learning development of common knowledge and understanding of mathematical fluency became a key factor in the success in the implementation process. The improvement plan is designed from research and information from thirty-six sources. Implementation of structured fluency routines, common assessments, and professional learning on mathematical fluency will increase elementary school students' proficiency in mathematics.

Keywords: mathematical fluency, conceptual understanding, procedural understanding, NCTM Effective Teaching Practices, professional development, proficiency, benchmarks

Table of Contents

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Introduction

Elementary students need to be provided opportunities for productive struggle in mathematics, before formalizing the skills and concepts. Students should be given time to tackle a task individually or with a peer, prior to a teacher's guidance. High-level tasks encourage students to solve the problem in a variety of ways and the facilitator tips allow the lesson to not stray too far away from the math learning outcome. There is a balance between aligning students' developing ideas and methods with the disciplinary ideas that they are ultimately accountable for (Smith et al., 2022). The problem is elementary students are taught to memorize and regurgitate facts, which results in a misunderstanding that math means memorization. Due to students being taught through the memorization and regurgitation process, mathematical difficulties do not only exist for individuals with low cognitive abilities. Instead, some students may have difficulty with mathematics because they have not become fluent in their computation skills. Math fluency is often called the ability to recall mathematical computation problems automatically (Solomon et al., 2017). Many have been taught math fluency skills through a process of drill and practice, which results in students lacking engagement, becoming disinterested or avoiding mathematics altogether. Studies have shown that students who develop math fluency comprehension skills maintain their understanding for extended periods of time (Ramos-Christian et al., 2008),

The purpose of this school improvement plan is to introduce math strategies and routines that develop students' procedural fluency in math and to certify teachers' ability to analyze

students' responses and data to math assessment and to have students develop their mathematical skills in an enjoyable way. By understanding the meaning of fluency, including robust math fluency routines and strategies, students' Measures of Academic Progress (MAP) and earlyMath, assessment scores and mathematical comprehension will improve. It is the author's goal to provide Ames Community School District and schools with similar contexts to make instructional decisions to enable students to develop creativity to choose the strategy for the numbers given in a problem.

For this research project, a literature review was conducted using journals available through the DeWitt Library at Northwestern College, Iowa, Google Scholar, and reference books provided by Ames Community School District. All the resources were peer-reviewed. The articles included keywords such as instructional approach, creativity in the classroom, math fluency, child development, screening, calculation strategies, procedures, motivation, collaboration, and sense-making. The research was intended to find a clear fluency definition, procedural and computational strategies, routines and practices, and assessments for elementary school students, in grade first through fifth grade and implemented aspects of rigor framework. This scope of research allows us to consider the continuum of math fluency rigor, effective routines, strategies and assessments, taught at the elementary level.

The belief is that students third through fifth grade at Abbie Sawyer Elementary School will make large gains on NWEA Math MAP (Measures of Academic Progress) testing when teachers drive instructional rigorous routines and strategies that utilize the *NCTM Effective Teaching Practices* reference source. This change will happen because teachers will be using a four-point fluency checklist to gather data to adjust the instruction when needed. When teachers incorporate the *NCTM Effective Teaching Practices* into their daily math routines and

interventions and then use the fluency checklist and observation tool as a progress monitoring tool to drive the instructional decisions, the overall instruction will be more effective and engaging, which results in students' mathematical comprehension to increase. Evidence-based strategies and data-driven instruction will support students' mathematical comprehension.

Teachers have not been taught how to teach math fluency from conceptual understanding effectively. Effective math teaching builds fluency with procedures on the foundation of conceptual understanding so that students become skillful in using procedures flexibly as they solve contextual and mathematical problems (Bay-Williams et al., 2021). The problem that this research will address is the misinterpretation of procedural fluency as mastery of basic algorithm problem-solving. In addition, the research will include ways to increase students' flexibility in mathematical thinking by providing multiple strategies to solve the problems. Teaching teachers' fluency efforts will ensure that all students have a range of multiple strategies and the ability to choose what strategy they want to use.

Literature Review

Educators and scholars continuously talk about being fluent in mathematics. When they mention the term fluent, what is it that they truly mean? Fluency is a concept mentioned in every elementary grade level standard, but what does the practice look like when implemented? Does it look like a student who can complete a set of math problems quickly and accurately? Is it having students complete mental math? Traditional literature often defines fluency as a combination of accuracy and response speed (Tikhomirova et al., 2017). In both traditional and new understandings of fluency, it is viewed as a foundational and essential for the success of students in everyday life (Tikhomirova et al., 2017). Real fluency is much more complex and more

distinct. Fluency moves beyond simply basic facts and embeds itself into fractions, decimals, and even algebra.

Purpose of Procedural Math Fluency

Math fluency has been a component of math instruction for a long time in elementary education. How formal instruction can promote intellectual expertise is an ongoing debate amongst educators. The conventional teaching practice has been to promote school-taught arithmetic through direct instruction and drill (Baroody et al., 2013). However, proponents of reform have recommended teachers encourage students to discover relations and to discover procedures. The change in fluency understanding has been developed based on studies on best practice of math fluency instruction.

Current practices, students are often faced with a senselessness approach to mathematics. The senselessness experienced may stem from a disconnection between procedural and conceptual understanding, due to how a problem changes from basics (manipulation) to application (word problems) (Biccard, 2018). Researchers who have studied transfer have concluded that, when solving real-world problems, students seldom have aptly applied school-taught procedures that were learned in a brief period of time. The results show people who have years of experience solving problems in each domain may be unable to solve problems outside of the experience. Concluding that people are only able to solve problems that are given familiar types of problems quickly and accurately but may not understand why their procedures work. The lack of understanding is why people are unable to modify known procedures to match the given problems (Baroody & Dowker, 2013). This result discovered by Baroody and Dowker seems to indicate that the lack of sensemaking results in people not being able to apply skills to new types of problems.

Real fluency involves reasoning and creativity that empowers students, which shapes their positive mathematical identities and develops their sense of mathematical literacy and agency. Dingman describes the term mathematical literacy as the capacity to identify, understand and engage in mathematics as well as to make well-founded judgments about the role that mathematics plays in an individual's current and future life as a constructive, concerned and reflective citizen (Dingman, 2019). Flexibility and adaptability are obtainable when there is some corresponding conceptual knowledge to give meaning to each step of the skill and provide conceptual knowledge to give meaning to each step of the skill and provide criteria for the selection among alternative possibilities for each step within the procedures.

To teach students how to be flexible, adaptable, and efficient in their thinking is by teaching mathematical concepts beyond the four operational components, known as procedural fluency (Bay-Williams & SanGiovanni, 2021). Procedural fluency consists of three elements: efficiency, flexibility, and accuracy. Efficiency is the ability to solve a procedure in a reasonable amount of time by selecting an appropriate strategy and readily implementing that strategy. Accuracy is being able to solve the procedure correctly. Flexibility is knowing multiple procedures and applying or adapting strategies to solve procedural problems (Baroody & Dowker, 2013). In a study completed by Bay-Williams and SanGiovanni (2021), three layers of understanding reasonableness of procedural fluency were established as:

1. Choose a strategy that is efficient based on the numbers in the problem.
2. Change the strategy if it is proving to be overly complex or unsuccessful.
3. Check to make sure the result makes sense.

In other words, mathematical procedural fluency skills enable students to obtain a variety of strategies resulting in them being able to problem solve by applying appropriate strategy to new problems.

Further development indicates the ability to think efficiently and flexibly, effective teaching of mathematics needs build fluency with procedures on a foundation of conceptual understanding so students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems. Bay-Williams and SanGiovanni describes how real fluency requires conceptual understanding of the operations, understanding properties, and having a repertoire of methods (Bay-Williams & SanGiovanni, 2021). The most common way that educators continue to teach mathematics is through using standard algorithms. Students who complete standard algorithms often result in the correct answer, however, they lack the understanding of alternative ways to approach problems.

Procedural fluency elements in a math curriculum are an important element to consider. A study conducted by Agodini and Harris illuminates that math curricula (and associated textbooks) have a strong influence on what students are taught in math because it provides guidance to teachers on how concepts are taught (2016). The results of the study indicate there are three reasons why specific elements need to be considered in the curriculum decision process. First, districts need to consider teachers' knowledge, teachers' attitudes toward instruction, and the need to differentiate instruction – because contextual factors influence effects of these curricula (Agodini & Harris, 2016). Second, effective curricula are different in their approaches to instruction and learning, which means educators have flexibility to choose a curriculum that best suits their teaching style (Agodini & Harris, 2016). Lastly, investing in professional development focused on teacher knowledge could increase the benefit of using

specific math curricula (Agodini & Harris, 2016). Through this study, a conclusion can be reached that teachers need to develop their own understanding of procedural fluency strategies to better implement them in the classroom.

Myths and Misconceptions of Fluency

Fluency is defined through actions and reasonableness. The actions that students participate in are used to focus on what must be taught and addressed. Even with the research that has been conducted and confirmed, long-standing beliefs and practices about procedural fluency are unproductive beliefs and result in inequities in learning mathematics. The responsibility of what does or does not happen in the classroom teachings stems from lack of precise language, limited conceptions of algorithms, and misaligned expectations for learning and teaching fluency.

The term fluency language presents itself in three distinct fallacies. First, people have drawn a conclusion that fluency is only about being quick and accurate in answering basic one-digit facts. For example, basic fact tests are often labeled as ‘fluency tests.’ However, in fluency includes basic one-digit fact practice but includes every procedure in mathematics. This fallacy is crucial in addressing and engaging families with them. Many adults view fluency as only basic facts. To help address this fallacy, precise language should be used – for example, basic fact fluency versus procedural fluency, operational fluency, or fluency with conversations between measurement units (Bay-Williams & SanGiovanni, 2021).

The second language fallacy is ideas about mastery, automaticity, and fluency are used interchangeably (Bay-Williams & SanGiovanni, 2021). Books and worksheets are often labeled as fluency practice, but they are only practicing standard algorithms. Language fallacy is presented on the web. When teachers and scholars search for resources to teach fluency, most are

presented using the standard algorithm. Basic fact practice should be labeled as ‘algorithm practice’ or ‘skill practice,’ but they should not be labeled as fluency practice. Misconceptions stem from the vocabulary understanding of standard algorithm, as well. Fuson and Beckmann describe:

> “The specific statement of the culminating standard for each operation in Common Core State Standards for Mathematics (CCSS-M) includes the expectation of use of ‘the standard algorithm.’... However, a definition for ‘the standard algorithm’ is not offered. If the authors of the CCSS-M had a particular standard algorithm in mind, it was not made explicit nor is an argument offered for why a particular (standard) algorithm is expected (2012-2013).”

Mastery is when students carry out the process in a reasonable amount of time and get the right answer (Bay-Williams & SanGiovanni, 2021). Automaticity is an outcome, usually used to label whether a student has mastered a basic fact. Automaticity means being able to efficiently produce answers from memory network via automatic reasoning processes or fact recall. (Baroody, 2016). Procedural fluency includes mastery of algorithms and strategies and knowing when to use them (Bay-Williams & SanGiovanni, 2021). Fluency is a way of thinking and reasoning that cannot be mastered, instead it is a process that continuously evolves, adapts and changes. The greatest indicator of fluency is the directions do not tell the students how to solve problems or how to think. Instead, the directions indicate the skill practice, which results in the practice of fluency.

The third language fallacy is the meaning of strategy. Developing fluency means that development of the ability to choose the appropriate strategy. Strategies are used to explain thinking of numbers. The fallacy is when one claims visual representations of numbers, like

manipulatives, as strategies. Visual representations are not strategies (Bay-Williams & SanGiovanni, 2021). A representation tool helps visualize the problem and what they are doing with it to solve it (Bay-Williams & SanGiovanni, 2021). Representational tools help mathematicians visualize a problem and what they are doing with it, but they are not an action. The connection between representations and strategies illustrates for others what students are sharing is supported by research as being successful for students (Hiebert & Grouws, 2007). To help combat the misunderstanding, a clear distinction needs to be made between representation and strategy.

Another type of fallacy found in fluency instruction is standard algorithm. Within fluency there needs to be a distinction between strategies and algorithms. Strategies are number-based while algorithms are digit-based (Bay-Williams & SanGiovanni, 2021). Also, strategies can be completed left-to-right, and algorithms are completed right-to-left. Lastly, strategies have many different approaches to get the correct answer and algorithms have the 'right way' to complete them (Bay-Williams & SanGiovanni, 2021). Consequently, when people learn the standard algorithm, oftentimes they believe it is the best choice.

The last type of common fallacy pertains to access and equity. Mathematical concepts are not universal, procedures and related notations can vary from country to country (Bay-Williams & SanGiovanni, 2021). The National Research Council report *Adding it Up* (Kilpatrick, et al., 2001) describes the variety of algorithms used in the United States. Variations also exist in other countries. The US standard algorithm is not standard in terms of notations. (Fuson & Beckmann, 2012-2013). For example, Fuson and Li (2009) describes algorithmic variations for multidigit addition and subtraction that have been found in China, Japan, and Korea's textbooks. Educators must respect the strategies that students bring from their cultures.

Teachers continue to work hard to introduce students to additional strategies that are not the standard algorithm. However, a fallacy occurs in response to students who have special needs or struggle to understand math concepts initially. Often teachers approach with the mindset that one algorithm is hard enough so learning more algorithms is too difficult. Students are told to remember procedures. Based on levels of cognitive demand, Bloom's taxonomy and/or Webb's depth of knowledge frameworks, *remember* and *understanding* boil down to low and high levels of thinking (Bokhove, 2019). To achieve fluency, students engaged with procedures must frequently ask students to think at high levels about procedures they are using (Bay-Williams, 2016). Limiting instruction to a single generalized algorithm is not in the best interest of any student. In my opinion, educators need to take on the role of teaching useful strategies and when they should choose them.

Effective Teaching Practices for Fluency Instruction

Mathematical identities include students' sense of competence as it relates to knowing and doing mathematics, as well as their vulnerability and/or confidence. Identities are shaped by experiences and interactions. There is a correlation between student's fluency abilities and their mathematical identities (Bay-Williams & SanGiovanni, 2021). According to the National Research Council – when a student can exhibit both conceptual understanding and procedural fluency, but also strategic competence, adaptive reasoning, and productive disposition, they are mathematically proficient (Kilpatrick et al., 2001). In my opinion, students would exhibit both skill sets and are able to transfer them into new content and concepts without direction or prompting.

Many educators have a belief that students with disabilities require step-by-step directions with little to nonconceptual understanding or reasoning. The lack of conceptual

understanding has been proven to be wrong on multiple points. First, memorizing a weak strategy. Procedural fluency, on the other hand, is backed by research-based strategies such as using concrete-semi-concrete-abstract (CSA) approach to learning procedures, think-alouds, peer-assisted learning, and explicit strategy instruction (Bay-Williams & SanGiovanni, 2021). Second, memorizing results in students not having understanding that led to negative math identity.

The traditional approach to teaching procedures has been to introduce and practice specific ways to complete mathematics. Memorizing procedural rules without a complete understanding leads to difficulty in being able to recall the specific practices (Bay-Williams & SanGiovanni, 2021). Continued pressure on the standard algorithm and memorizing procedures weakens students' confidence, which may result in math anxiety that results in lower achievement (Bolar, 2015a; Jameson, 2014; Ramirez et al., 2018). Algorithms should be taught as one of a repertoire of strategies to use when needed. Algorithms should be introduced conceptually and then connected to the procedures for completing them. By approaching the standard algorithm this way, students have the knowledge to adapt and use the algorithm and recognize their mistakes. Students need to learn when algorithms are useful and when they are not.

New understandings have found well-implemented fluency instruction, attending to all eight Fluency Actions (shown in Table 1 below), can be a potential counter to negative dispositions about math and doing math. The methods taught require conceptual understanding and support to establish the how and logic. Understanding number relationships is vital to student success (Bay-Williams & SanGiovanni, 2021). To ensure that students understand number relationships, effective teaching needs to occur. Effective teaching facilitates students to

understand how to use relevant strategies and provides opportunities to choose among strategies (Bay-Williams & SanGiovanni, 2021). Establishing clear understanding of strategies lends itself to having students grow in procedural fluency understanding, which generates confidence in their mathematical thinking. If a student can understand the numbers, they will be able to check the reasonableness of the answers found.

Table 1

Effective Teaching Practices Connected to Fluency Instruction

Teaching Practice	Application to Fluency Instruction
Establish mathematics goals to focus learning.	Goals for fluency lessons attend to all three components of fluency and are part of balanced assessment practices. Fluency instruction is based on the progression of strategies.
Implement tasks that promote reasoning and problem-solving.	Fluency tasks include instructions for students to select and use different strategies, and implementation of these tasks includes reflection on when strategies make sense and when they do not, attending to reasonableness.
Use and connect mathematical representations.	Strategies are taught with mathematical representations so that students see the inherent mathematical relationships.
Facilitate meaningful mathematical discourse.	Students have opportunities to discuss and explain strategy selection, efficiency, and reasonableness during instruction and practice.
Pose purposeful questions.	Students are asked to explain strategy selection, flaws, and relationships.

Teaching Practice	Application to Fluency Instruction
Build procedural fluency from conceptual understanding.	Strategies are developed from understanding of concepts, and conversely, using strategies strengthens students' understanding.
Support productive struggle in mathematics.	Students have time and support to grapple with learning strategies and determining when they should employ a strategy. They have processing time to develop their own ideas about the utility with strategies.
Elicit and use evidence of student thinking.	Efficiency, flexibility, accuracy, and reasonableness – in particular, the six observable Fluency Actions – are assessed in a variety of ways and the information is used to establish goals and differentiated support.

Note. This table demonstrates effective teaching practices and how they are connected to fluency instruction. Adapted from *2017 Figuring out fluency in mathematics: Teaching and learning,* by Bay-Williams and SanGiovanni, 2021.

NCTM's Effective Mathematics Teaching Practices are research-based, effective instructional practices that frame equitable, effective practice, ensuring every student has opportunity and access to high-quality mathematics programs. The instructional practices have a direct relationship to fluency instruction. According to the National Research Council, strategic competence can be described in five strands of mathematical proficiency, is the ability to formulate, represent, and solve mathematical problems (2009). The five strands are interwoven and interdependent in the development of proficiency, which include: conceptual understanding,

procedural fluency, strategic competence, adaptive reasoning, and productive disposition. The five strands are designed to build confidence, knowledge, and skill needed to learn mathematics successfully. Conceptual understanding provides student more than just isolated facts and methods (Kilpatrick et al., 2001). Students are able to organize knowledge into a whole understanding, which enables them to learn new ideas and connections. Without the support of procedural fluency skills, students struggle with understanding mathematical ideas or solving mathematics problems. Strategic competence refers to the ability to create mathematical problems, represent, and solve them (Kilpatrick et al., 2001). Students are able to think flexibly amongst different methods to match the demands of the problem and situation. Adaptive reasoning is the capacity to logically think about the relationships amongst situations and concepts (Kilpatrick et al., 2001). Productive disposition is the ability to see sense in mathematics and how continuous learning in mathematics is applicable to the world, resulting in effective learning (Kilpatrick et al., 2001).

In a fourth-grade inclusive classroom, action research concluded that combining explicit strategy instruction and mastery practice to build arithmetic fact fluency (Morano et al., 2020). Students received ten minutes a day of instruction focused on fluent retrieval of arithmetic facts with two strategies: strategy instruction and mastery practice. The strategy instruction focused on teaching methods for deriving facts and highlighting patterns to help students organize and generalize their factual knowledge, through the use of graphic organizers or visual representation. Mastery practice consisted of the traditional drill-type practice, often in a form of flashcard practicum, computer-based practice, or partner practice. The results of the research demonstrated that students developed fact fluency by combining explicit strategy instruction and mastery-practice activities (Marano et al, 2020).

Assessing Fluency

Assessing fluency must contain the three components of fluency and ensure that attention is visible to students to communicate the real meaning of (and the goal of) procedural fluency (Bay-Williams & SanGiovanni, 2021). The assessment of fluency can be measured using the six observable Fluency Actions. Six observable Fluency Actions support the teaching practice by the ability to elicit and use evidence of student thinking (Bay-Williams & SanGiovanni, 2021). The six observable Fluency Actions are selecting an appropriate strategy, the ability to trade out or adapt strategy, get the correct answer, solve in a reasonable amount of time, apply a strategy to a new problem type, and complete steps accurately (Bay-Williams & SanGiovanni, 2021).

When developing assessments there are three key questions that educators can ask to audit whether or not it is related to students' conceptual foundations and their knowledge and use of strategies and automaticities. Students should be assessed early in order to identify effective interventions for individuals struggling to achieve academic and behavioral success in a regular education classroom (Gilbertson et al., 2008). According to Bay-Williams and Saniovanni's study following questions should be included:

1. What strategies and automaticities are relevant for a procedure?
2. What foundational concepts and skills might students need to engage in those procedures?
3. How will I ensure every student has the foundation they need and is developing necessary strategies and/or automaticies?

Identification of interventions assessed should be based on framework targeting common factors that may be influencing academic difficulties (Gilbertson et al., 2008).

Planning is a key component in assessing. Creating plans that align with learning outcomes is important for the assessment process. Having fluency as a leading component in the students' learning outcomes, it is paramount to consider which reasoning strategies and/or automaticities students will learn within the unit (Bay-Williams & SanGiovanni, 2021). From that point, teachers should ask themselves, "How will I assess that students can use these strategies and that they are able to make good choices about when to use these strategies? How will I ensure they have opportunities to become adept at doing the selected automaticites?" The next step is to create or gather a collection of assessments ideas/tools to use during the unit (Bay-Williams & SanGiovanni, 2021). The third step is to revisit what students should have already obtained in prior knowledge (Bay-Williams & SanGiovanni, 2021). Prior knowledge will help develop the criteria for the preassessments. In my opinion, the more preassessment data that you can obtain, the more you will be able to tailor the new lessons to align with students' fluency development. Preassessment data leads to the fourth step, determine the lessons, fluency routines, and activities to provide support for the prerequisite skills that need additional attention (Bay-Williams & SanGiovanni, 2021).

To keep track of students' fluency progress, educators need to formulate a measuring tool that assesses beyond basic facts. The fluency progression needs to contain the procedural fluency actions. An example of a procedural fluency checklist is shown in Table 2 below and obtained from *Figuring Out Fluency in Mathematics: Teaching and Learning* (2021). The checklist grants the teacher the ability to measure whether students can demonstrate an understanding, indicate if students need reteaching on fluency area or not observed. Not observed indicates there is a lack of evidence to prove a student's ability to demonstrate the skill.

Table 2

Fluency Checklists

Fluency Actions Checklist			
Procedural Fluency Actions	**Evident?**		
1. Selects an appropriate strategy	Yes	No	Not Observed
2. Solves in a reasonable amount of time	Yes	No	Not Observed
3. Trades out or adapts strategy	Yes	No	Not Observed
Procedural Fluency Actions	**Evident?**		
4. Applies a strategy to a new problem type	Yes	No	Not Observed
5. Completes steps accurately	Yes	No	Not Observed
6. Gets correct answer	Yes	No	Not Observed
Instructional Next Steps:			

Note. This table demonstrates fluency actions checklist and how students can be evaluated based on procedural fluency action steps demonstrated in learning. Adapted from *2017 Figuring out fluency in mathematics: Teaching and learning,* by Bay-Williams, J. and SanGiovanni, J., 2021.

Fluency rubrics are another form of grading scale used to evaluate fluency. Rubrics communicate clear goals and show what it means to perform at a higher level and can be altered to match the work that students are participating in. Table 3 below demonstrates an example of a Four-Point Fluency scale. The Four-Point Fluency scale was found in Figuring Out Fluency: Teaching and Learning (2021). Rubrics describe the goals in procedural fluency, which creates an avenue to differentiate students who gets the correct answer. Considering that accuracy is only one of the components of fluency, the assessment grading tool should reflect this.

Table 3

Four-Point Fluency Rubric

Beginning 1	Developing 2	Emerging 3	Accomplished 4
Knows one algorithm or strategy but continues to get stuck or make errors.	Demonstrates efficiency and accuracy with at least one strategy/algorithm but does not stop to think if there is a more efficient possibility.	Demonstrates efficiency and accuracy with several strategies, and sometimes selects an efficient strategy, though still figuring out when to use and not use a strategy.	Demonstrates efficiency and accuracy with several strategies and is adept at matching problems with efficient strategies (knowing when to use each and when not to).

Note. This table demonstrates learning progression of fluency skills. Educators utilize rubric to monitor student progress through fluency instruction. Adapted from *2017 Figuring out fluency in mathematics: Teaching and learning,* by Bay-Williams, J. & SanGiovanni, J., 2021.

Beyond assessing traditional tests, assessing fluency comes through another lens which is assessing student thinking. The data that is collected when assessing student thinking is through discussions and by listening to students. To truly assess student thinking, planning needs to be intentional about including interviews, observations, and journaling. Also, students should be provided with opportunities to reflect on their own learning.

Site Profile

Community Characteristics

Ames, Iowa is an urban community located in central Iowa (Story County). According to the 2020 Census, a city census, Ames has a total population of 66,427, with Iowa State University comprising 36,000 of the population (Bureau, U.C., 2023). The average age of a resident is 23.4 years old. The population is 53.42% are male and 46.58% are female (Point2, n.d.). Of the resident pool of Ames, 86.69% of the population is US-born citizens, while non-US-born citizens account for 4.63%. Additionally, 8.68% of the population is non-citizens (Point2, n.d.). The working population in Ames is 85.58% white-collar workers, while the blue-collar employers account for 14.42%. Approximately 14.63% of the population in Ames holds a high school degree, 41.77% have attained a college certificate, and 21.42% have a bachelor's degree (Point2, n.d.).

District Characteristics

The schools that make up the Ames Community School District are across Ames. There is one preschool, five elementary schools, one middle school, and one high school. The preschool is for the ages of three- and four-year-olds. The five elementary schools (Abbie Sawyer. Fellows, Kate Mitchell, Edwards, and Meeker) are campuses for kindergarten to fifth grade. Middle school is for grades 6th to 8th grade. The Ames Community School District has

4,558 students (Ames Community School District, 2022). The district students who are English Language Learners make up 5.72% of the population, special education 12.07%, and 31.33% of the students receive free and reduced lunch. Of the students who attend Ames Community School District, 65.1% of the students are white, 7.48% are Asian, .17% American Indian/Alaskan Native, 9.77% are Black/African American, 10.54% are Hispanic/Latinx, and 6.87% are two or more races (Ames Community School District, 2022). The district staffs 718 people of those 397 are teachers, 45.96% of which have advanced degrees (Ames Community School District, 2022).

Student Mission and Vision

The Ames Community School District's mission statement is "The Ames Community School District commits to equity and access that empowers every individual to reach their full personal and educational potential (Ames Community School District, n.d.)." Ames Community School District developed a Strategic Planning team that assessed the current reality of the school district and developed a plan of action to improve the learning environment and academic success of students. The team identified six major areas of work: physical, mental, and emotional health & safety, instructional framework and programs, meeting diverse needs, organization responsiveness and communication, building stakeholder engagement and support, and attracting, recruiting, and retaining a high-quality staff. The six areas are used to guide the vision for the district.

The commitments made by the stakeholders are continually reported on. The first commitment is the physical, mental and emotional health and safety will benefit each student because the work helps create a safe and vibrant environment that facilitates learning and promotes physical, mental, emotional, and social wellbeing (Ames Community School District,

n.d.). This will be addressed with the implementation of RULER curriculum, therapeutic classroom strategies, safety concerns, and learning environment options. Second, instructional framework and programs will benefit each student from a consistent and viable curriculum, engaging instruction, and connected programs designed to meet individual needs (Ames Community School District, n.d.). Teachers will implement the Danielson framework that analyzes instructional strategies, instructional programming, the way stakeholders engage in curriculum review, and differentiation. Third, the district implements a Multi-tiered Support System (MTSS) that benefits students by having a clear system that outlines academic, behavior, and social emotional needs that are identified, skills are taught, and high expectations are met (Ames Community School District, n.d.). Fourth, the academic and behavior data gathered will be used to inform instructional and programmatic decision making, and programs to support students with unique needs. Fifth, building stakeholder engagement and support will be developed through community partnerships. Last, attracting, retaining, and developing high-quality staff will benefit each student due to a diverse staff that participates in high-quality professional learning and reflection with topics that relate to ideas on how to reduce turnover and attract teachers, administrators, and support staff.

District Learning Priorities

Ames Community School District has three distinct priorities which are to improve student achievement with emphasis on reading, improve student classroom connectedness, and improve school culture. Ames Community School District has made the commitment to annually increase reading growth for marginalized students (specifically students who identify as Black, Hispanic, Multi-racial, English Learners, and disabled) in three other key indicators until opportunity gaps are eliminated and all students are reading at grade-level (Ames Community

School District, n.d.). Theories of action to obtain this goal are to provide consistent, guaranteed, and viable, culturally sustaining curriculum across content teams and grade levels; buildings and the district consistently review data and act upon data indicators; the district effectively implements research-based instructional practices; and staff operate from a mindset that marginalized students can and desire to learn at high levels. The data to monitor progress will be determined by assessment data (MAP, progress monitoring, and intervention screening data).

Another district goal is to increase the sense of connectedness that students who are marginalized (specifically students who identify as Black, Hispanic, Multi-racial, English Learners, and disabled) experience in our system until opportunity gaps are eliminated. There are four theories of action to align with this goal. First, the theory of action for this goal is focused on incorporating identification of students' needs and implementing culturally responsive, engaging instructional practices. Next, administrators, teachers, and staff implement common expectations for behavior and draw on a wide range of responses. Third, the district implements a social emotional learning (SEL) curriculum in conjunction with culturally responsive teaching practices. Last, all district staff continue to increase their prioritization of system diversity, equity, and inclusion efforts. The measurement of success will be determined by survey results from staff on school climate.

The last priority for the school district is to improve school culture. Ames Community School District's goal is to annually increase our marginalized students' sense of belonging (specifically students who receive special education services or identify as Black, Hispanic, Multi-racial, English Learners) based on three key indicators until all students feel safe, connected, and affirmed. The district lists four theories of action that align with the goal. First, there are culturally sustaining instructional practices across content teams and grade levels.

Second, buildings consistently support and sustain programs to support students' cultures, identities, and interests and create conditions for students' voices to be heard. Third, relationships are cultivated and valued between students and staff, students and students, and families and school. Last, staff develop their understanding of diversity, equity, and inclusion and prioritize system efforts. The goal will be measured by increased favorable responses on the Panorama Survey.

School Characteristics

Ames Community School District is a public school district in central Iowa, north of Des Moines, Iowa. The district has one preschool center, five elementary schools, and a junior high and high school. Abbie Sawyer Elementary School serves students in grades kindergarten through fifth offering special education reading, writing, math, and behavior services, Title I reading and math services (SUCCESS), and English Language services. Abbie Sawyer Elementary offers services outside of school, for families that request it. The services are coordinated through the school's social worker. There are multiple sections of each grade level. All grade levels have three sections, with an average of twenty-five students, except for third grade has two sections, with a ratio of twelve students to every one teacher. There are a total of 30 teachers, 70% of the teachers with three or more years of experience. The teaching staff is 97% white and 3% Latinx. For the 2023-2024 school year, Abbie Sawyer Elementary retained 93% of their teaching staff, with the hire of a new principal.

Student Characteristics

The elementary school is in Ames, Iowa, which had a population of 66,427 people reported from the 2020 census; 80.6% of the population was white, 10.5%

was Asian alone, 4.4% was two or more races, and 3.1% was Black or African American (U.S. Census Bureau, 2020). The school district serves students that fall within city limits. The district also allows for open enrollment from neighboring towns such as Gilbert, Story City, and Boone. As of the 2022-2023 school year, Abbie Sawyer Elementary School enrolled a total of 374 students, 9.33% are English Language Learners, 11.73% receive Special Education Services, and 32.8% qualify for Free and Reduced Lunch. The school makeup of race and ethnicity is 10.24% Hispanic/Lantix, .37% American Indian/Alaskan Native, 18.06% Asian, 5.40% Black/African American, 66.6% White, and 10.67% two or more races. The average class size is 23 students.

Student Performance

Students, in third through fifth grade, complete MAP benchmark assessments three times a year, one in the fall, winter, and spring. In the fall, students are expected to meet a beginning of the year benchmark scores that correspond to their grade level. By the end of the school year, the students should be reaching spring benchmark scores, indicated in Table 4. According to the Iowa Department of Education, Abbie Sawyer Elementary School's average mathematics achievement score was 48.98/100 and the average school achievement in English Language was 50.16/100. Abbie Sawyer's overall performance scored 51.75/100 in 2022, which is below the state average of 54.65/100 (State of Iowa, 2021).

Table 4

2022-2023 MAP benchmark scores

Grade	Season	Mathematics
		Threshold
3	Fall	181
	Winter	189

Grade	Season	Mathematics
		Threshold
	Spring	194
4	Fall	192
	Winter	198
	Spring	202
5	Fall	201
	Winter	206
	Spring	210

Note. 2022-2023 benchmarks used for MAP assessments in Iowa for the purpose of ELI and Healthy indicator reports. The benchmark sets available elsewhere are not intended for Iowa use.

Based on data gathered from MAP English language arts and mathematics and Iowa Statewide assessment, the students are making average growth in English language arts and below average growth in mathematics data. However, the students who are targeted, with low socio-economic status, are not making significant growth. The growth percentage for all the students in English language arts is 51% and students who are identified as low socio-economic status have a growth percentage of 27 (State of Iowa, 2021). All the students demonstrate a 40% mathematics growth rate and for students identified as low socio-economic status is 28% (State of Iowa, 2021). There was an average Gap Cut for all students was 7.58 and low socio-economic status was -5.25 (State of Iowa, 2021). However, students who are white are scoring 7.82 (State of Iowa, 2021). This indicates that not all students are making the growth needed to be

considered college and career ready. The gap of achievement is greater for students who identified as low socio-economic status.

Parent Involvement

Abbie Sawyer Elementary School uses a variety of digital tools and organizations designed to communicate with parents and families about upcoming events, student behavior, successes, and concerns. Upcoming events, volunteer voids, and schedule changes are posted on the school's Parent Teacher Organization (PTO) Facebook page and communicated with parents through email notification. The PTO is a partnership between families and schools that strength communication between home and school. The purpose is to promote social activities for families and support the school through fundraising events. Parents and guardians may serve as officers or volunteer in other ways. Abbie Sawyer Elementary offers parent-teacher mini-conferences at the beginning of the school year, so the parents have a chance to ask questions or share concerns prior to the start of the academic school year. Throughout the school year, parents are offered two additional chances to meet with teachers. The school has a reserved conference week twice a year, once in the winter and once in the spring. The conferences are designed to discuss academic progress, concerns, behavior and emotional development.

Curriculum

Ames Community School District defines curriculum as a "plan that outlines what students shall be taught." They further recognize that curriculum encompasses what students experience, learn, and retain from both intentional curriculum and the hidden curriculum (Ames Community School District, n.d.). Ames Community School District Teaching and Learning department facilitates the review and implementation of curriculum. Curriculum guides are reviewed by teachers, administrators, and facilitators in all content areas. To develop skills

needed to be successful for all students, is the goal in the deciding process for curriculum guides. The elementary school programs consist of a variety of curriculum guides. For reading and writing, Lucy Calkins is the curriculum guide used. Mystery Science is a science curriculum guide that is used for most grades.

Many teachers supplement with additional lessons to ensure all standards are met and assessed appropriately. For math, the curriculum guide chosen is Envisions. However, the math curriculum is going to be replaced within the next two years. A new social emotional learning curriculum guide, RULER, adopted for the 2023-2024 school year. There is not an elementary program set for social studies. In the grades kindergarten through third grade, Fundations is the phonics curriculum that is used. Kindergarten and first grade teachers use Heggerty Phonemic Awareness for instruction. Upper grade levels utilize Heggerty Phonemic Awareness for interventions. Another reading intervention guide utilized is the PRESS Manual. There is no guide assigned for math intervention or supplemental tools. Teachers make sense of students learning with Iowa Common Core State Standards.

Instruction

At Ames Community School District, teachers are able to decide the best instructional strategies, based on their teaching style. There have been no district-wide strategies that have been implemented. There have been professional development opportunities for teachers to be involved with reviewing and to become more informed on new strategies. These professional development opportunities are up to the teachers' discretion on what they need more support or knowledge in. The professional development opportunities that are provided often review strategies to support ELL students, reading intervention, or better supports for marginalized students. The sessions are often peer led or leaders from Heartland AEA.

Abbie Sawyer Elementary School has one instructional coach, whose job is to support teachers. The coach is assigned to collaborate with teachers and identify their areas of improvement or goals. The coach works together with the teachers to decide on a specific goal and the measurement to know when the teacher has met their goal. The coach may complete a coaching cycle, walk-throughs, co-teach lessons to improve the instructional strategies or management of the classroom. The purpose of the coaching process is to help enhance student learning by improving the instruction process.

Assessment

Teachers are repeatedly performing assessments, both formative and informative, in every content area. District summative assessments are given at the end of each unit of instruction to determine if students have met grade level expectations for the priority standards assigned. The schools operate on a trimester schedule. Families receive grade level reports on their student's progress in regard to behavior, academic, and social learning goals, at the end of each trimester. The grading scale at the elementary level is based on a scale from one to four. The four represent exceeding grade level expectation, whereas one indicates a need for tier three support to obtain grade level content. The goal for each student is to receive a three by the end of the academic school year. For middle school and high school students, they are assessed using a percentage grading scale system.

Professional Development Practices

According to the Ames Community School District, educators work together in a professional learning community (PLC) to develop instruction using the following driving questions:

1. What do we expect all students to learn?

2. How will we know our students have learned it?
3. How will we respond if they do not learn it?
4. How will we respond if they already know it?

These questions are the root of the efforts for improved teaching and learning and professional development. Teachers at Abbie Sawyer Elementary are assigned to meet with their grade level PLC weekly. The PLC meetings have all grade level teachers, instructional coach, and principal present, unless there is a conflict in schedule. During these meetings, teachers discuss upcoming plans that are driven by data obtained from assessments. Challenges noticed and next steps that can be taken to better the learning environment. Every month, there is one full day of professional learning for all staff, teachers and paraprofessionals, and students are not in attendance on the day. On the whole building, professional development days, the learning is chosen based on the needs that are present and all academic core teams present new information provided from district level learning.

Needs Assessment

What is the problem?

Based on Abbie Sawyer Elementary's school profile, school improvement is needed in math proficiency. In 2022, students in grade 3-5 averaged 48.9/100 math achievement score on the Iowa school profile (Iowa Department of Education, 2022). This score is below the state's average of 50/100. Complimenting the achievement score, the students who scored 65.38/100 are proficient in mathematics (Iowa Department of Education, 2022). This is slightly above the state average of 64.97/100. Due to the scores, Abbie Sawyer Elementary has been identified as a targeted school. A targeted school is identified for Targeted support and improvement if a student subgroup score is as low as the lowest 5% of the schools in the state. Student subgroups are

students who are eligible for free and reduced-price meals, English learners, students with disabilities, and students by racial/ethnic minority group (Iowa Department of Education, n.d.). The average group of students compared to their academic peers indicates Abbie Sawyer Elementary is 40/100, while the state's growth average is 50/100. Growth is measured by using Student Growth Percentiles (SGP), which describes a student's growth compared to other students with similar prior test scores (their academic peers). It also demonstrates the student's growth and academic progress, even if they are not meeting the proficiency benchmark (Iowa Department of Education, 2022). The assessment scores are based on the Iowa Statewide Assessment. The district provides professional development opportunities, however, many of them are made-to-meet the needs of district-wide curriculum initiatives and state-wide policy changes.

Students at Abbie Sawyer Elementary School need consistent and organized math fluency instruction. Currently, the school's math proficiency scores are concerning. This needs to be improved to close the gaps in achievement. The concern about the essential standard is the apparent disconnect between what the term fluency means and how it should be taught and implemented in the classroom. Fluency procedures should include practice in operations with whole numbers, finding equivalents, making conversions, solving equations, and so much more. Many teachers have not been able to devote time and energy into understanding the concepts of fluency, due to the district priorities being focused on reading.

Over the years, there has been consistent discussion about increasing students' proficiency and comprehension in literacy. There has been very little discussion around increasing students' number sense proficiency. There is a continual debate between what math skills elementary students need to obtain for them to be successful with more complex problems

in the future. On one side of the debate some people claim that it is important for students to memorize facts and others state the need for students to have "number sense." Number sense is when students have the ability to describe the process and quantity of the numbers. The skill differentiates students who have memorized basic math facts and students who are able to apply the answers to more complex problems (Schuman, 2007). Number sense practices demonstrate students' thinking in the process. The process of inventing, refining and reflecting on algorithms coupled with the ability to communicate with others about multiple strategies, and various ways of representing these, is of far greater importance and value than memorizing basic facts (Gerzel-Short & Hedin, 2022).

Some researchers argue that children who are low attainers in the early grades continue to be low attainers with the gap between learners with solid number sense and those without increasing as they move up the grades in school (Graven, et al., 2013). Children who have trouble with number sense are more likely to experience difficulties with more complex mathematical concepts. Research has shown that the students that are most affected by the inability to develop number sense often have a learning disability such as dyscalculia. Dyscalculia, a specific learning disability in mathematics, affects as many as 6% of the overall elementary school population (Gerzel-Short & Hedin, 2022). Students' problems may be represented in multi-step problem solving, representing and retrieving basic facts, and quantity concepts. To help develop these skills more consistently, a specific number sense routine can help develop those skills to create a better foundation for more complex mathematical reasoning and problem solving.

In contrast, some researchers have defended the importance of students' basic fact fluency. They have stated that students who struggle with numeracy benefit from memorizing the

facts, so they do not have to complete time consuming strategies. Fluency in basic mathematical skills is essential for the success of students in primary education because it serves as a foundation for mathematical applications such as time, money, and problem-solving (Smith, et al., 2011). However, it does not provide students with the skills needed to complete more complex math tasks.

Starting in kindergarten and extending all the way through eighth grade, the Common Core State Standards include math fluency. However, there is a gap in most math curriculums due to lacking any math fluency routines or procedures. Instead, many of the fact fluency skills are provided from supplemental materials to the curriculum guides (Riccomini, et al., 2017). To ensure effective practice educators must consider classroom constraints and the routine to be implemented with fidelity. The practice should be individualized based on students' individual skill level. Students need to participate in these meaningful practices at least three to four times a week, with each session lasting between five and ten minutes.

A school improvement plan is needed in math intervention in the Multi-tiered Support System due to the percentage of students who are not proficient on the Iowa Statewide Assessment of Student Progress (ISASP), Fastbridge early Math, aMath, and CBMmath (Panorama, n.d.; Iowa Department of Education, 2022). The data collected from the screening assessments, used for schoolwide benchmark data, show the need for intensified instruction and interventions based on the number of students proficient in math. To improve teachers' understanding of math fluency and strategies, professional development needs to be focused on how to implement procedural fluency-based practices. With an understanding of what fluency means and what instruction should look like, students’ MAP and assessment scores and mathematical comprehension will increase.

Data Analysis

The data from Abbie Sawyer Elementary School supports the area of need for change in the math's curriculum design and implementation process. The assessments that reflect the need are the school's Iowa Statewide Assessment of Student Progress (ISASP), Fastbridge early Math, aMath, and CBMmath testing scores for all students (Panorama, n.d.; Iowa Department of Education, 2022). The students were expected to meet the grade level expectations to be proficient in mathematics. Currently, enVisions curriculum is implemented by teachers, with supplemental lessons depending on the teachers' discretion. The enVisions curriculum lacks targeted fluency practices. Without scope and sequence for fluency instruction, many teachers turn to their own ideas or resources they discover, or they do not incorporate any fluency routines in their mathematics instruction.

How Do We Know?

Ames Community School District administers benchmark reading and mathematics assessments every trimester at the elementary level. The assessments given differ between the grade level bands. Data is reviewed every trimester with grade level teams, intervention teachers, special education team, instructional coaches, English language teachers, and building principal. The data from Abbie Sawyer Elementary School's math Fastbridge early Math and MAP assessments benchmark scores indicate a need for a change in instruction.

The Fastbridge early math assessment is taken in kindergarten and first grade. Fastbridge early math measures developing math skills. Students are assessed in the fall, winter, and spring on a variety of skills that are essential to math using the FAST earlyMath screener. Kindergarten students are assessed on match quantity, number sequence, number identification (ID), and decomposing. Match quantity assesses matching a numeral with the quantity it represents.

Number sequence provides the correct oral sequence of numbers. Number ID is assessing when students are able to recognize numerals. The decomposing portion assesses students on identifying a missing part in a part-part-whole problem. First grade students are assessed in the domains: number sequence, number ID, decomposing, place value, and story problems. The additional domains, place value and story problems are different than kindergarten and first grade is no longer assessed on match quantity. Place value assesses on identifying the place values and amounts of pictured objects. First-grade students are asked to solve story problems that are verbally told to them.

Each domain of the screening process is compiled into a composite score and is weighted differently in each screening period (fall, winter, and spring) in order to best optimize the students' outcome in the spring. The developmental trajectories of mathematics skills, more of an emphasis on the Number domain is seen in kindergarten, while more Operations skills are assessed in first grade. In addition to the domain, specific scores can be used to discover patterns. Interpreting the subtest scores provides a sense of each student's strengths and weaknesses.

Commonalities are found with students who consistently perform below or above the benchmark, but there is a possibility for students to have strengths in a particular subtest. Subtest scores need to be considered for the students who test below in one or two subtests and above on the composite. Although rare, this scenario should be considered in the decision-making process. In essence, the Composite score is the best predictor of future mathematical success. Table 5 indicates the benchmark scores that are determined for proficiency levels for subtests in the fall, winter, and spring for kindergarten. Table 6 indicates benchmark scores that determine proficiency levels for subtests in first grade, in the fall, winter, and spring.

Table 5

Benchmark: earlyMath: Kindergarten

Measure	Metric	Risk Level	Fall	Winter	Spring
Match Quantity	Rate	Some Risk	< 7.0	< 11.0	< 13.0
		High Risk	< 4.0	< 9.0	< 10.0
Number Sequence	# Correct/ 13	Some Risk	< 4.0	< 7.0	< 9.0
		High Risk	< 1.0	< 5.0	< 7.0
Numeral ID	Rate	Some Risk	< 12.0	< 22.0	< 32.0
		High Risk	< 5.0	< 13.0	< 21.0
Decomposing	# Correct/ 8	Some Risk	< 2.0	< 4.0	< 6.0
		High Risk	< 0.0	< 2.0	< 4.0

Note. 2022-2023 benchmarks used for kindergarten earlyMath assessments in Iowa for the purpose of ELI and Healthy indicator reports. The benchmark sets available elsewhere are not intended for Iowa use.

Table 6

Benchmark: earlyMath: One

Measure	Metric	Risk Level	Fall	Winter	Spring
Number Sequence	# Correct/ 14	Some Risk	< 5.0	< 8.0	< 11.0
		High Risk	< 2.0	< 5.0	< 8.0
Numeral ID	Rate	Some Risk	< 26.0	< 36.0	< 42.0
		High Risk	< 16.0	< 31.0	< 36.0
Decomposing	Rate	Some Risk	< 3.0	< 7.0	< 8.0

Measure	Metric	Risk Level	Fall	Winter	Spring
		High Risk	< 1.0	< 3.0	< 5.0
Place Value	Rate	Some Risk	< 0.0	< 3.0	< 4.0
		High Risk	< 0.0	< 2.0	< 3.0
Story Problems	# Correct/ 6	Some Risk	< 2.0	< 4.0	< 4.0
		High Risk	< 0.0	< 3.0	< 3.0

Note. 2022-2023 benchmarks used for first grade earlyMath assessments in Iowa for the purpose of ELI and Healthy indicator reports. The benchmark sets available elsewhere are not intended for Iowa use.

The students who are considered not proficient, due to assessment data indicating below the benchmark receive additional considerations for support from their classroom teacher, math intervention teacher, or special education teacher. If a student is consistently assessing above the benchmark, the student may be considered for Extended Learning Program (ELP) services. ELP services provide extension to grade level standards, which may include lessons that align with above grade level mathematics standards. In Table 7, the Fastbridge earlyMath proficiency composite scores are shown. The data indicates that kindergarten students were benchmarking at the end of the school year, above the goal of 80%. Also, the data shows that first grade students did not meet the proficiency goal at the end of the year, indicating that students are not receiving appropriate Tier 1, known as large group, instruction.

Table 7

Fastbridge earlyMath Proficiency Scores

FAST earlyMath						
Grade	Fall Scores		Winter Scores		Spring Scores	
	Screened	Proficient	Screened	Proficient	Screened	Proficient
Kindergarten	96%	71%	99%	83%	99%	83%
1st	100%	81%	100%	73%	100%	78%

Note. Abbie Sawyer Elementary School's 2022-2023 proficiency percentage and percentage of students screened in kindergarten and first grade on the earlyMath assessment. Scores were obtained in the fall, winter, and spring benchmarks.

The math MAP Growth assessment scores chart a student's academic progress. The score is generated using the RIT scale. MAP Growth assessments are adaptive interim assessments aligned to state-specific content standards and administered in the fall, winter, and spring. RIT scores range from 100 to 350. The scale measures the value of a student's score in relation to their score on previous tests. The scores shown in Table 8 are not to be interpreted as target scores, instead they should be used as benchmarks of students' academic skill level over a period. The benchmark scores given to a student predict that at specified difficulty level, a student is likely to answer around 50% of the questions correctly. Results are not determined by grade level, instead they focus on a score dependent on the difficulty level of student understanding.

Table 8

Math MAP Growth Assessment RIT Scores

MAP Math Growth Assessment Benchmarks		
Grade	Season	Threshold
2nd	Fall	168
	Winter	177
	Spring	182
3rd	Fall	181
	Winter	189
	Spring	194
4th	Fall	192
	Winter	198
	Spring	202
5th	Fall	201
	Winter	206
	Spring	210

Note. Math MAP Growth Assessment RIT scores describe the grade level trimester benchmark scores for each grade level that administers the MAP assessment.

The RIT scores third-fifth grade students obtain in the Spring are linked to being able to predict student achievement on the Iowa Statewide Assessment of Student Progress (ISASP). Educators take scores from the MAP assessment to identify students at risk of not meeting state proficiency standards early in the year and are able to respond with more tailored interventions. The ISASP Grades 3-10 Mathematics tests are Iowa's state summative assessments aligned with

the Iowa Core Standards. Based on the scores earned, students are considered Not Yet Proficient, Proficient, and Advanced.

The state goal is for 80% of the students to meet the benchmark for math on the earlyMath assessment. In the 2022-2023 school year, Abbie Sawyer Elementary School did not have any grade level that met the benchmark of 80% proficiency by the end of the year, except for kindergarten (shown in Table 5 above and Table 9). This lack of proficiency shows the need for more intensified and intentional math interventions with research-based strategies and progress monitoring techniques geared towards fluency instruction. The low proficiency results indicate the need for intervention fluency practices. Since the proficiency levels did not significantly change, the need for clarity and resources for intervention and structures to build fluency is present.

Table 9

Abbie Sawyer Elementary Math Growth MAP Assessment Data 2022-2023

Math Growth MAP Assessment Data						
Grade	Fall Scores		Winter Scores		Spring Scores	
	Screened	Proficient	Screened	Proficient	Screened	Proficient
2nd	92%	69%	96%	60%	98%	62%
3rd	99%	66%	97%	63%	99%	63%
4th	96%	64%	97%	68%	99%	74%
5th	92%	71%	94%	66%	89%	63%

Note. Abbie Sawyer Elementary School's 2022-2023 proficiency percentage and percentage of students screened in grades second-fifth on the math MAP assessment. Scores were obtained in the fall, winter, and spring benchmarks.

The math fluency intervention plans need to be supported by research-based strategies, practices, and curriculum. Students are assessed and progress monitored using different assessments. Challenges arise because as students transition into a new grade level or different grade level content, it becomes difficult to accurately intensify instruction. There is a need to increase students' proficiency in mathematics fluency and skill transfer at Abbie Sawyer Elementary School based on the data shown in Table 7 and Table 9 above. When students are unable to complete grade level math skills fluently, they are less likely to develop understanding around new math concepts. An improved math fluency intervention will allow for growth in mathematics proficiency.

School Strengths

A strength at Abbie Sawyer Elementary is that teachers have the authority to make adjustments to curricular decisions, when they see fit to benefit the outcome of student success. Due to the power to adjust when they see fit, there is a strong sense of seeking out professional learning opportunities. For example, at the beginning of the year, teachers are allowed to participate in the Little Cyclone Teachers Academy. The purpose of the Little Cyclone Teachers Academy was to facilitate sharing best practices in instructional methods, to provide opportunities for teachers to showcase their talents with their peers, and to provide opportunities and support for teacher-driven professional learning. According to the participant data from the 2022 session, 225 teachers attended a variety of sessions (Ames Community School District, n.d.). With the number of participants, the Ames Community School District has brought back

the opportunity for the 2023 school year. The strength comes from teachers' willingness to make changes and adjustments to their teaching practice to enhance the students' learning experiences. Peer collaboration and cooperation amongst teachers are keys in the argument for any relevant and successful fundamental change to occur in the classroom (Tachie, 2022). Teacher collaboration provides a powerful structure which teachers understand and reflect on new approaches. The collaborative work aims to plan and design lessons through reflection on action and helps teachers to understand mathematical concepts (either difficult or easy), stimulate critical thinking amongst learners and promote learning through hands-on activities.

School Challenges

One challenge Abbie Sawyer Elementary demonstrates is professional development is up to teacher's discretion, which results in lack of targeted learning based on students' needs. Because of the lack of consistent instruction, there is little data available to demonstrate whether specific instructional routines increase student development. The lack of consistent communication on instructional routine implementation suggests interventions and routines were not occurring consistently. Consistency in leadership attendance lacked during Professional Learning Community (PLC) designated times. The lack of consistency in leadership guidance prevented student progress from being consistently reviewed throughout the duration of the school year. A consequence was teachers resulted in using the methods they found easiest to implement. Naturally, teachers are more likely to use interventions that are not only effective but also efficient, easy to implement, and sustainable (Musti-rao et al., 2015). Lack of communication on what efficient and effective practices resulted in the lack of insurance of students' mathematical understanding acceleration and addressing the achievement gaps from the beginning of the school year.

Another challenge Abbie Sawyer Elementary has is the low number of proficient students in mathematics. When comparing Abbie Sawyer Elementary's Iowa School Profile with a neighboring school district, Marshalltown Community School District's Franklin Elementary's Iowa School profile, there are trends to indicate that common result to assessments. The Iowa School Profile's percent proficiency rates are calculated by the numerator is the number of students who scored proficient on the state assessments (Iowa Statewide Assessment of Student Progress and DLM). The denominator of the measure is calculated to ensure maximum participation of the assessment, with a minimum amount of 95%. Then, to standardize the proficiency rate, the mean is calculated and the standard deviation for distribution of school proficiency percentages. Finally, multiply the standard score of index points a school receives for proficiency. The Franklin Elementary School has shown that 71.86/100 percent proficiency in mathematics (State of Iowa, 2022). This number is higher than Abbie Sawyer's 65.38/100 percent proficiency in mathematics. Having similar results and similar demographics indicates there could be more systematic concern. However, there is a common trend across multiple elementary schools that indicates there was a significant shift in the proficiency trend across the state so lack of proficiency could stem from a systematic issue.

Assessment Options

A full picture of procedural fluency understanding would be obtained by multiple assessments. Teachers and students need to be provided with a structured intervention system that can be implemented across all grade levels. The purpose behind a uniform intervention system is the ability to continue the same intervention process throughout the duration of the students' academia years. With the data that is gathered, there would be a clearer understanding of what the students' needs are and if the structure is working.

Future research could look at the pattern between students' fluency proficiency and staff retention. Data could include the number of years teachers have taught and the level of math proficiency in the classroom. The information provided from the data would give an idea of the effects of professional development and if inexperienced staff are continuously being trained in practices and strategies the district wants to implement. Another area of research could be in the relationship between students who are considered at-risk.

Action Plan

Proposed Improvement Plan

A conclusion that can be drawn from the literature and theme is that procedural fluency is a crucial element to mathematical understanding and sense-making (Bay-Williams & SanGiovanni, 2021). Also, the literature suggests teachers lack in understanding strategies, assessments, and terminology (Agondini & Harris, 2016; Bicer, 2021; Bay-Williams & SanGiovanni, 2021). The proposed improvement plan to help Abbie Sawyer Elementary staff increase their understanding in mathematical fluency, implement routines and strategies, resulting in students' mathematical fluency skills to increase. This will be done by implementing NCTM Effective Teaching Practices (2014), using professional development to further knowledge and discussions on strategy development, and using students from "Fluency Checklists" to assess the effectiveness of the teaching practices.

Impact on Teaching and/or Learning

The proposed plan will impact teachers because they will receive professional learning on procedural fluency importance, practices and strategies. In response to the new strategies, routines, and practices knowledge, the teachers will integrate and implement them into their mathematical large- and small-group instruction. Continual assessments will be given during

instruction and the data gathered will drive the follow-up grade level PLC conversations. Educators will grow in their teaching practice and gather resources and tools to better meet the needs of the students through professional development.

As a consequence of the teachers' learning, students will grow and develop in their mathematical sense-making. Students will be taught many different procedural fluency strategies that will enable them to think flexibly, effectively, and accurately when solving mathematical problems. When students are unable to solve a math problem with one strategy, they will have the skills to trade out or adapt the strategy while working, in order to obtain the accurate answer. The strategies that students understand are tailored to the needs of the curriculum, grade-level Common Core Standards, and learning targets. The encouragement of students to have a multitude of mathematical strategies is what is missing from current instruction.

Alignment to Research

The Effective Teaching Practices Connected to Fluency Instruction are research-based, effective instructional practices that frame equitable, effective practice, ensuring every student has the opportunity and access to a high-quality mathematics program (Bay-Williams & SanGiovanni, 2021). The teaching practices can be directly aligned with curriculum guides for individual grades' learning targets. Even with each grade level having different learning targets, the teaching practices provide guidance for teachers to establish fluency focused instruction. Table 1 shown above explains the Effective Teaching Practices and how they align to fluency instruction. The learning targets drive unit and daily planning. Unit planning extends attention to learning a topic potentially over a course of a month or more.

Researchers also support the idea that in order to develop mathematical fluency teaching practices, teachers need professional learning on student systematic strategies, routines and

procedures. Strategies are often introduced in one grade and then move into the category of fluency in the following grade level. Through discussions and professional development around grade-level expectations and the unit expectations enables coordination, adjustments to instruction, and the ability to make decisions about what ideas must be prioritized and what students practice within a unit. The procedures taught can be followed mentally or communicated using words or by drawings, number symbols, operations, gestures and so on (Roberts, 2019). The routines should be composed of different elements. Routines need to include explicit instruction through showing and telling students what to do or think while solving problems, enacting strategies, completing tasks, and classifying concepts (Gerzel-Short & Hedin, 2022). An example of explicit instruction is a teacher who performs think alouds, during instruction. When a teacher performs a think-aloud, students can receive step-by-step instruction on problem solving strategies and draw them to think about more critical task features. Whereas a student think-aloud provides teachers with formative assessment data on students' understanding. Overall, number sense routines can positively impact the mathematical reasoning that students walk away with.

Lastly, the researchers support planning and the assessments of fluency go hand in hand. The planning process needs to consider the strategies and automaticities that are relevant to the learning target, what foundational concepts and skills might students need to engage in the procedures, and how will students be assessed to ensure that students have developed the necessary strategies and/or automaticities (Bay-Williams & SanGiovanni, 2015). Because teachers typically only assess accuracy, they need to be provided an accountability grading tool. The grading tool that can be utilized to assess students' procedural fluency and to help determine

the effectiveness of the implementation of NCTM Effective Teaching Practices. The grading tools that can be used are shown above in Table 2 and Table 3.

Summary

Professional development on mathematical procedural skills, procedures, and routines will enable teachers to effectively implement in the classroom. The educators will then be provided with the necessary knowledge and tools to enhance their teaching practices. An instructional change must take place to increase the math proficiency of students at Abbie Sawyer Elementary School. With fluency focused math instruction, students will also become more comfortable in selecting the appropriate strategy for mathematical problem solving. They will be able to solve the problems within a reasonable amount of time, while being able to trade out or adapt strategies to meet the academic demands of questions. With the increase in these areas, students will become more accurate in their responses.

Implementation of School Improvement Plan

Introduction

To implement a school improvement plan effectively it is important to consider all of the participants, time, what limitations might present themselves, and what role each participant takes on in the process. Most of the time allotted in the school implementation process is focused on providing adequate training to staff who are affected by the guidance. Providing stakeholders with common vocabulary, practices, and strategies will increase the likelihood of teachers being prepared to implement the practices effectively. The first year of the process will be spent having teaching develop their understanding of mathematical fluency and analyze the status of the mathematical system. Professional development that provides educators with math strategies,

practices, and routines that develop students' procedural fluency in math and certify teachers' ability to analyze students' responses and data to math assessment.

The second year of the process teachers will be required to implement and reflect on new structures of math. Discussions and observations will focus on reflection, student data, and how to improve practice. Progress monitoring will occur bi-weekly on individual student's progress and every trimester to track grade level progress towards math proficiency. This school improvement plan does have potential limitations including the additional factors that contribute to students' academic success.

Timeline

A successful way to implement procedural fluency instruction is a timeline for expectations and agreements must be created and executed. The timeline will take a total of two academic years to be fully implemented. First, the administration must approve the implementation process before the end of September 2023 to be fully implemented throughout the 2024-2025 school year. Everyone must be on the same page when teaching fluency, which means the whole-team, whole-school, or whole-district agreements about what fluency is and how it can be developed for coherent, effective instruction **(**Karp et al., 2020**).** To reach effective agreements, staff need to have an understanding of mathematical fluency. A timeline for integration of NCTM Effective Teaching Practices and fluency grading tools has been developed to assist teachers, interventionists, instructional coaches, and administration in the process for successful implementation (see Table 11).

Table 11

Abbie Sawyer Elementary Implementation Scope

Month	Activities
early-September	• Administration approves implementation process • Timeline for integration of NCTM Effective Teaching Practices and fluency grading tools
September Professional Development	• Academic math team and administration will present last year's math proficiency data • Whole-team, whole-school, or whole-district agreements about: • Definition of fluency • NCTM Effective Teaching Practices • Distribute individual copies of *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni to all stakeholders • Stakeholders are assigned to read the first two chapters of *Figuring Out Fluency in Mathematics: Teaching and Learning*
mid-September Assessment	• Kindergarten and first-grade students are assessed using earlyMath • Second- through fifth-grade students are assessed using Math MAP • Staff identify how fluency comprehension is shown in benchmark data • Stakeholders collaborate to create intervention groups based on skill set • Instructional coach develops a skillset data gathering tool to

Month	Activities
	track students' progress
October-November	• Staff will read chapters three and four of *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni • Teachers work with instructional coach to develop integrated strategies into curriculum guided lessons
December	• Staff will read chapters five and six of *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni
December Professional Development	• Instructional coach and math academic team lead a session on NCTM Effective Teaching Practices • Stakeholders discuss how NCTM Effective Teaching Practices align with "Launch, Explore, and Summarize" lesson structure
January through May	• Grade level PLC teams analyze formative and informative assessments • PLC teams analyze summative assessments on what questions should be adopted, adapted, added, or eliminated • Teachers align a scope and sequence for fluency strategies to their grade-level mathematical standards
2024-2025	• Teachers are required to implement mathematical fluency routines and assessments in their daily instruction • PLC analyze math data bi-weekly

Month	Activities
	• Instructional changes are continually guided by math data

Note. Abbie Sawyer Implementation Timeline provides a list of activities to be completed each month of math fluency implementation plan.

At the beginning of the 2023-2024 school year's professional development launch, the academic math team and administration will present last year's math proficiency data. The meeting will present the goals for the yearlong professional development and integration of teaching practice that promote procedural fluency practices. Presenters will define fluency vocabulary and introduce NCTM Effective Teaching Practices. With a clear definition of what fluency looks like in math and NCTM Effective Teaching Practices, stakeholders will have a clear purpose for participating in a book study, *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni. Within a month, participants will be required to read the first two chapters of the text. The purpose of reading the first two chapters is to gain a clearer understanding and address misconceptions of mathematical fluency.

In mid-September 2023, students will be assessed using earlyMath and MAP math. The assessments will provide a clear data point on the level of proficiency for each student and grade level. Staff will spend time identifying how fluency comprehension is shown in the benchmark data. Application of fluency to the benchmark data enables the stakeholders to set a purposeful approach when assessing the current data set. Stakeholders will collaborate with creating intervention groups based on skillset. The instructional coach will develop a skillset data gathering tool to track students' progress. The data gathering tool will be utilized by the intervention teachers, special education teachers, and general education teachers.

In October-November 2023, staff will be assigned to read chapters three and four of *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni. These two chapters will provide knowledge on how to begin mathematical fluency practices and strategies to implement in instruction. Having a common understanding of potential strategies will enable stakeholders to create intentional groups for students to develop their mathematical fluency. Teachers will work with the instructional coach on how to integrate strategies into curriculum guided lessons. Focusing on specific strategic work encourages the beginning of the implementation process in the daily instruction.

In December 2023, staff will read chapter five and six of *Figuring Out Fluency in Mathematics: Teaching and Learning* by Jennifer Bay-Williams and John J. SanGiovanni. Staff will receive exposure to different types of routines and practices. During the monthly professional development day, the instructional coach and math academic team will lead a session on the NCTM Effective Teaching Practices. While in professional development, teachers will discuss with their grade level teams the commonalities between the fluency routines mentioned in the book study and the NCTM Effective Teaching Practices. The discussion will lend itself to the stakeholders discussing when the practices, strategies, and routines will show up in the "Launch, Explore, and Summarize" lesson structure.

January through May will focus on what formative and informative assessments on the fluency components (efficiency, flexibility, and accuracy), during mathematical instruction will look like. Staff will work with their grade level teams and analyze a current math summative assessment given and come to an agreement about what questions need to be adopted, adapted, added, or eliminated, based on fluency checklists (shown above in Table 2 and Table 3). Through

the development of summative assessments and rubrics, teachers will align a scope and sequence for the fluency strategies to their grade-level mathematical standards.

Starting in the 2024-2025 school year, the teachers will be required to implement mathematical fluency routines and assessments in their daily instruction. After the fall benchmark assessments, stakeholders will work together to analyze math data in their PLC grade-level teams. Fluency skill-level will be a determining factor in students' intervention groups. Grade-level PLC teams will meet bi-weekly to discuss data and progress of students. Instruction adjustments, including intervention groups and large groups, will be made every PLC, unless students are making adequate progress towards individual goals. Throughout the school year, the instructional coach will observe individual teachers on the routines and implementation of math fluency practices, strategies, and routines, teachers will continue to progress monitor students throughout the 2024-2025 school year, and stakeholders will collaborate to adapt, add, or eliminate fluency routines and assessments.

Role Clarifications and Assignments

Abbie Sawyer Elementary School success of the implementation of mathematical fluency structures, practices, and routines has multiple people that have a clear role in the process. The first year of the implementation will be led by the math academic team, instructional coach, and administration. This team will design professional development and lead the discussions during PLCs. The professional development that this team provides is learning on fluency vocabulary practices, structures, and routines and working together to develop scope and sequences that align with curriculum. The collaborative process will include the instructional coach, principal, interventionist, and teachers. Stakeholders will be split into teams based on their grade levels. Each grade-level team will include the instructional coach, principal, and interventionists.

Additional roles of the instructional coach and principal include attending district level meetings pertaining to math curriculum development, supporting and coaching teachers to help improve the mathematical fluency structures. Teachers will be responsible for attending PLC meetings, professional development, implementing practices, and gathering data. In the second year of implementation, teachers implement the routines daily and progress monitor.

Progress Monitoring

Teachers and interventionists will take informal notes on success and challenges with implementing math fluency practices, strategies, and routines into instruction. The teachers will bring their notes to the bi-weekly math focused PLC meetings. Table 12 shows the data resources the teachers will use to complete bi-weekly student math fluency assessments and bring information to PLC meetings. Also, Table 12 shows the resources students will use to complete their three benchmark math assessments, once every trimester, and will be used to observe grade level trends and help form intervention plans for individual students.

Table 12

Progress Monitoring Data Collection Tools

Data The data I need to collect…	**Measurement Instrument** Validity and reliability of the test is…	**Data Collection** The process for data collection…
earlyMath & NWEA Math Map Testing	The earlyMath and MAP math data comes from the NWEA website. The assessment is a requirement by the Ames Community School district. Teachers view students' individual data	NWEA Math MAP data will be collected three times a year. The data will demonstrate whether or not students' fluency affects their outcomes grade level expectations.

Data The data I need to collect…	**Measurement Instrument** Validity and reliability of the test is…	**Data Collection** The process for data collection…
	and assess the areas of need.	
Fluency Checklists (from *Figuring Out Fluency in Mathematics: Teaching and Learning*)	The fluency checklist is created based on researched based practices. The information provided can determine instructional strategies that need to occur. The checklist will be completed manually. The log will demonstrate whether or not the students are utilizing the different elements of fluency (efficiency, flexibility, and accuracy). The fluency checklist comes from *Figuring Out Fluency in Mathematics: Teaching and Learning* resource tool. This tool will analyze students' progress.	The fluency checklist data will be collected bi-weekly from all students to monitor progress.

Note. Abbie Sawyer Elementary School's progress monitoring tools used to monitor student math proficiency progress.

Limitations

There are potential limitations when completing the research. The quantitative benchmark data that is collected is based on an assessment that is lengthy. If a student does not have stamina in test taking, the results may become affected. Another limitation is the teacher's understanding of strategies could affect the results. If the teacher does not understand the variety of strategies and number choices that warrant fluency understanding, the learning will be affected, and the data may be skewed. Also, student attendance could also become a factor. With a spike in the number of students who are ill throughout the duration of the school year, not having students who are consistently in attendance affects how the students will perform. Lastly, there are minimal resources that are provided in conjunction with the fluency routines that can affect the results because the teachers are dependent on their own understanding, and it is not a systematic approach.

Conclusion

Mathematical fluency components and determining the reasonableness of answers helps beyond math, it serves students in areas throughout their lives. A diverse set of strategies enables students to be able utilize mental math in real life (Bay-Williams & SanGiovanni, 2015). Being able to learn different strategies helps children move between strategies based on their own thinking, developing mathematical confidence and competence (Bay-Williams & SanGiovanni, 2015). In addition to confidence and competence, students are supported in their grade-level work and more complicated numbers and concepts. Most of the strategies that are taught are used in daily life and avoid the standard algorithm. When children understand concepts and procedures perform better than those who simply memorize the procedures because memorization is not an effective learning style (Boaler b, 2015; OECD, 2010; Willis, 2006). For

a school to recognize and benefit from mathematical fluency practices, implementation of fluency structures, routines, and practices must be done with fidelity.

This school improvement plan is created to introduce math strategies and routines that develop students' procedural fluency in math and to certify teachers' ability to analyze students' responses and data to math assessment and to have students develop their mathematical skills in an enjoyable way. Due to an increased number of students who are not proficient in mathematics, the research shared the importance of educators receiving professional learning on procedural fluency strategies, routines, and practices, for them to implement the practices in their classroom. The improvement plan is necessary for the district to seek improvement in mathematics instruction and student performance on assessments. Articles about mathematical procedural fluency presented themes: teacher understanding and professional learning, development of rigorous procedures and routines, and effective fluency assessment. If this school improvement plan is implemented with fidelity, it will help raise students' benchmark scores and help students gain more confidence in their mathematical mindset.

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