Fall 12-14-2022

The Effect of Daily Fluency on Algebraic Procedural Fluency in Students

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The Effect of Daily Fluency on Algebraic Procedural Fluency in Students

A Quantitative Research Methods Proposal

[Component of Dissertation Proposal]

By

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ED 696

Methods of Research

Master of Science in Curriculum and Instruction

August 27, 2022

Abstract

Algebra 1 students in the ninth grade struggled to follow procedural steps to answer elementary algebraic problems. An early pre-test found that the majority of pupils lacked the necessary fundamental knowledge to comprehend and investigate algebra's abstract concepts, patterns, and relationships. Fifteen students from one of the researcher's algebra one classes participated in a daily fluency skill-building intervention program to investigate whether daily fluency practice will affect students' procedural fluency skills. They engaged in 50 minutes of daily fluency practice for five weeks. During each 50-minute session, students practiced specific skills to develop procedural fluency competencies, such as solid number sense and integer operations, using additive and multiplicative properties to solve elementary linear equations and inequalities. The researcher administered a post-test on the last day of the intervention plan to determine the effect of daily fluency practice on students' procedural problem-solving abilities. The researcher used descriptive statistics to summarize and compare the initial pre-test and post-test mean scores to further assess the efficacy of the daily fluency skill-building practice. The results indicated a statistical improvement in the students' ability to perform mathematical procedures with greater efficiency.

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CHAPTER 1

INTRODUCTION

Introduction

In the first year of algebra, some students in the ninth grade encounter a problem that is universal to all math classes: Problem-solving skills in algebra. Some algebra students in high school sometimes struggle to correctly complete the necessary steps in the problem-solving process because of the complexity of the subject. In addition, learning algebra is a process that takes place through several stages. The research that was carried out mostly centered on this topic. Therefore, students must be able to carry out a series of actions in sequential order to find the solution (answer) to a particular problem. As a consequence, many students have difficulty succeeding in algebra classes because they are unable to solve algebraic problems effectively. According to the findings of recent studies, teaching children in mathematics from k - 12 should place a significant emphasis on developing their ability to solve problems (NCTM, 2021). Therefore, for mathematics

instructors to assist students in overcoming these problems, they need to incorporate meaningful problem-solving strategies into their daily teaching plans and the mathematics curriculum they teach. When problem-solving practice is provided, students' procedural knowledge and problem-solving skills may develop, affecting their overall arithmetic growth and success (Corral

et al.,

2020).

Brief Literature Review

This literature review focused on the following topics: mathematical attitude, procedural fluency, and conceptual comprehension. Only via the development of procedural fluency can mathematical learning be successful. However, this vital talent must be developed through two competencies: mathematical attitude and comprehension. Students that achieve success in mathematics are those who develop a mathematical mentality over time and are motivated to research and explore topics and ideas as they advance through the grades. Both procedural fluency and conceptual understanding build on a solid mathematical mindset. Students with a growth mindset focus on mastery and intellectual comprehension (Sun, 2018). Al least some successful math students feel their hard work, efforts, and willingness to try new ideas will lead to success and mastery. When evaluating students' understanding, mathematical mindset and conceptual knowledge seem abstract focuses on procedural steps.

However, conceptual comprehension is necessary for this ability (Berger, 2017). Students fail to apply critical thinking and abstract thinking to procedural arithmetic tasks. Some Student with conceptual knowledge of reasoning can represent and solve problems based on prior knowledge, and as they progress in grade levels, they become confident in using mathematical procedures. Math teachers must push students beyond daily drills and memorization to discover underlying

concepts. Students develop procedural fluency when they can justify each problem-solving step (Clinch, 2018). Conceptual understanding must take precedence over procedural fluency; students must understand why they must choose one method over another to solve a particular problem.

Statement of the Problem

Some high school students have difficulty completing the procedural problem-solving abilities required for algebra. That hurts their mathematical comprehension and capacity for critical reasoning about other areas of mathematics. In addition, students must improve their problem solving and number-sense skills to excel in algebra. That could result from a student's failure to develop a "number sense" through regular participation in fluency activities.

Purpose of the Study

This study underlined how daily fluency tasks affected students' ability to solve procedural algebraic problems. The study also examined the potential impact of daily mathematical scaffolding exercises on students' procedural fluency skills. Additionally, the instructor included everyday fluency problems from a unit on linear or nonlinear functions into day-by-day lesson plans to make up for whatever skill deficiencies learners may have. Students in this study completed common practice problems involving algebraic competencies and fluency, such as formulating the balanced equation to solve word problems and simplifying numerical and algebraic expressions, and solving one-, two-, or multi-step linear equations and inequities using additive and multiplicative inverse. The investigation lasted five weeks and conducted for one hour for every instruction day in one of the researcher's algebra one classes. Students completed pre/posttests during this study to gauge how well they performed on their daily fluency exercises.

Research Question(s)

How does daily fluency practice impact students' algebraic procedural problem-solving- skills? **Definition of Variables.** The following are the variables of study:

Variable A: (Independent variable); The independent variable in this study was the amount of time and space allotted to students so that they can be creative with their mathematical thinking. During this time, students allowed to use familiar strategies and developed ways to reduce the number of steps it takes them to solve algebra equations by using problem-solving skills.

Table of Contents Some students might experience anxiety regarding completing the daily fluency tasks, especially if they have knowledge gaps in managing signed numbers or terms. When taking the pre-test and post-test, students might also experience the normal test anxiety everyone gets. The benefits of this study include the development of a robust understanding of fundamental mathematics as well as conceptual knowledge in the process of solving algebra problems. The provision of algebra provides students with a better experience of algebra as well as the opportunity for them to become more proficient in mathematics and solidify algebra skills. The research may provide the researcher and other educators with additional teaching strategies to make learning easier for students.

Research Ethics

Permission and IRB Approval. In order to conduct this study, the researcher will seek MSUM's Institutional Review Board (IRB) approval to ensure the ethical conduct of research involving human subjects (Mills & Gay, 2019). Likewise, authorization to conduct this study will be seek from the school district where the research project will be taking place (IRB Approval)

Informed Consent. Protection of human subjects participating in research will be assured. Participant minors will be informed of the purpose of the study via the Method of Assent (See Appendix X) that the researcher will read to participants before the beginning of the study. Participants will be aware that this study is conducted as part of the researcher's Master Degree Program and that it will benefit his/her teaching practice. Informed consent means that the parents of participants have been fully informed of the purpose and procedures of the study for which consent is sought and that parents understand and agree, in writing, to their child participating in the study (Rothstein & Johnson, 2014). Confidentiality will be protected through the use of pseudonyms (e.g., Student 1) without the utilization of any identifying information.

The choice to participate or withdraw at any time will be outlined both, verbally and in writing. **Limitations.** Some students will struggle to solve mathematical problems if they do not first develop abstract thinking and critical reasoning skills before attempting to apply procedural methods to solve mathematical problems. Students will struggle to complete procedural steps unless they have a solid foundation in basic operations and algebra skills.

When completing procedural problem-solving steps, students entering algebra courses must understand working with signed numbers/algebraic terms.

Students who lack basic mathematical knowledge and procedural solid fluency skills will struggle in algebra courses as they progress to a higher-grade level.

Conclusion

Algebra 1 assists students struggle to solve problems procedurally.

So, it affects students' math success and ability to attend advanced courses. Algebra students' skill inadequacies necessitate evidence-based educational solutions. This study examined everyday fluency activities affect procedural fluency and problem-solving.

Conceptual understanding and procedural fluency are targeted to help students build basic math and algebra skills. In this study, the researcher (teacher) poses questions that elicit critical thinking and provoke students to develop a mathematical mindset. Students must justify/explain their answers to fluency practice questions. For procedural fluency, students must show all problemsolving steps.

During the study's intervention period, students practice and may develop algebra problem solving skills through "daily fluency activities." Daily fluency practice may also improve algebra problem-solving and math learning. Students must also show problem-solving fluency. In answer to research questions on "daily fluency exercises" as an intervention plan, students practiced during the study's intervention phase, increasing their math problem-solving skills. Daily fluency exercises may improve algebra problem-solving and math learning. Mathematical attitude, procedural fluency, and conceptual comprehension build on algebra problem-solving skills. This literature evaluation helps me determine how daily fluency practice affects students' algebraic procedural problem-solving.

CHAPTER 2

LITERATURE REVIEW

Introduction

The following concepts are covered in this review: mathematical attitude, procedural fluency, and conceptual understanding. Learning mathematics effectively requires, first and foremost, the cultivation of procedural fluency. On the other hand, this essential skill needs to be founded on two competencies: an aptitude for mathematics and a mathematical mindset. Students who can excel in mathematics do so because, over time, they develop a mathematical perspective and find that mindset motivating.

As they advanced through the grades, a drive to research and explore topics and ideas. Furthermore, while procedural fluency and conceptual understanding are both required for success and mastery, both skills are built on a solid mathematical mentality.

Students who approach mathematics with a growth mentality, as Sun said, are more likely to focus on mastery and conceptual comprehension (Sun, 2018). It indicated that students who succeed in mathematical procedures believe that their willingness for hard work, perseverance, and the ability to attempt new ideas will eventually lead to achievement and mastery.

In addition, grading or assessing learners' comprehension, mathematical thinking, and conceptual knowledge may seem abstract, yet researchers typically concentrate on how well they carry out procedural activities.

As a result, procedural fluency as a critical skill. However, this he ability must be built on a foundation of mental understanding (Berger, 2017). A lack of conceptual thinking and critical

reasoning might make it difficult for students to use procedural methods to solve mathematical problems.

Furthermore, children with conceptual knowledge of reasoning can describe and solve problems based on recollection of prior knowledge, and as they go through the grades, the skills they have already mastered become more confident in employing mathematical processes. This emphasizes the necessity of developing and executing instructional strategies that encourage pupils to think conceptually; math teachers must guide students beyond daily drills and memorization to uncover underlying concepts. It means that students achieve procedural fluency when learners can theoretically justify each step in the problem-solving process (Clinch, 2018). Conceptual comprehension needs precede procedural fluency; students may realize why learners choose one problem-solving strategy over another. Inadequate conceptual understanding results in computational errors and incorrect answers.

As Foster (2018) pointed out, when students feel confident in their conceptual knowledge, they have more power to apply mathematical processes to more challenging situations (Foster, 2018). Unlike other disciplines or courses, mathematics is made up of interconnected and linked concepts that can be both abstract and concrete. As a result, students may be required to solve many issues to complete a single task. In a single procedure, more than one or two mathematical principles must be implemented.

This implies that students must remember factorization and multiplication to solve a quadratic problem. According to Laswadi et al. (2016) to lead successful mathematics teaching practices, there are two underpinning mathematical competencies that students need to develop; conceptual understanding and procedural fluency. That illustrates that without developing conceptual knowledge and procedural fluency skills, students in math courses always face challenges grasping the fundamental mathematical concepts and ideas necessary to solve and complete mathematical tasks. The third competency students need to develop is a mathematical mindset; students focus on effort and improvement when learning math. In other words, students develop mathematical thinking ability in which they understand that their success depends on motivation and efforts. Students who approach mathematics with a growth mindset tend to focus on mastery and conceptual understanding (Sun, 2018).

Procedures Fluency

Procedural fluency is one of the essential abilities that students must develop in mathematics. Learners who don't have enough information to complete procedural stages have difficulty deepening their comprehension of mathematical concepts or using concepts they've already acquired to solve new issues. It shows that a lack of fundamental mathematical skills and knowledge hinders students' development of procedural fluency. It essentially means that Students constantly face hurdles that impede their capacity to link ideas and recall and apply a series of problem-solving techniques if procedural knowledge is not developed (Riccomini et al., 2017). Examining how the property of multiplication is used to solve one-step linear equations (e.g., $x+3 = 4$) demonstrates this. Students must remember that multiplications are the inverse of division to solve for the variable. To undo the division, they must multiply each side of the equation by three.

As a result, students must learn and comprehend conceptually that to address one problem; they may need to use multiple strategies. They must be able to recall and apply various mathematical principles they have already learned.

Combinations simultaneously enable effective and efficient problem solving, Coe et al. (2019) write (p. 53). "Students must recollect and combine many mathematical principles to finish a given procedural problem-solving process". Furthermore, the excellent numerical sense is required for students to carry out tasks precisely and efficiently in a fluid and flexible manner.

Furthermore, students who are able to do basic arithmetic operations properly and fluently fare better on examinations that measure total mathematical aptitude (Greene et al., 2018). math aptitude test is significant because students struggle to finish even fundamental procedural problem-solving processes if they do not know how to do the four basic arithmetic operations. AlMutawah et al. (2019) also point out that students succeed in mathematics only after they gain the ability to select and use relevant processes appropriately. Additionally, problem-solving is built on a foundation of procedural fluency that children gain through time (Hendrickson et al., 2018). Finally, Learners must develop procedural fluency in math to reach mastery level.

Understanding of Concepts

Students must have conceptual comprehension to demonstrate mathematical proficiency and deeply understand how to connect complex mathematical concepts.

According to Pratt and Eddy (2017), noted that "conceptual understanding is essential to help students learn and make sense of mathematical ideas, reason mathematically, and communicate their mathematical thinking" (p. 31). Students who have not enough basic algebra skills will

struggle to understand how mathematical concepts interact so that they can transition and move fluidly through the problem-solving process if they do not gain conceptual understanding. Understanding mathematics entails more than knowing isolated facts conceptually; it also entails comprehending, connecting, and using that information in problem-solving, which leads to the proper solution.

Furthermore, conceptual knowledge can be defined as mathematical concepts that are linked to one another, implying that students have conceptual understanding if they can apply and explain their ideas in a variety of ways and understand how different representations can be helpful in a variety of situations (Malatjie & Machaba, 2019). If the students are unable to understand how two different mathematical ideas are connected to one another, learners may have difficulties to solve algebraic equations. When concepts are linked, such as how the qualities of exponents and square roots relate to solving equations with square roots, it is an indication of a lack of conceptual knowledge as well as the capacity to integrate mathematical ideas in order to solve one problem. In other words, those with a solid conceptual understanding of exponents may recall and apply their properties to solve problems involving square roots. Students who comprehend mathematical principles are better able to come up with new solutions to challenges. On the other hand, learners who lack understanding fail to apply what they've learned to new contexts or finish computational procedures. In contrast, the most successful pupils have a deeper and more linked knowledge of mathematics (Hodgson et al., 2012). It's also worth noting that conceptual knowledge increases students' enthusiasm for mathematics, which increases their chances of developing procedural fluency as their conceptual understanding improves. Kandeel also claims that high levels of

mathematics competency start with strong conceptual skills, which then lead to procedural fluency (Kandeel, 2018).

Researchers emphasized the necessity of gaining conceptual knowledge and its connection to other math skills. Hurst and Cordes (2018) stated that higher achievement and success in algebra learning depend on a thorough comprehension of fundamental mathematical ideas, especially integer operations, before gaining procedural fluency.

To be proficient in arithmetic, students must gain conceptual knowledge, which is critical for success in mathematics education, regardless of their grade level or mathematical aptitude. Furthermore, as Corral et al. (2020) point out, the main obstacle students encounter while solving mathematical problems is understanding the problem's relational idea rather than following procedural problem-solving processes. It indicates that learners who cannot think conceptually will always struggle to accomplish procedural problem-solving skills.

Mindset of a Mathematician

IT is a good that students adopt a mathematical mindset approach in which they look at patterns and relations before beginning a sequence of actions to solve the problem to succeed in the procedural solution process. According to Boaler, math students must develop a mathematical mindset that includes the capacity to reason and make sense and the drive to conceptualize and think about the solution process (Boaler, 2018). Furthermore, when students approach problems with a mathematical perspective, they investigate each one and think conceptually to come up with fresh solutions. This indicates that children who approach mathematics with a mathematical mentality are more likely to gain both conceptual and procedural fluency. Students with mathematical mindsets are also more likely to become self-directed, resilient learners who work

with little or no teacher guidance or supervision, according to Russo et al. (2021) this suggested that students with a growth attitude can finish mathematical activities without the assistance of a teacher. In addition, learners with a mathematical perspective are more likely to persevere even when faced with difficulties, eventually developing procedural skills and achieving higher levels of academic success (Sun,2018). Furthermore, students' views and attitudes about mathematics favor their problem-solving abilities and mathematical proficiency (Arifin et al., 2021).

Research Questions

What effect does daily fluency practice have on students' algebraic procedural problem-solving abilities?

Conclusion

Students in algebra one assistance classes fail to execute procedural problem-solving stages when completing arithmetic problems accurately.

As a result, this impacts kids' mathematical success and their ability to enroll in upper-level math courses. Evidence-based instructional strategies must be designed to help algebra students overcome their skill weaknesses. This study aims to see how their "everyday fluency activities" affect their procedural problem-solving abilities. Three characteristics must be focused on to assist pupils in developing exceptional algebra skills: mathematical mentality, conceptual comprehension, and procedural fluency. All participants are provided practice tasks encouraging a mathematical mentality as part of the therapeutic plan. Furthermore, while students complete individual fluency tests, the researcher (teacher) provides questions that encourage critical thinking and provoke students to create a mathematical mentality in order to assist them in developing a mathematical growth mindset. Students must also justify/explain their responses to demonstrate their conceptual understanding skills in addition to solving fluency practice questions.

CHAPTER 3

METHODS

Introduction

In the first year of high school, many students lack the knowledge and skills necessary to answer algebra problems.my ninth-graders third hour class needed to improve their conceptual and procedural understanding of algebra problems. Therefore, this research was appropriate for addressing the issue identified in this study, as the pre/post-test data is used to assess students' basic knowledge in solving algebraic problems before and after the intervention plan is implemented. The study used pre/post-tests to evaluate the educational intervention plan's success; after assessing the data, each student's post-test score was compared to their pre-test score to determine if the intervention plan met the research questions. This research is also essential to help students solve procedural problems. Daily procedural fluency assignments were used to assist algebra learners in overcoming skill deficits. After the study, pre-and post-test data are assessed and analyzed to determine if the intervention plan addresses the need or problem in which the students encounter in completing math procedural procedures.

Research Question(s)

How does daily fluency practice impact students' algebraic procedural problem-solving? skills?

Research Design

Quantitative methods were used to systematically explore the topic. The researcher collected quantitative data in the first five weeks of each quarter. When assessing the data, each student's post-test score is compared to his/her pre-test score to establish if the intervention plan answers the study concerns.

Setting

The study was conducted at a high school in North Minneapolis, Minnesota. For its basketball teams, which compete at high school levels. Only 870 students in high schools, making it a small institution. 89.5% of the students at the middle and high schools are of East African descent, and 46% of them are English Language Learners (ELLs). Of the remaining students, 2.5% are Hispanic, 4.2% are African Americans, and 3.8% identify as having two or more races. Furthermore, 98.2% of students are entitled to a free meal.

Participants

In total, there are approximately 15 people taking part in the study. Students who are enrolled in this course have been determined to have deficiencies in the fundamental mathematical knowledge required for the previous grade levels. Students in algebra 1 support classes who have difficulty completing mathematical procedures and problem-solving steps are likely to benefit from the implementation of intervention strategies in mathematics. 25 students in the class but 15 participants but were English language learners. Furthermore, most the students in this class scored below the proficiency level on the MAPs test (which stands for Measure of Academic Progress).

Sampling.

The students that participated in the study were hand-picked by the researcher since they were enrolled in the specific sections of the researcher's classes designated for the research. It is

based on their assessment scores from the pre-tests and post-tests that gave the students throughout the year.

Instrumentation and Data Collation

The researcher will use test scores as a data collection tool in this study. The researcher collected data quantitatively because doing so is essential to examine and investigate the students' performance on the tests. During the inquiry, a pre-test and a post-test were given to students to determine how the daily fluency practice improves the students' ability to demonstrate procedural fluency. Furthermore, the five-day intervention plans covered fundamental numerical and algebraic procedural fluency skills, such as adding, subtracting, dividing, and multiplying signed integers and algebraic expressions. Students' basic skills in solving linear equations and inequalities, such as additive and multiplicative inverses, will also be covered. Students will be given 16–20 problems to answer, each requiring them to provide concise responses and simplify the associated numeric and algebraic formulas. The students' performance will be evaluated based on the percentage of questions that they correctly answer out of the total number of questions. The post-test score of each student will be compared to his or her score on the corresponding pre-test to evaluate how successfully the intervention plan was implemented. The measure of central tendency was applied to the data (the students' test scores), and then the mean and median of the post-test scores were compared to the mean, median, and mode of the students' pre-test scores. This was allowed for further analysis of the data.

Data Analysis.

The information that was asked in the survey was gathered by the researcher, who then utilized descriptive statistics to analyze and present the findings. In addition, the researcher provided and displayed the statistical data through charts and graphs (e.g., histogram or line graph). Aslo, the

researcher used the measure of central tendency (mean, median, mode) to finalize the data analysis and ensure that it is comprehensive in all aspects.

Research Question(s) and System Alignment.

Table 3.1.

Research Question(s) Alignment

Research Question	Variables	Design	Instruments	Validity & Reliability	Technique (e.g., interview)	Source

RQ1 How does daily fluency practice impact students' algebraic procedural problemsolving skills?	IV. Help students who are having difficulty solving difficulties using a procedure. DV. Students' Progress	Quantitative methods.	Pre/Posttests	Following the daily fluency practice implementation, students saw an increase in them median scores by comparing their pretest and post-test scores.	After taking the posttest, all participants showed improvement in their ability to complete procedural problem-solving steps in solving basic algebraic questions. Despite some of them showing slow improvement.	15 students in the ninth grade

Procedures

Before implementing the intervention plan, the goal of the pre/post-tests were to assess students' learning deficiencies on abilities. In addition, the goal of the pre/post-tests were to assess the efficacy of the daily fluency tasks as an intervention technique for helping students to develop procedural problem-solving abilities. The duration of the intervention plan was five weeks each week, students practiced two to three specific skills that require fluency development. After three weeks of waiting for the IRB to review the forms and documents, permission is granted to begin data collection. Summarizing and analyzing the study's collected data, writing a conclusion, and the intervention plan's outcome (whether the intervention strategy addressed the knowledge gap). The resources the study uses include: For daily fluency practice to build procedural skills Smartboard: The main teaching and display tool and instructional source; used to display practice worksheets. Textbook: was used as a source for worksheets and practice materials

(procedural fluency practice works)

Pre/post-tests: were used as a tool to assess students' procedural fluency knowledge before and after the intervention plan was implemented. The data collected from pre/post-tests were also used to evaluate the effectiveness of the daily fluency tasks as an intervention strategy to help students' progress of problem -solving.

Ethical Considerations

While the researcher (the educator) was concentrating on answering the research question know how vital it is to safeguard the confidentiality and rights of the individuals and groups of people (the students and their families) who participate in the investigation.

In addition, the researcher is aware that to fulfill his ethical and moral obligations, he must use the data and information he has gathered exclusively to answer the research question. In addition, the following measures are taken to protect both the privacy of the individuals whose personal information is collected and the security of the data overall:

No one is allowed to see the information provided in the consent forms, any personal identifiers collected, or the data collected. The researcher, in this case, myself, is responsible for ensuring that any files or forms that contain personally identifiable information are kept safe until the research is finished. At this point, they are securely deleted or destroyed. In addition, all personal information and research data are kept on a laptop computer, which can be accessed by the researcher using a unique username and password combination.

Conclusion

This action research study is carried out by the researcher, a high school math teacher at an urban charter school with a significant number of ELL students. The studied class is one of the researcher's algebra one support classes. In total, there are approximately 15 people taking part in the study. Students enrolled in this course have been determined to have deficiencies in the fundamental mathematical skills required for the preceding grade levels. The researcher incorporates an intervention strategy into daily lesson plans in his instructional setting. As part of this strategy, students must complete daily fluency tasks to improve their procedural fluency. The study uses quantitative research to synthesize and analyze pre/post-test data. The intervention plan aimed to build mathematical procedural abilities and determine if daily fluency tasks were an effective way to narrow a knowledge gap. This study exclusively uses personal information and

data for research. The researcher stores all files/folders in a safe file cabinet and laptop with secure login.

CHAPTER 4

RESULTS

Research Summary

The daily fluency tasks implemented as an intervention strategy in this action research study positively affected students' procedural problem-solving skills. Fifteen 9th-grade students from one of the researcher's algebra one support classes took a pre-test that assessed their basic problemsolving skills in algebraic procedures. The average score on this pre-test, as indicated by the qualitative data collected, was 11. After administering the pre-test, the researcher implemented an intervention plan in which students were required to complete daily fluency tasks for five weeks, each day lasting 50 minutes. After the five-week intervention, students completed a post-test measuring the same skills as on the pre-test. The mean score on the post-test was 17, representing an increase of 6 points from the mean score on the pre-test.

In addition, the data revealed that students with higher pretest scores demonstrated more remarkable growth on the post-test. These improvements were attributable to their daily fluency practice. According to additional data analysis, the group that scored in the lowest third on the pretest had a mean score of 6 compared to 12 on the post-test. The average post-test score for a group that scored in the middle third on the pre-test was 11, which rose to 17 on average. In addition, the data revealed a correlation between the mean scores of the group with the highest mean scores on both tests; students with the highest mean score of 16 on the pretest also had the highest mean score of 23 on the post-test. This study's findings indicated that implementing "daily fluency activities" as an intervention strategy over a while positively affected students' procedural

knowledge, increasing their ability to solve algebraic problems. However, the growth demonstrated by the top half may be attributable to their basic proficiency in the pretest skills. In addition, due to their level of conceptual comprehension, they may have an advantage over those who achieved lower gains. A copy of the pre-test that students took on the first day of the intervention plan is depicted in Figure.

The researcher began implementing the intervention plan after students completed the pre-test; each week, students completed daily fluency tasks targeting specific procedural problem-solving skills identified in the pre-test. On the last day of the intervention plan, the researcher gave the post-test to see how well the program worked and if the daily fluency tasks changed the students' procedural problem-solving skills.

Summary of Results

After completing the five-weeks, each day 50-minute sessions of daily fluency skill-building exercises, students retook the post-test.

The preliminary examination data revealed a mean score of 11.

On the pre-test, students answered an average of 11 questions with a standard error of 4.7%. Furthermore, according to the data summary, the median pre-test score was 11, and the median post-test score was 18.

Another method of measuring average student growth revealed a median increase of 7 on average. On the post-test, 50% of students correctly answered 18 out of 25 questions, compared to 11 out of 25 on the pre-test.

Figure 1 depicts the median scores on the pre-test and post-test.

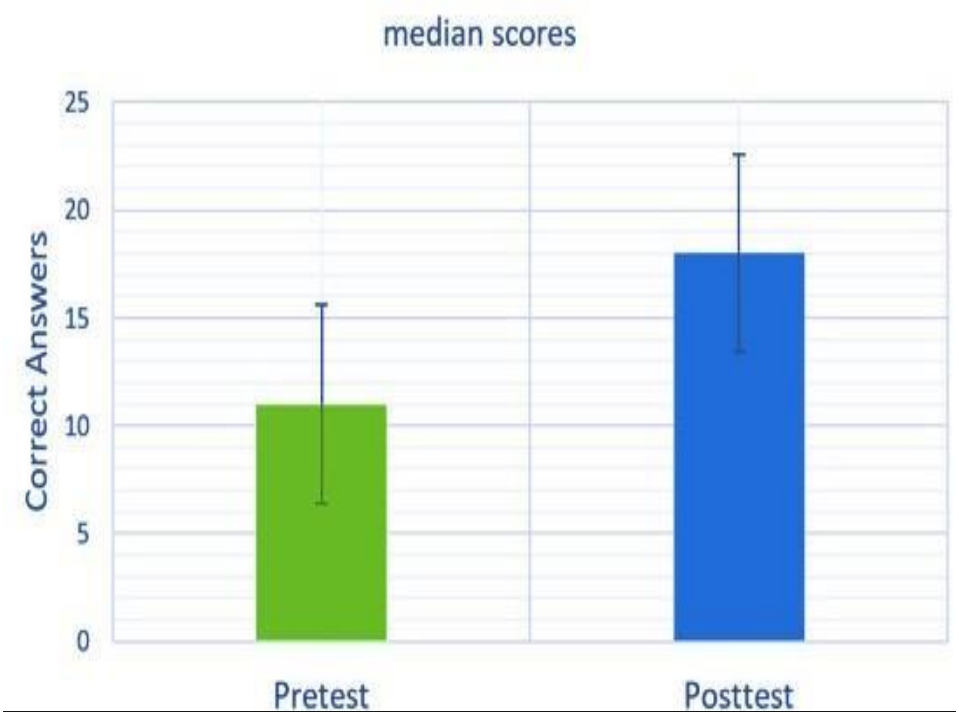

Figure 1. After incorporating daily fluency practice, students' median scores improved from the pre- to post-test.

According to the data, the average score before and after the intervention was 15.

In other words, the middle third of test takers scored in the highest range before treatment, while the middle third scored in the lowest range after treatment.

Figure 2 shows the average scores from the practice test and the final exam.

Figure 2. Pre-test and Post-test mode scores

The post-test data analysis revealed an improvement in the procedural problem-solving skills of the students, with a mean score of 17 and a standard error of 6.7. Figure 3 illustrates this increase. Therefore, it supports the notion that the improvement results from daily fluency tasks.

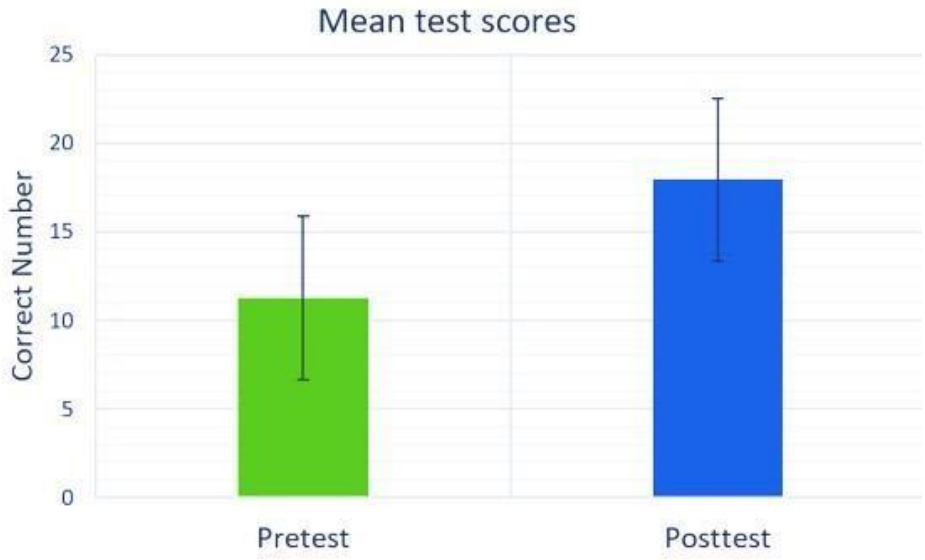

Figure 3. Pre-test and Post-test mean scores with error bars are provided (showing the standard error of the mean).

Following the implementation of the Daily Fluency Activities plan, the findings indicate a considerable increase in the post-test scores.

After taking the post-test, all individuals improved their ability to complete procedural problem-solving procedures when answering elementary algebra questions, although some participants exhibited sluggish improvement. Overall, 87 percent of participants had significant growth. Figure 4 illustrates the pre-and post-test scores ordered from lowest to highest. Notable is the fact that the individual with the lowest pre-test score of 4 achieved a post-test score of 13. Figure 4 shows that student 13 improved the most, going from a pre-test score of 16 to a post-test score of 25, a gain of 9 questions. Furthermore, at least 19 questions were answered correctly by 40% of students, indicating that they had mastered the skills assessed by the post-test Further observation on the two tests showed that students 2 and 3 skipped five questions that they may have perceived difficulty or would lower their scores if they gave incorrect answers.

Question these students skipped involved signed integer operations such as $7(-8)\ or\ 6x\ (-9)$. The result could suggest a lack of fundamental operating abilities, which was consistent with the issue that this study sought to solve.

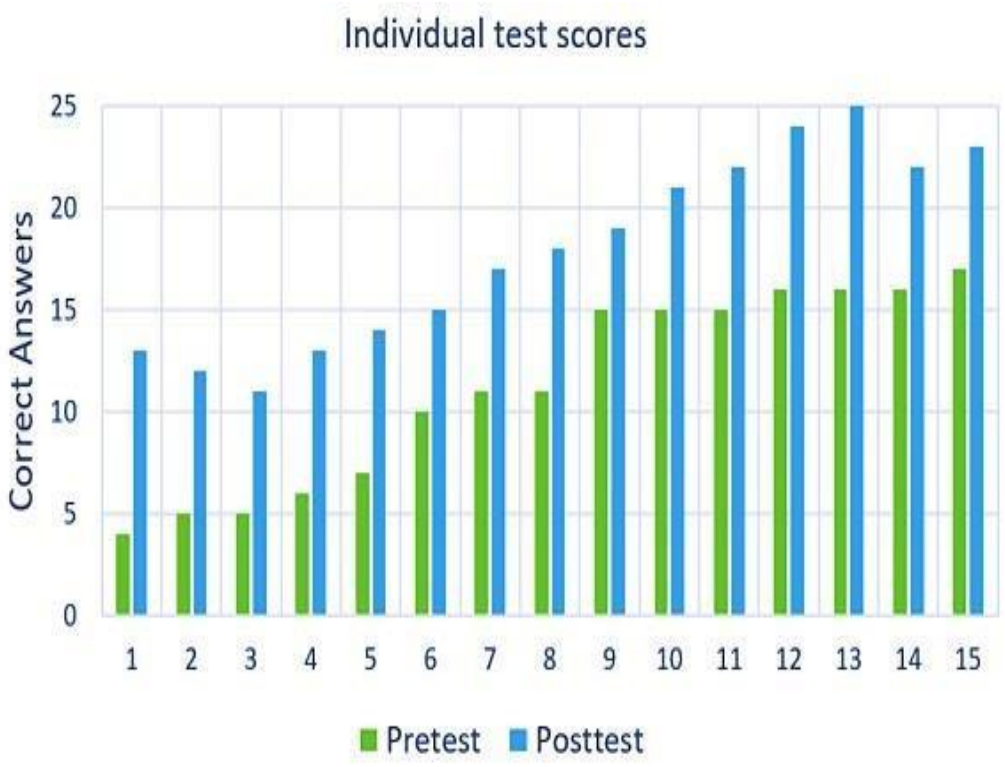

Figure 4. Students are put into three groups based on how well they did on the pre-test. Figure 3 shows that the lowest-performing group, which had a mean score of 5 on the pre-test and a mean score of 12 on the post-test, learned an average of 7 questions. The discrepancy in scores may be attributable to the daily fluency practice schedule.

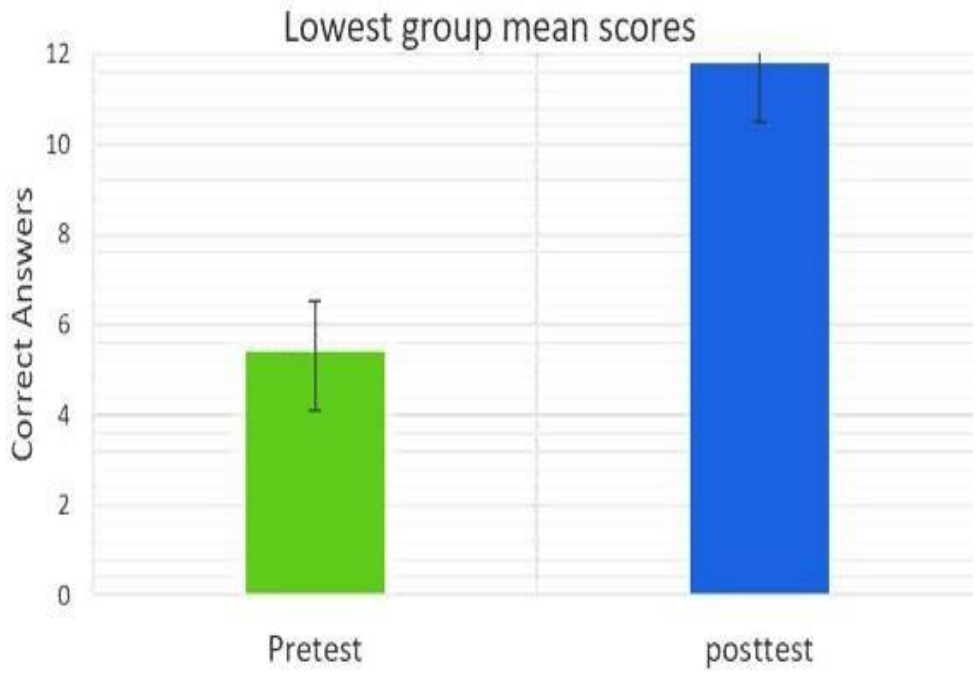

Figure 5. The pre-test and post-test mean scores are displayed with error bars (showing the standard error of the mean). After adopting the Daily Fluency Activities, post-test scores increased significantly. Figure 6 depicts how students in the middle group performed, with a mean score of 11 on the pre-test and 16 on the post-test, gaining an average growth of 5 questions answered correctly. According to the findings, the difference in scores was caused by implementing the daily fluency tasks.

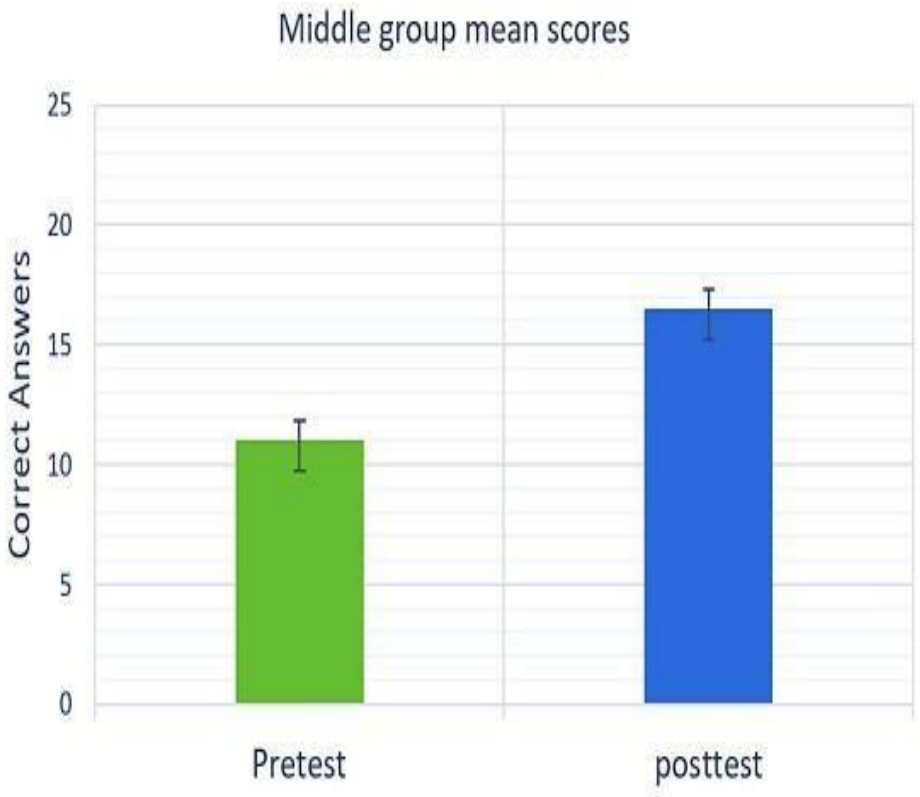

Figure 6. Mean scores from the pre-test and post-test are shown with error bars (showing the standard error of the mean). The data show an increase in post-test scores following implementing the Daily Fluency Activities.

As shown in Figure 7, the group in the top third had a mean score of 16 on the pre-test and 23 on the post-test, gaining an average of 7 questions answered correctly. The increase provided evidence that the improvement resulted from the intervention's implementation plan.

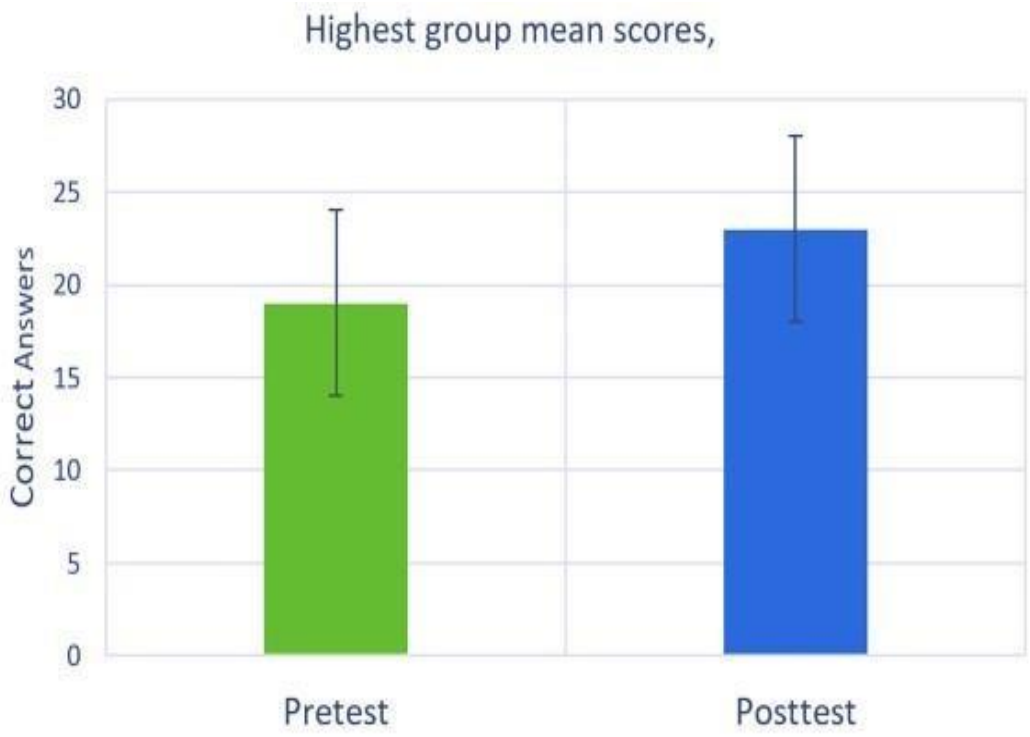

Figure 7. The highest third pre-test and post-test mean scores are shown.

The data showed that the post-test mean score increased after implementing the Daily Fluency Activities.

Implementation

A skill-building intervention plan was implemented for 15 ninth-grade students in this study. These students were identified as having difficulties with basic procedural problem-solving steps. The researcher gave the students a pre-test to determine their level of knowledge deficiency and the skills they needed to develop. The descriptive data were summarized and analyzed to create an intervention strategy; the pre-test was calculated to determine the average number of questions correctly answered by students. The pre-test scores were then studied by splitting the students into three groups: those with the lowest performance, intermediate performance, and those with the

highest version. After the intervention plan was implemented, the scores of these three groups would be reapplied to the post-test information.

Students were required to perform a 50-minute daily fluency task as part of a five-weeks intervention plan. Each practice session emphasized the mastery of specific abilities.

Figure 8 depicts a sample of the daily fluency exercise. After each intervention session, the researcher collected the students' fluency practice worksheets and recorded which skills were not mastered by each student. At the conclusion of the fifth session of the daily fluency intervention program, the researcher administered the post-test, which assessed the same skills as the pre-test. The post-test scores were summarized and analyzed in the same manner as the pre-test scores; the group's mean score was calculated and compared to the pre-test group's mean score. In addition, the scores were divided in the same manner as the pre-test scores: the lowest-performing third, the middle performing third, and the highest-performing third. The average pre-and post-test scores of each group were compared and further analyzed. In addition, the two mean scores for each group were plotted on a bar graph and compared. To visualize the growth of each student, the pre-test and post-test scores of the entire class were plotted on a bar graph from lowest to highest score.

The findings and the Summary of this study were based on the results displayed by the data mentioned earlier Summary and analysis. Further analysis indicated a significant difference between each group's pre-test and post-test mean scores. The researcher used Microsoft.

Excel to summarize and analyze the research data.

Answer(s) to the Research Question(s)

In this study, the researcher sought to determine whether "daily fluency practice" was a viable intervention strategy for addressing the research question, how does daily fluency practice affect students' ability to solve algebraic procedural problems? This study demonstrated that participants' knowledge of procedural algebraic steps increased. Based on the data analysis, the group's average test results increased from an average of 11 correctly answered questions to an average of 17 correctly answered questions, a gain of an average of 6 correctly answered questions.

In addition, the study's results revealed that 87% of students completed mathematical procedural steps, demonstrating the positive effect that daily fluency activities had on students' ability to solve procedural problems.

This study also revealed that students in the highest-performing third on the pre-test had a deeper understanding of fundamental mathematics.

This group exhibited the greatest growth with a mean of 16 on the pre-test and 25 on the post-test. The pre-test and post-test mean scores for each subgroup reveal that other subgroups achieved less growth than the group with the highest performance.

The study concluded that daily fluency practice positively affected students' algebraic procedural problem-solving skills, even though students who performed in the lowest and middle tiers also improved, albeit less than those in the highest tier.

Product

This study used action research to determine the impact of daily fluency practice on students' procedural problem-solving skills in algebra. In addition, this study investigated how daily fluency skill-building practice can improve students' procedural fluency in algebra. Students participated in a five-week, fifty-minute daily skill-building intervention. Students initially took the pre-test to evaluate their algebraic fundamentals and identify any learning gaps from previous grades. Students practiced several skills determined by the pre-test on each task requiring procedural fluency.

Students began by learning fundamental algebraic skills such as adding and subtracting signed integers, such as 9 +(7) or 8x 3x, and multiplying and dividing algebraic expressions, such as 12m(4m) or k. Other educational objectives include employing the additive and multiplicative inverse properties to

4 solve linear equations and inequalities. For example, $x - 3 = 7$ *or* $3x < -6$. Figure 9 below shows a copy of the daily fluency practice worksheet.

Daily fluency practice worksheet

Add or subtract the following expressions

1. 9+ (−7) = 2. −9 + (+7) = 3. −8x + (−5) = 11

4. $-7x + 12x = 19$

Which pairs of integers are additive inverses?

5. (6, 6), (6, −6), (8, −4), (9, −9) 6. (−8, −8), (7, −7), (8, 8), (−8, 8), (−1, 1)

Multiply the following integers and expressions

7. $+5(-9) =$ 8. $-12(-5) =$ 9. $-9x\,(-9) =$ 10. $(-12)\,(-5\text{ m}) =$ 11. $(-11)8n =$ Divide the following integers and expressions

12. $12x - 6x =$ 13. $18x + 9x =$ 14. $-21r - 4r =$ 15. $-9w + 1w =$

Solve each inequality showing all procedural steps.

16. $r + 4 > 8$ 17. $2m - 6 < 14$ 18. $8w$–> 64

Solve each equation showing all procedural steps

21. $y - 12 = 24$ 22. $5x + 7 = 54$ 23. $24k + 4 = 24$

Correct: _____ Incorrect: _____ Unanswered: _____

Figure 8. Daily fluency practice worksheet.

Students completed one fluency practice worksheet during each fifty-minute session. As students worked on practice questions, the researcher recorded which competencies and skills they had not mastered so they could receive the additional course. After the 50minute session, the researcher gathered all fluency practice worksheets and recorded the number of questions answered correctly, incorrectly, or incorrectly by each student. After the fifth session of the five-day fluency practice, students took the post-test to

evaluate the effectiveness of the intervention plan and the effect of the daily fluency skill-building practice on the student's ability to solve algebraic procedural problems.

Conclusion:

There was a tremendous amount of uncertainty during the time that the data was obtained. I considered this concern before beginning my daily fluency work on the procedural problem-solving skills of my students. The qualitative data gathered and presented as part of this study's conclusions validated these concepts in multiple respects. Daily fluency practice had a favorable impact on student's ability to solve algebraic procedural problems, although students who performed at the lowest and middle levels also improved, albeit to a lesser extent than those who achieved at the highest level on the pre/post-tests.

CHAPTER 5

IMPLICATIONS FOR PRACTICE

Overview of Implication for practice

Algebra 1 support students face a common challenge: completing procedural steps when solving algebraic problems. This study aimed to address this issue by implementing daily fluency tasks as an intervention plan. The results showed that the

daily fluency tasks improved students' procedural problem-solving ability after five week sessions of 50-minute daily skill-building practice. Furthermore, students with more vital mathematical fundamental skills outperformed those with less developed essential skills before the daily fluency skill-building intervention plan. Moreover, the subgroup of students who performed the best on the pre-test had a more significant impact on the overall effect of daily fluency practice on students' growth. Since the researcher also taught in the classroom, he had a personal connection with the students, which might have influenced their motivation and slowed down their progress. In addition to daily fluency practice, other factors, such as consistent daily math curriculum instruction, may impact the rise in kids' overall achievement. The regular daily math curriculum instructions may be to blame for the overall increase in achievement.

Strengths and Weaknesses of Methodology

Utilizing a pre-test and post-test was one of the benefits of this action research project. Using the initial pre-test and the final post-test as a comparison approach made it easy to understand the difference in performance outcomes and the progress students had made as a result of the daily fluency practice plan. In addition, the pre-test and post-test made the comparison of the growth of subgroups more transparent and intelligible when comparing the mean scores based on the first pre-test outcome. Using numerical data to summarize and analyze the pre-test and post-test results was the second strength of this study. In addition, using quantitative action research allowed the researcher to collect and summarize numerical data to address a previously identified learning issue. The impact of daily fluency practice was measured and evaluated using the numerical data

results. The third strength of this study in terms of using the action research method was the critical information gained by the researcher to improve future instructions and further support the students. Furthermore, the researcher used the collected data to identify students who required additional intervention and targeted practice to help them progress in developing procedural fluency skills.

Students' knowledge acquisition or skill progress might not have been partially measured, a study limitation that might have affected their performance and, therefore, their ability to learn procedural fluency. That can be because of a flaw in the study's instrument or the methodology employed to assess pupils' development. Students were also told that their performance on the pre-test and post-test would not affect their grades; therefore, they might have perceived they could have left some questions unanswered. The small sample of 15 participants was another possible weakness in this study. All participants were in the same classroom, and most were in the same community. For this reason, the study results couldn't be generalized without collecting data from a more diverse population and a larger sample size. Further, results from a larger population would have increased the chances that the difference amongst the individual subgroup mean scores would likely secure a threshold to show a significant difference in achievement, reflecting the entire group.

Factors of Influence

Participant absence was the first probable factor in this study that may have influenced the results. Although all participants took the pre-test and post-test, some would arrive late to practice sessions, and others would take lengthy toilet breaks. If they

had participated fully in the skill-building practice sessions, their performance on particular skill sets might have been affected, leading to different outcomes.

The second crucial component was the relationship between the researcher and the subjects. The teacher-student interaction could have affected the students' motivation and interest in the research. In addition, participants may have felt driven to make efforts above their capabilities because the daily fluency intervention plan had consequences beyond enhancing skill fluency, such as earning extra credit toward regular course grades.

Recommendations for Further Investigation.

It would have been more helpful to design an intervention program that tackles kids' skill deficits over a more extended period, preferably at the beginning of the school year. By implementing this skill-building intervention plan for an extended length of time, students may be given the additional time they need to achieve mastery. Moreover, the sooner the intervention strategy is implemented, the greater the likelihood that children will gain procedural fluency mastery.

Algebra students regularly struggle with a lack of foundational procedural knowledge; by expanding the study to include students from a broader range of backgrounds, we can learn more about how these students learn to solve problems quickly and accurately. A more generalized conclusion about how much of an effect daily fluency practice had on students' algebraic abilities development may have been drawn if the study had involved a bigger sample size. The researcher's ability to form a strong rapport with the study's participants may also suffer if the sample size is increased.

Barriers or Limitations of Implementation

The research was conducted with a tiny sample of participants and, therefore, cannot be generalized. There were only 15 students who participated in this study, and their growth was assessed based on the difference between the mean scores of the pre-test and post-test, reducing the study's confidence level. In other words, drawing a conclusion from the initial pre-test and post-test limited the opportunities to collect more data that could have more reliably reflected the progress the student would have made during the intervention plan. In addition, if a larger sample size had been used, the results would have been higher reliability. In addition, the survey had a short time frame; only five weeks were set out for data collection. Another restriction was that there was no way to work with a more representative sample of the population because all participants were from the same socioeconomic background.

Implications of Research on Educational Practice

While the focus of this study was on how daily fluency practice might help students in specific classes learn basic algebra concepts. The results also suggested that students in grades 5-8 math classes could have benefited from an intervention program like daily fluency practice if it had been implemented at the beginning of the school year. A student's chances of succeeding in higher-level math courses may improve if they begin algebra classes with solid foundational procedural skills (Riccomini et al., 2017).

Results from such a study would have been more reliable if they had been collected from a representative sample of the district's pupils, ideally those in fifth through ninth

grades. Such evidence could have bolstered our ability to reach a broad conclusion about the efficacy of daily fluency practice as an intervention strategy.

The necessity of academic intervention programs like daily fluency skill-building to enhance future lessons and select a comprehensive mathematics curriculum that fully supports the needs of students from various educational backgrounds. In total, we expected to spend five days on the study. Because of this, the researcher may not have been able to perform a survey that exhaustively examined the influence of the intervention plan without a time limit, suggesting that future studies be designed over a more extended period. The other implication was that the content teachers and district could have benefited from additional research into the efficacy.

REFERENCES

BOALER, J. (2018). Developing Mathematical Mindsets: The Need to Interact with Numbers Flexibly and Conceptually. American Educator, 42(4), 28–40.

Foster, Colin. (2018). Developing Mathematical Fluency: Comparing Exercises and Rich Tasks.

Educational Studies in Mathematics,97(2),121-141.
Hurst, M., & Cordes, S. (2018). A systematic investigation of the link between rational number processing and algebra ability. British Journal of Psychology (London, England: 1953), 109(1), 99–117. https://doi.org/10.1111/bjop.12244

Al-Mutawah, M. A., Thomas, R., Eid, A., Mahmoud, E. Y., & Fateel, M. J. (2019). Conceptual Understanding, Procedural Knowledge, and Problem-Solving Skills in Mathematics: High School Graduates Work Analysis and Standpoints. International Journal of Education and Practice, 7(3), 258–273.

Berger, A.M. (2017). Using Number Talks to Build Procedural Fluency through Conceptual Understanding. *Ohio Journal of School Mathematics, 75, 1-7.*

Kandeel, R. A. A. (2021). Learners' mathematics proficiency levels on Pisa 2018: A comparative study. International Journal of Instruction, 14(3), 393-416.

Hodgson, T., Eisenhardt, S., & Mugavin-Smith, J. (2012). Toward an Understanding of

Mathematical Procedures. Ohio Journal of School Mathematics, 66, 17–24.

Meaney, T., & Lange, T. (2012). Knowing Mathematics to be a Teacher. *Mathematics Teacher Education & Development*, *14*(2), 50–69.

Pratt, S. S., & Eddy, C. M. (2017). Selecting Tools to Model Integer and Binomial

Multiplication. Journal of Mathematics Education at Teachers College, 8(2), 31–40.

Sun, K. L. (2018). Brief Report: The Role of Mathematics Teaching in Fostering Student Growth Mindset, Journal for Research in Mathematics Education JRME, 49(3), 330-335. Retrieved December 3, 2021, from https://pubs.nctm.org/view/journals/jrme/49/3/articlep330.xml

Flores, M. M., Moore, A.J., & Meyer, J. M. (2020). Teaching the partial products algorithm with the concrete representational abstract sequence and the strategic instruction model. *Psychology in the Schools,* 57(6), 946-958.

Arifin, S., Wahyudin, & Herman, T. (2021). The Effect of Students' Mathematics Self-efficacy on Mathematical Understanding Performance. *Ilkogretim Online*, *20*(1), 617–627. https://doiorg.trmproxy.mnpals.net/10.17051/ilkonline.2021.01.52

Ross, A., & Willson, V. (2012). The Effects of Representations, Constructivist Approaches Engagement on Middle School Students' Algebraic Procedure and Conceptual Understanding. *School Science & Mathematics*, *112*(2), 117–128. https://doi-org.trmproxy.mnpals.net/10.1111/j.1949-8594.2011.00125.x

Clinch, A. (2018). Factoring for Roots. Mathematics Teacher, 111(7), 528–534. Corral, D., Quilici, J. L., & Rutchick, A. M. (2020). The effects of early schema acquisition on mathematical problemsolving. Psychological Research, 84(6), 1495–1506.

Laswadi, Kusumah, Y. S., Darwish, S., & Afghani, J. D. (2016). Developing Conceptual

Understanding and Procedural Fluency for Junior High School Students through Model Facilitated Learning (MFL). European Journal of Science and Mathematics Education, 4(1), 67–74.

Malatjie, F., & Machaba, F. (2019). Exploring Mathematics Learners' Conceptual Understanding of Coordinates and Transformation Geometry through Concept Mapping. EURASIA Journal of Mathematics, Science and Technology Education, 15(12). NCTM. (2021). Problem Solving.

Greene, I., Tiernan, A. M., & Holloway, J. (2018). Cross-Age Peer Tutoring and Fluency-Based Instruction to Achieve Fluency with Mathematics Computation Skills: A Randomized Controlled Trial. Journal of Behavioral Education, 27(2), 145–171.

Powell, S. R., & Fuchs, L. S. (2012). Early Numerical Competencies and Students with Mathematics Difficulty. Focus on exceptional children, 44(5), 1–16.

Riccomini, P. J., Stocker Jr., J. D., & Morano, S. (2017). Implementing an Effective Mathematics Fact Fluency Practice Activity. Teaching Exceptional Children, 49(5), 318– 327. https://doi.org/10.1177/0040059916685053

Hendrickson, S. J., Kuehl, B., & Hilton, S. (2018). Connecting the Dots: Building Procedural Fluency, Mathematics Teaching in the Middle School MTMS, 24(2), 104-110. Retrieved December 16, 2021, from https://pubs.nctm.org/view/journals/mtms/24/2/article

Hong, D. S., & Runnalls, C. (2020). Examining preservice teachers' responses to area

conservation tasks. *School Science & Mathematics*, *120*(5), 198–208. https://doi-org.trmproxy.mnpals.net/10.1111/ssm.12409