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Digital-Based Approach for Computational Fluency in Elementary Education

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Abstract:- This study was conducted to determine the impact of the routine practice of math operations utilizing digital devices on computational fluency in elementary education. Students working with computers or handheld devices practiced automaticity of basic operations on a regular basis, supplementing regular instruction and practice in the classroom. A control group of another school with similar academic and socioeconomic conditions was used for comparison purposes. The study focus was to measure fluency on addition and subtraction at third grade complexity according to state standards. An assessment was given to all the students to compare levels of skill development between the experimental group that utilized electronic devices to practice math operations and the control group that worked in standard classroom settings, with the absence of supplemental digital-based resources.

Keywords:- *Computational Fluency, Elementary Education, Mathematics.*

I. INTRODUCTION

The practice of math operations is an important factor in developing and maintaining knowledge and skills, increasing computational fluency and to ensure further development of problem-solving skills (Hinton, Flores & Shippen, 2013).

The current availability and portability of electronic devices, along with their affordability, make computers and tablets increasingly common in classrooms providing educators various alternatives to engage students in educational practices. Some schools allow use of personal devices or have adopted the “bring your own device” (BYOD) strategy, converting cellphones as educational allies when appropriate applications are utilized, giving more opportunities for math practice that can be extended outside the classroom and throughout the day.

II. METHODOLOGY

A. Participants

The selection of the third-grade students who participated in the study was determined based on the similarities in their socioeconomic and academic contexts. The schools included in the research are located in contiguous neighborhoods in the Dallas, Texas area. The distance between the participating schools is 2.4 miles and they are part of the same charter school district following identical academic curriculums.

B. Forming Groups

Ten students were randomly selected from one of the schools to form the Experimental Group (EG). They attended a campus with a population that was 98.4% Hispanic and 96.7% identified as economically disadvantaged (Texas Education Agency, 2019). The EG campus is located in zip code 75211 whose median household income in 2019 was $44,893 (United States Census Bureau, 2021).

Twenty students from the other school were randomly selected to form the Control Group (CG). They attended a campus with 97.5% of Hispanic population and 100% of its students were identified as economically disadvantaged (Texas Education Agency, 2019). The CG campus is located in zip code 75233 whose median household income in 2019 was $51,062 (United States Census Bureau, 2021). Based on the aforementioned data, it was assumed that the academic and socioeconomic conditions are similar for the EG and the CG.

The score of Computations and Algebraic Thinking of the school-approved assessment conducted at the beginning of the 2019/2020 school year was used as a baseline for the skills of the students at participating schools. The class of the students in the EG scored an average of 45.56% compared to 55.86% of the classes conforming the CG. Considering these slight differences between the two groups as shown in the Table 1, the students were assumed to have similar starting points, and due to the research was conducted after summer vacation when many students experienced academic regression referred for some scholars as summer learning loss, summer setback, or summer slide (Quinn & Polikoff, 2017).

Table 1
Socioeconomic and academic background

Group	Hispanic	Economically disadvantaged	Median Income	Computation and Algebraic thinking
EG	98.4%	96.7%	$44,893	45.56%
CG	97.5%	100%	$51,062	55.86%

C. Hypotheses

The following hypotheses were presented for the possible outcomes of the research:

H_0. The difference of the scores obtained by the students having supplemental practice over the students working in traditional settings does not present sufficient evidence to infer that additional practice of math operations using digital devices produces an improvement in computational fluency.

H_1. The difference in scores of the students in the EG over their peers in the CG produced significant evidence that math practice with the regularity and duration of the present study resulted in an improvement of computational fluency.

D. Practice

Focused and purposeful practice contributes to develop of computational fluency in students (Cozad & Riccomini, 2016). The recommendations for fluency improvement interventions suggested by Gersten et al. (2009) consisted of a systematic plan that focuses on retrieval of facts, includes an adequate allowed response time, provides immediate feedback, and suggests that mathematics achievement could be improved by a motivational component. The digital-based application designed by the author and utilized to perform the practice incorporated the mentioned features, including a reward system to motivate students. Average response time and scores were collected in a database to generate skill-growth reporting and data analysis. The pupils in the EG collectively answered a total of 7,780 math facts over a period of seven weeks administered in weekly assignment including additions, subtractions, multiplications, and comparisons. The complexity and the type of operation presented to the students were selected according to the third-grade Texas Essential Knowledge and Skills (TEKS) and the curriculum adopted by the schools.

III. RESULTS

Students were assessed after the seven-week practice period. The assessment consisted of 15 addition and 15 subtraction operations to be completed in 5 minutes. The math operations consisted of two three-digit numbers for additions and two two-digit numbers for subtractions. A composite score consisting of the average of the additions and subtractions on a scale from 0 to 100 was defined. The mean and standard deviation of the EG and the CG of the compound score of additions and subtractions are presented in Table 2.

Table 2
Statistical Analysis

	N	M	SD
Experimental Group	10	66.0	28.7
Control Group	20	44.2	29.9

A. Data Analysis

Based on the size of the EG and CG the author conducted the statistical analysis using unequal variances t-test -also known as Welch's t-test- that is suitable for independent samples of unequal sizes (Ruxton, 2006). The statistical processing was performed using the IBM SPSS Statistics application. The area of rejection of the unilateral test is located at the top end of the t-distribution. The 10 students that practiced math facts regularly utilizing electronic devices (M = 66.0, SD = 28.7) compared to 20 participants in the control group (M = 44.2, SD = 29.9) demonstrated significant better scores $t(28) = 1.94$, $p = .034$. The result led us to reject *Ho*. Therefore, H_1 is accepted and makes evident that regular practice of math facts produced a significant improvement of math fluency in the students in the experimental group compared to the counterparts in the control group.

IV. DISCUSSION

The present study demonstrates how enhanced practice contributes to the improvement of computational fluency. Due to the disruption caused by the COVID-19 pandemic, more intervention and remediation tools will be needed in the coming years to recover the academic loss in students in all subjects. Continuous practice of mathematical computations should be included as part the routine in every grade level, as students who invest too much time in basic computations may not have sufficient capacity to apply cognitive processes when solving complex math operations (Arnold, 2012). The digital-based approach proposed by the author focused on the improvement of precision only, leaving aside the response speed. Although more studies are necessary to determine a specific instrument to measure mathematical fluency integrating speed and precision, the present approach is worth considering due to the gains in accuracy demonstrated by the students who had supplemental practice on electronic devices.

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