

THE EFFECT OF DAILY 5-MINUTE INTEGER FLUENCY DRILLS ON THE SPEED AND ACCURACY OF GRADE 7 STUDENTS

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ABSTRACT

For grade 7 students to succeed in higher mathematics, procedural fluency in integer operations is important. However, many of the students are still struggling to perform basic integer operations quickly and accurately. This indicates the need for instructional strategies that can improve both their speed and accuracy in solving integer operations. This study examined how effectively students in Grade 7 could solve integer operation problems more quickly and accurately after they were exposed to daily 5-minute integer fluency drills. Sixty students participated in this study, who were divided into an experimental group ($n = 30$) that received the drills and a control group ($n = 30$) that did not. Speed was measured by the average number of problems attempted per minute, while accuracy was measured by the percentage of correct answers out of the total problems attempted. Results revealed that the experimental group had a large increase in speed level from a pretest mean of 2.72 to a posttest mean of 3.83 problems per minute, while the control group had a smaller increase from 3.15 to 3.53 problems per minute. Accuracy levels also improved descriptively in both groups with the experimental group increased from 47.56% to 59.71% and the control group from 37.92% to 54.23%. However, analysis of covariance (ANCOVA) controlling for pretest results has revealed a significant effect only for speed, $F(1,57) = 4.60$, $p = .036$, partial $\eta^2 = .075$, while accuracy showed no significant difference, $F(1,57) = 0.02$, $p = .880$. These findings suggest that daily 5-minute integer fluency drills are an efficient and beneficial instructional strategy for improving computational speed in integer operations. However, the limited impact on accuracy indicates that the drills should be used for a more extended implementation period and it should be combined with the complementary strategies such as immediate feedback, error analysis, and conceptual reinforcement to improve a balanced procedural fluency of speed and accuracy.

Keywords: integer operations, fluency drills, computational speed, accuracy, grade 7 mathematics

1. INTRODUCTION

Procedural fluency is important factor for students in improving their mathematical skills and academic performance. According to the National Council of Teachers of Mathematics (NCTM, 2023), procedural fluency refers to the ability of the students to perform mathematical operations with accuracy, efficiency, and flexibility. If the students are procedurally fluent, it could mean that they can solve mathematical problems quickly and accurately with less likely to make mistakes. One of the most common challenges in mathematics regarding procedural fluency among high school students is the inability to solve integer operations. According to studies, many high school students who struggled in

solving simple integer operations, had struggled more in learning advanced math topics and concepts. Studies have also shown the hindrance of students in obtaining procedural fluency in integer operations are procedural errors, fundamental misconceptions, and a lack of practice.

In a global context, several international studies have also revealed persistent difficulties in students' fluency with integer operations with regard to speed and accuracy. In Malaysia, Khalid and Embong (2020) found that poor foundational knowledge, rule confusion, and superficial understanding of integer concepts were common causes of mistakes made by Year 7 students. At the same time, Lin and Riccomini (2025) extended

this work in the US by examining error patterns in students with and without specific learning disabilities and identifying systematic errors like misinterpreting signs and ignoring unary/binary distinctions. In addition to decreased accuracy, these errors slowed their performance, indicating a lack of automaticity. Complementing these findings, Nurnberger-Haag, Kratky, and Karpinski (2022) developed and validated an assessment tool measuring the middle school students' accuracy and speed in integer calculations. Their study found that the poor conceptual understanding directly reduces both fluency and efficiency, and the persistent misconceptions with negative numbers, particularly in subtraction. Collectively, these studies demonstrated the variety of situations in which students struggle to become automatic in integer operations. It demonstrated how misconceptions hinder students' advancement to advanced mathematics by causing slower and more error-prone performance.

Local studies conducted in the Philippines also supported the global findings on students' persistent difficulties with integer operations, like in the study of Dela Rosa et al. (2023), which identified the common errors among Grade 7 students that include misconceptions about negative numbers and excessive reliance on their rote memory, which are the frequent causes of mistakes in addition, subtraction, multiplication, and division. This finding was supported by an intervention study by Harun et al. (2024), which showed that even in the presence of continuing misconceptions regarding negative numbers in integer operations, a targeted educational approach greatly increased Grade 7 students' mastery. In addition, Alfante et al. (2024) found that Grade 9 students were able to add and subtract numbers more quickly and accurately when they practiced structured math exercises.

Overall, these Philippine studies showed how students find it more difficult to become fluent when they lack fundamental skills and have misconceptions. However, they acknowledge how effective the teaching strategies and interventions with the consistent practice can help students improve their automaticity and reduce errors.

This study was based on established theories that guided this approach in understanding the improvements among grade 7 students in integer fluency. According to Sweller's Cognitive Load

Theory (1988), when students achieve fluency and automaticity in basic operations, their cognitive load is reduced. As a results, they can avoid overloading their mental energy and can focus more on exercising their higher-order thinking and problem-solving. Additionally, in Bloom's Mastery Learning (1968), students can develop strong fundamental skills through structured instruction and constructive feedback. Furthermore, in Ericsson's Deliberate Practice (2016), mastery learning requires a regular and repetitive practice with targeted feedback. Thus, these frameworks demonstrate that fluency with integer operations goes beyond speed. It is also about developing a solid conceptual foundation through consistent practice. As a result, students become more precise, automatic, and prepared for more complex and advanced mathematics.

Although there are many strategies for procedural fluency, there is limited evidence that short, structured, and repetitive daily timed drills involving integer operations can increase students' computational speed and accuracy in Grade 7 students. Most previous studies either combine speed and accuracy into a single measure or focus solely on accuracy. Only a few interventions are designed to improve speed without compromising accuracy, or vice versa. This study creates a gap because math teachers lack a specific, evidence-based method for targeting both skills separately. Teaching strategies might improve procedural fluency but not the balance of speed and accuracy. To address this gap, new teaching methods or strategies, along with their corresponding assessment designs, are needed to improve and separately measure the speed and accuracy of Grade 7 students in integer operations. A teaching strategy that is brief, targeted, and repetitive, like drills, can help with this matter. Furthermore, there is a lack of evidence on this teaching strategy in integer operations within the context of private high schools, which were not well explored.

The challenge and opportunity here is to design and implement a teaching strategy grounded in established theories that directly enhances Grade 7 students' speed and accuracy in integer operations. Thus, this study investigates the effectiveness of a daily 5-minute integer fluency drills as a teaching strategy integrated into the regular mathematics class of Grade 7 at Xavier de Damulog High School, Inc. By doing so, this study

aims to contribute to the evidence-based instructional strategies in mathematics education and to bridge the gap between theory and practice by demonstrating how short, targeted and repetitive drills can develop speed and accuracy as two different learning outcomes. This study is particularly beneficial for a private high school setting, as this teaching strategy is rarely explored by researchers and rarely used in the school context. This was also the reason why the researcher was determined to do this study.

2. STATEMENT OF THE PROBLEM

This study aimed to investigate the effect of daily 5-minute integer fluency drills on the speed and accuracy of Grade 7 students at Xavier de Damulog High School, Inc.

Specifically, it sought to answer the following questions:

1. What are the levels of students' speed in integer operations (measured as the average number of problems attempted per minute) between students exposed to the drills and those who are not, in terms of:
 - a. Pretest results;
 - b. Posttest results.
2. What are the levels of students' accuracy in integer operations (measured as the percentage of correct answers out of the total problems attempted) between students exposed to the drills and those who are not, in terms of:
 - a. Pretest scores;
 - b. Posttest scores.
3. Is there a significant difference in speed between the two groups when controlling for pretest results?
4. Is there a significant difference in accuracy between the two groups when controlling for pretest scores?

3. METHODOLOGY

3.1 Research Design

This study employed a quantitative quasi-experimental, pretest and posttest non-equivalent group design, chosen due to the impracticality of random assignment. Two intact Grade 7 sections at Xavier de Damulog High School, Inc. were purposively selected: one served as the experimental group, receiving the daily

5-minute integer fluency drills, while the other served as the control group, following a standard instruction. Pretest scores were used as covariates in ANCOVA to control for baseline differences between groups.

Speed was measured as the average number of problems attempted per minute within the 5-minute time limit. At the same time, accuracy was measured as the percentage of correct answers among all the attempted problems. Data from the pilot phase were used solely for evaluation, refinement, and improvement of the research instrument, procedures, and feasibility, and were not included in the primary analysis.

This study spanned seven class days. On Day 1, both groups participated in the 5-minute timed pretest, used to establish baseline performance. For the next 5 class days, the experimental group was exposed to a 5-minute integer fluency drill each day. Meanwhile, the control group remained in their regular instruction. On Day 7, both groups completed the identical timed posttest. The researcher assessed the effect of the drills on students' computational speed and accuracy using posttest data, controlling for pretest scores with ANCOVA.

3.2 Locale of the Study

This study was conducted at Xavier de Damulog High School, Inc., a private secondary school located in the Municipality of Damulog, Province of Bukidnon, Northern Mindanao, Philippines. This school was chosen because it is accessible to the researcher, has a manageable student population, is anticipated to cooperate with the researcher, and offers the opportunity to investigate also in the context of a private high school, where such an empirical study remains underexplored.

3.3 Participants of the Study

Initially, the study involved 73 Grade 7 students from two intact sections of Xavier de Damulog High School, Inc. They were St. John with 36 students and St. Alphonsus with 37 students. However, among all of these students who provided informed consent to participate in the study, only those who completed all phases were included in the final sample. Thus, the final sample consisted of 60 students whose data were included in the study analysis. The St. John section with 30 students was the experimental group,

which received daily 5-minute integer fluency drills integrated into their math class. In comparison, the St. Alphonsus section with 30 students served as the control group, continuing with their regular instruction without the drills.

3.4 Research Instruments

This study used two primary instruments: pretest/posttest assessments and the daily 5-minute integer fluency drills as the instructional strategy.

Pretest/Posttest Assessment

The first main instrument is an assessment test developed by Signocan (2025) and modified to align with the Grade 7 curriculum at Xavier de Damulog High School, Inc. Removing parentheses from positive integers and eliminating the use of positive signs other than the one representing addition improves students' familiarity. The modified test consisted of 24 integer operation problems covering addition, subtraction, multiplication, and division.

The test was reviewed by four mathematics educators and experts to establish content validity and ensure clarity, appropriateness, and alignment with the Grade 7 curriculum objectives. It was also pilot-tested on Grade 7 students of Stella Matutina Academy of Bukidnon, Inc., a private secondary school in Bukidnon, Philippines. The results from the first pilot test produced a Cronbach's alpha of 0.598. The test was then modified and refined based on the pilot test results to capture better and measure the desired outcomes. It includes reducing the time limit from 15 minutes to 5 minutes to capture students' speed under timed conditions better, and revising a few items for the accuracy measure. Other adjustments were made to improve the test's reliability and validity before it was given to the actual participants in the main study. When it was pilot-tested again with the same participants, it yielded a new Cronbach's alpha of 0.730, indicating acceptable internal consistency.

Daily 5-Minute Integer Fluency Drills

This second instrument is the daily 5-minute integer fluency drills, which is a researcher-developed tool. For five class days, five drills have been prepared. Eight integer problems with a balanced mix of operations in each drill, parallel to other drills, and a five-minute time limit were

all included. The drills also underwent a self-conducted dry run and expert validation by the same four math educators. However, due to the study's brief implementation window, it was not fully pilot-tested with students. This procedure confirmed that the test was suitable for grade 7 students in terms of content, clarity, and classroom viability. To prevent rote memorization, the drills focused on brief, focused, repetitive, low-stress practice exercises with a variety of problem sequences. As teaching strategy tools, these drills also supplemented the pretest/posttest assessment, which served as the primary measure of students' speed and accuracy in integer operations.

3.5 Data Gathering Procedure

Before data collection for this study, the researcher obtained consents and approval letters from the school Directress, school administrators, student participants, and their parents or guardians to ensure ethical compliance and cooperation. The data were collected between September and October 2025, over 7 class days.

On day 1, the experimental and control groups were given the modified 5-minute integer operations pretest. Within the allotted five minutes, students from both groups were instructed to quickly and accurately solve as many integer operation problems as possible. With the math teacher serving as a research assistant, the researcher monitored the session and documented the total number of problems attempted and correctly solved. Speed was calculated as the number of problems attempted divided by 5 to produce an average problems-per-minute rate. In contrast, accuracy was calculated as the percentage of correct answers among the problems attempted. Then the ANCOVA analysis that followed used these baseline measurements as covariates.

For Days 2 to 6, only the experimental group was exposed to and engaged with the daily 5-minute integer fluency drills as part of their math class instruction, which was conducted after the class discussion. To create a supportive, stress-free learning environment, the math teacher distributed each drill to the class each class day, monitored the 5-minute timed practice, and gave direct, accuracy-focused feedback without grading. The control group continued with their

regular math class instruction on integers without the practice drills.

On day 7, both groups completed a posttest that was identical to the pretest. The researcher then recorded the posttest data for both groups, which were analyzed using ANCOVA, controlling for pretest results.

3.6 Statistical Techniques

The data were encoded and analyzed using IBM SPSS Statistical software. Descriptive statistics of means and standard deviations were used to summarize the pretest and posttest performance of both the experimental and control groups. Speed was calculated by dividing the total number of problems attempted by five to get the average number of problems per minute. The accuracy was calculated as the percentage of correctly answered problems among the problems attempted.

For the inferential analysis, Analysis of Covariance (ANCOVA) was used to compare posttest means for speed and accuracy between the experimental and control groups. This method statistically adjusted for initial group differences by using pretest results as covariates. ANCOVA was considered appropriate for this quasi-experimental design, as it increased statistical power and enabled a more confident attribution of significant posttest differences to the effect of the daily 5-minute integer fluency drills.

Results were analyzed at $\alpha = 0.05$ significance level to determine whether the daily 5-minute integer fluency drills produced a statistically significant effect on the speed and accuracy of Grade 7 students in integer operations.

4. RESULTS AND DISCUSSIONS

This section contained the presentation of findings, data analysis and its interpretation, implications, and the supporting studies. It was organized according to the research objectives of this study.

4.1 Descriptive Statistics of Students' Speed on Integers

The first research objective of this study was to identify the levels of students' speed in integer operations (measured as the average number of problems attempted per minute) between students exposed to the drills and those who were

not, in terms of pretest and posttest results. The data were collected from the results of the 24-item timed pretest and posttest assessment that were administered to the Grade 7 students of both experimental and control groups. Table 1 presents the means and standard deviations of students' speed for both experimental and control groups from their pretest and posttest performance.

Table 1. Descriptive statistics of students' speed on timed integer operation tests

Group	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental Group (With Drills)	30	2.72	1.16	3.83	0.99
Control Group (Without Drills)	30	3.15	1.28	3.53	1.08
TOTAL	60	2.94	1.23	3.68	1.04

The descriptive statistics showed that the groups' speeds differed noticeably. In the baseline pretest, the experimental group's mean speed was 2.72 problems per minute, while the control group's was 3.15 problems per minute. These results suggest that, at first, the students in the control group solved integer operations more quickly than those in the experimental group. The experimental group's posttest mean speed increased to 3.83 problems per minute after the implementation of the daily 5-minute integer fluency drills. The posttest mean speed of the control group, on the other hand, increased to 3.53 problems per minute. Students' computational speed increased following the daily 5-minute integer fluency drills, as demonstrated by the experimental group's speed gains of 1.11 problems per minute, surpassing the control group's gains of 0.38 problems per minute, indicating that students' computational speed was directly improved after having the daily 5-minute integer fluency drills. Additionally, the slight decrease in standard deviation in both groups from the pretest to the posttest suggests that students performed more consistently, whether or not they used the drills.

The significant increase in computational speed in the experimental group after the implementation of the daily 5-minute integer fluency drills highlights the impact of brief, targeted, and repetitive practice drills in a math class. Students

in Grade 7 evidently solved integer operations more quickly with less mental effort and increased their automaticity. Based on the researcher's observation of the experimental group during the practice drills, students also increased their engagement and confidence in answering the practice drills, even in a timed condition.

According to a study of Ronquillo and Parangat (2024), students in grades 7 to 10 at Sagpat High School who engaged in timed practice drills had demonstrated a significant increase in mastery across integer operations which emphasized the significance of immediate feedback in developing automaticity. In a similar study, Soto and Uchang (2025) found that Grade 8 students who were engaged in timed drills also demonstrated a significant increase in their math fluency indicating the capacity of the drills to boost computational speed. While a study on Grade 10 students in plane coordinate geometry, Lozano (2019) also found that explicit timed drills significantly accelerated problem-solving speed with the majority of students in the experimental group either maintained or increased their speed unlike to the stagnant performance of the control group. In addition, Lesaca and Falle (2021) confirmed the effectiveness of repetitive timed practice drills in improving automaticity with the four fundamental operations among Grade 8 students at Zambales National High School. These local findings are also aligned with international study by Baker and Cuevas (2018), which emphasized developing automaticity through fluency practice lowers cognitive load, enabling students to devote more mental resources to higher-order problem-solving.

Generally, these studies confirmed the practical benefit of integrating short, targeted, and repetitive drills into mathematics instruction. It implies that drills are not only effective in improving computational speed but also align with the study of automaticity and efficiency in mathematics education.

4.2 Descriptive Statistics of Students' Accuracy on Integers

The second research objective of this study was to identify the levels of students' accuracy in integer operations (measured as the percentage of correct answers out of total attempts) between students exposed to the drills and those who were not, in terms of pretest and posttest scores. Table 2

presents the means and standard deviations of students' accuracy for both the experimental and control groups, based on their pretest and posttest performance.

Table 2. Descriptive statistics of students' accuracy on timed integer operation tests

Group	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental Group (With Drills)	30	47.56	17.76	59.71	21.69
Control Group (Without Drills)	30	37.92	18.45	54.23	22.44
TOTAL	60	42.74	18.60	56.97	22.05

The descriptive statistics showed a meaningful improvement in both experimental and control groups. Before the implementation of the daily 5-minute integer fluency drills, the experimental group's pretest mean accuracy was 47.56%, while the control group's was 37.92%. These results imply that, at baseline, the experimental group performed slightly better in terms of accuracy than the control group. The experimental group improved their mean accuracy to 59.71% in the posttest, a gain of 12.15%. While the control group also improved their posttest mean accuracy to 54.23%, a gain of 16.31%. But despite the slightly greater numerical increase of the control group in accuracy, the experimental group maintained a higher overall accuracy in the posttest. In addition, the increase of the standard deviations in both groups indicated the greater variability in their posttest accuracy.

These results implied that although 5-minute integer fluency drills can sustained accuracy, the improvements were not as significant as those in speed. These results emphasize the importance of balancing both speed and accuracy to avoid careless mistakes that can result from rushed answering. The increased variability in posttest accuracy across both groups further indicates how students varies in their individual learning development. In the context of the students in experimental group, they responded and adapted the drills in different ways with the time pressure, individual engagement, repetitive practice, and even with the simple validation of their scores when they were acknowledged and given immediate constructive feedback.

A study by Torres (2025) identified a high error rate in integer operations among students due to misconceptions, but a game-based intervention has improved the students' performance in the below-average range especially in multiplication and division. Similarly, Flores et al. (2024) found that students in Grade 7 who performed well in addition, multiplication, and division but had difficulty with subtraction. As a result, they created an intervention that was focused on subtraction principles to be used in the classroom and additional drills to increase student proficiency. Additionally, in the study by Roy et al. (2025), students showed greater fluency with exceptional problems than with common ones, demonstrated the distinct cognitive processes in mental arithmetic and highlighted the particular challenges that can inform individualized teaching strategies and focused interventions for students who struggle with arithmetic. According to Ronquillo and Parangat (2024), daily 5-minute fluency drills increased accuracy across students with different learning speeds especially the slower learners. Similarly, Soto and Uchang (2025) discovered that timed drills have improved the automaticity and precision of grade 8 students with diverse cognitive abilities which emphasizes the importance of building fluency interventions that can address individual differences. Furthermore, a study by Baker and Cuevas (2018) found that fluency reduces cognitive load which allows students to maintain accuracy while solving problems more efficiently.

In general, targeted fluency drills improved computational speed and accuracy. However, it addresses the need for a strategy that balances both speed and accuracy in integer operations.

4.3 Analysis of Covariance for Posttest Speed Between Groups

The third research objective of this study was to determine whether there is a significant difference in posttest speed between the groups when controlling for their pretest speed. The ANCOVA results presented in Table 3 indicate a significant group effect, $F(1,57) = 4.60$, $p = .036$, partial $\eta^2 = .075$. These results showed that the daily 5-minute integer fluency drills accounted for 7.5% of the variance in posttest speed, beyond baseline scores, in both the experimental and control groups.

Table 3. ANCOVA results for posttest speed between groups controlling for pretest speed.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	19.01 ^a	2	9.51	12.23	.000	.300
Intercept	47.66	1	47.66	61.33	.000	.518
Speed Pretest (Covariate)	17.66	1	17.66	22.73	.000	.285
Group	3.57	1	3.57	4.60	.036	.075
Error	44.29	57	.78			
Total	877.32	60				
Corrected Total	63.30	59				

a. R Squared = .300 (Adjusted R Squared = .276)

The covariate pretest speed demonstrated a significant effect ($F(1,57) = 22.73$, $p < .001$), indicating that students' posttest performance was influenced by their initial speed. The shown group variable remained statistically significant ($F(1,57) = 4.60$, $p = .036$) even after controlling for baseline performance, suggesting that the daily 5-minute integer fluency drills have improved the computational speed. Based on the partial eta squared of .075, after controlling for pretest scores, group assignment accounts for about 7.5% of the variance in posttest speed, indicating a small to moderate effect size. Given the five-day duration of the drills, the overall model already accounted for 30% of the variance in the students' posttest speed ($R^2 = .300$).

These findings highlighted that the daily 5-minute integer fluency drills had a substantial impact on students' computational speed beyond their starting level. On a practical level, the findings demonstrated that the drills can enhance the students' computational speed without requiring a long intervention period in actual classroom. The evidence of improved speed in integer operations over a short period of days was indicated by the overall model which explained nearly one-third of the variance in posttest speed.

The results of this study were supported by the study of Duque, Albor, and Lagon (2025), which demonstrated that the experimental group using FlashDrills showed significantly higher proficiency scores than those in control group receiving the traditional instruction. It further suggests to continue using the FlashDrills as a transformative tool for improving numeracy skills particularly in student-centered learning

environments. In a related study, Lesaca and Falle (2021) demonstrated an improvement in academic performance among students using the Timed Practice Drills (TPD) which achieved significantly higher mean posttest scores compared to those using Non-Timed Practice Drills (NTPD). It indicates that timed practice drills effectively enhance computational speed and automaticity in basic math operations which allows students to allocate their cognitive resources to more complex problems in the future. Further study in adjusting for baseline skill levels, Ronquillo and Parangat (2024) found that timed practice drills were an effective strategy in improving the academic achievement of students in mathematics and recommended using them in classroom instruction across all grade levels.

In general, these studies supported the findings of this study that daily 5-minute integer fluency drills improved the computational speed of students in integer operations beyond initial skill differences, suggesting the use of timed drills as an efficient teaching strategy integrated into math classrooms to produce measurable gains in speed.

4.4 Analysis of Covariance for Posttest Accuracy Between Groups

The fourth research objective of this study was to determine whether there was a significant difference in posttest accuracy between the groups, controlling for their pretest accuracy. The ANCOVA results in Table 4 showed no significant group effect, $F(1,57) = 0.02$, $p = .880$, indicating that the daily 5-minute integer fluency drills did not significantly influenced the accuracy of the students after accounting for pretest scores.

Table 4. ANCOVA results for posttest accuracy between groups controlling for pretest accuracy.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8437.99 ^a	2	4218.99	11.87	.000	.294
Intercept	7599.94	1	7599.94	21.39	.000	.273
Accuracy Pretest (Covariate)	7987.15	1	7987.15	22.48	.000	.283
Group	8.19	1	8.19	.02	.880	.000
Error	20256.54	57	355.38			
Total	223421.41	60				
Corrected Total	28694.527	59				

a. R Squared = .294 (Adjusted R Squared = .269)

Pretest accuracy was a significant covariate ($F(1,57) = 22.48$, $p < .001$), and students' initial accuracy levels had a substantial impact on their posttest accuracy. Although both groups showed descriptive improvements in accuracy, the ANCOVA results indicated that the control group showed a numerically larger raw gain. After baseline differences were statistically controlled, the daily 5-minute integer fluency drills did not significantly improve accuracy. The partial eta squared value for the group effect was .000, indicating a tiny effect size. About 29.4% of the variance in posttest accuracy was explained by the overall model ($R^2 = .294$), suggesting a moderately strong model fit, driven mainly by baseline accuracy rather than the drills. This result indicated that although the integer fluency drills improved speed, they did not result in a statistically significant increase in accuracy.

This result is in line with Bryant et al. (2020), who showed that at-risk learners' performance was improved by Tier 2 mathematics interventions only when accuracy was reinforced through guided practice and explicit feedback. Additionally, after Stocker et al. (2019) integrated 20 years of behavioral fluency research, they concluded that interventions should incorporate corrective feedback and mastery-based strategies to achieve a balance between automaticity and accuracy.

In local findings, Carriaga-Baril and Abapo (2025) showed in their study that the intervention was an effective and adaptable strategy for improving mathematical fluency to address the pandemic-induced learning gaps in fundamental mathematical skills, strongly recommending the use of tailored interventions, such as the Learning Support Intervention (LSI). In a similar study, Flores et al. (2024) concluded that poor performance in integer operations was primarily driven by difficulty with subtraction and recommended that teachers implement remedial sessions and use enhancement exercises and drills (such as flashcards) to address integer subtraction specifically.

The results in this study aligned with the above fluency studies that highlight the need to balance automaticity with conceptual clarity and accuracy to avoid impulsive errors in solving integer operations. This study demonstrated that when the baseline differences are statistically controlled, the daily 5-minute integer fluency

drills have increased the students' computational speed but were insufficient to generate significant accuracy gains. These results emphasized the importance of creating instructional strategies or interventions for integer operations fluency that combined both computational speed and accuracy to ensure that speed improvements do not compromise in improving accuracy.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the results of this study investigating the effect of daily 5-minute integer fluency drills as an instructional strategy for Grade 7 students on speed and accuracy in integer operations, the following conclusions were drawn.

1. Students in the experimental group who received and were exposed to the daily 5-minute integer fluency drills showed greater descriptive gains in computational speed than students in the control group who did not receive the drills, as indicated by their pretest to posttest results.
2. Although both groups improved their accuracy percentages from their pretest to posttest scores, the experimental group who received the daily 5-minute integer fluency drills, consistently maintained higher overall accuracy percentages in both pretest and posttest than the control group.
3. After controlling for baseline level, the ANCOVA results showed that there was a statistically significant difference in posttest speed between groups, which indicates that the daily 5-minute integer fluency drills contributed to the improvements in students' computational speed.
4. However, ANCOVA also showed that the posttest accuracy of students in the experimental group had no statistically significant difference from the control group, which indicates that the drills did not produce substantial improvements beyond their baseline level.
5. Overall, these results showed that the daily 5-minute integer fluency drills were a beneficial and time-efficient instructional strategy for increasing the computational speed of Grade 7 students in integer operations but were not sufficient to achieve a significant improvement in accuracy. However, despite its limitations,

given its 5-day implementation period, it has already produced meaningful results that could contribute to and improve future studies.

5.2 Recommendations

Based on the results and conclusions of this study, the following recommendations were established.

1. It is recommended that the math teachers implement the daily 5-minute integer fluency drills as their teaching strategy and integrate them into the classroom instruction when teaching integer operations with the grade 7 students, with extended implementation periods, and ensure that these drills are engaging, varied, and combined with immediate supportive feedback to maintain motivation.
2. Instructional designers may create more comprehensive fluency strategies that combine timed practice drills with feedback, error analysis, and conceptual reinforcement in order to achieve a balance between speed and accuracy.
3. Private secondary school is encouraged to support the professional development of their math teachers to ensure the successful implementation of teaching strategies and to monitor students' progress.
4. Future studies may also explore the effects of drills over a more extended implementation period, explore other kinds of drills, such as technology or game-based fluency tools to improve engagement, and examine these strategies across diverse student populations and school settings to strengthen generalizability.

However, this study has several limitations, including a short implementation period of daily 5-minute integer fluency drills and a focus on integer operations fluency for Grade 7 students at a private high school in Bukidnon, which may not have been sufficient to yield significant gains in accuracy. Caution must be taken when generalizing the results to other grade levels, mathematical domains, or longer-term instructional outcomes.

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