A Comparative Study of the Effect of Student Participation and Dosage in the Catapult Learning Intervention Program in Early Elementary School Math

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ABSTRACT

Purpose:

This study examines the effect of participation in the Catapult Learning Intervention program in Mathematics services offered in a religious non-public school system in the Northeastern United States from grades K-2. Student scaled scores from the NWEA MAP assessments administered at the beginning of the school year in Fall 2023 (pre-test) and at the end of the school year in Spring 2024 (post-test) were used in the comparative analysis to determine the difference in scores of Catapult Learning (CL) enrolled students and students who did not participate in the CL intervention programs. Additionally, the differences in student outcomes based on the duration of participation in the Catapult Learning programs were studied.

Findings:

The results indicate that students who scored at the 60th percentile or below on their pretests and who were enrolled at the K-2 grade level and participated in the CL intervention program had higher average Spring (post-test) test overall scaled (RIT) scores in Math than students who did not, when controlled for their pretest achievement.

Students from the K-2 grade level participating in the program who scored 60th percentile or below on their pretests and who met the recommended Catapult Learning attendance thresholds, also had higher average Spring (post-test) test overall scaled (RIT) scores than students who did not participate in the intervention program in Math, when controlling for the student pretest achievement.

Methodology:

A between group quasi-experimental study was conducted to ascertain if there was difference in student outcomes based on student participation in the Catapult Learning intervention program in Math and to identify the difference in student outcomes based on the duration of their participation in the program. The following research questions guided this quantitative study:

1) Is there a difference in student outcomes between students who participated in the Catapult Learning intervention program and those who did not?

2) Does participation in and meeting the minimum attendance threshold of the CL intervention program impact student outcomes?

Description of the Intervention:

Catapult Learning's instructional curricula is systematic, intensive, and explicit and is built on the critical components of effective programs, as reviewed in current research, including the National Reading Panel and the National Council of Teachers of Mathematics. The Catapult Reading and Math intervention uses the Achieve Literacy and Math curricula as the basis for the program.

The Achieve Literacy program provides Catapult Learning teachers with proven research-based lessons that include high-quality routines and strategies to increase independence and accelerate literacy learning. Highly trained intervention teachers create comfortable and supportive learning environments by modeling and encouraging students to use existing knowledge to understand new concepts. Instructional techniques include providing immediate feedback, choosing appropriate independent-reading and instructional texts based on students' needs, differentiating and scaffolding instruction, as well as explicitly teaching critical thinking skills to increase students' self-confidence, independence, and motivation to read, write, listen, and speak.

Some additional aspects of Achieve Literacy include:

- A library of culturally-relevant and developmentally-appropriate texts designed specifically for intervention.
- Student Resource Books, take-home books, and student manipulatives
- Delivered in a small-group setting (no more than 8:1 student-to-teacher ratio).
- Developed using proven, research-based routines and strategies to accelerate students' literacy achievement.

Achieve Math provides systematic and explicit instruction to improve students' math skills, math literacy, and confidence. The program assists students in transferring and applying newly learned skills in the classroom. Teachers introduce concepts with concrete manipulatives followed by pictorial representations and algorithms. Math skills are presented sequentially within and across grade levels.

Additional aspects of Achieve Math include:

- Designed to increase struggling students' math skills, number sense, and math fluency.
- Delivered in a small group setting, with no more than an 8:1 student-to-teacher ratio, using proven, research-based math instruction.
- Includes a significant amount of grade-level appropriate manipulatives.
- Correlated to NCTM Standards, and draws upon findings of the National Research Council and the National Math Panel.

Data and Criteria Used:

Data from the NWEA Measures of Academic Progress NWEA MAP given in the Fall of 2023 and in the Spring of 2024 testing windows were used as the outcome variable in this analysis. The Measures of Academic Progress (MAP) assessment is an online adaptive interim assessment that is widely used to assess student academic growth and achievement in Math. MAP uses the RIT scale to measure student academic progress. RIT stands for Rasch Unit which was measurement scale developed as an equal interval scale making it possible to measure student progress year over year. The scale ranges from 100-350. All students who were administered the NWEA MAP assessment and the observations that fulfilled the criteria for analyses, outlined below, were included in the analytic dataset. Students not enrolled in Catapult Learning programs were considered as the Control Group and the students enrolled in Catapult Learning Mathematics intervention program were considered as the Treatment Group.

Students enrolled in Catapult Learning intervention services were identified using a unique identification with the combination of their Catapult Learning student identification number and the intervention subject. This was done to ensure that any duplicate observations were eliminated prior to performing the analysis. Students in the dataset were also grouped into grade bands between grades K-2 and categorized based on their attendance in the Catapult Intervention program.

Following were the criteria or parameters used to the dataset for the analyses:

- Students should have both their Fall and Spring tests with their Fall 2023 (pre-test) test administered between August to November 2023 and their Spring 2024 (post-test) test administered between March 15 and June 2024.
- Catapult Learning enrolled students had at least one day of attendance in a Catapult Learning Math intervention program in the time period between the two test administrations.

Table 1 shows the demographic characteristics of the sample of students included in this study.

Table 1: Demographics of Participants:

Ethnicity & Gender	Control	Treatment
American Indian or Alaskan Native	0.1%	0.3%
Asian	3%	4%
Black or African American	9%	19%
Hispanics of any race	21%	47%
Native Hawaiian or Other Pacific Islander	0.1%	1%
Two or more races	4%	4%
White	63%	25%
Female	52%	57%

n	3149	1014

Analytical Method:

The study was conducted to identify the difference in student outcomes based on the overall test scores of students enrolled in Catapult Learning programs in comparison to students who were not enrolled in the programs. This was achieved by using an Analysis of Covariance (ANCOVA) model in SPSS with the students' Spring 2024 posttest overall scaled score as the outcome variable. Student participation and duration in the program were considered as the independent variable for the analyses to answer the two research questions. The students' Fall 2023 or pretest scores were used as the covariates in the analyses.

The adjusted marginal means of the comparative groups resulting from the ANCOVA provide a measure to compare the two groups and, therefore, were used to determine which students in which grades or grade bands among those who were enrolled in Catapult Learning services had higher overall Spring scaled scores. The greater the effect size and the adjusted mean of the enrolled students, greater is the amount by which the students outperformed the students not enrolled.

The analytic models used in the Math analyses are as follows:

For Research Question 1: Spring Overall Scaled Score (RIT Score) ~ Participation in the CL Intervention Program + Fall Overall Scaled Score (RIT Score)

For Research Question 2: Spring Overall Scaled Score (RIT Score) ~ Participation in the CL Intervention Program & Meeting subject-wise attendance threshold + Fall Overall Scaled Score (RIT Score)

where,

Spring Overall Scaled Score (RIT Score) was the numeric overall scaled score in Math of each student obtained as the RIT scores from the Spring 2024 NWEA MAP;

Participation in the CL Intervention Program was used as a nominal variable that identified if the students was in the treatment or control group;

The Fall Overall Scaled Score (RIT Score) was the numeric overall scaled score in Math of each student obtained as the RIT scores from the Fall 2023 NWEA MAP;

Participation in the CL Intervention Program & Meeting subject-wise attendance threshold variable is another nominal variable that denotes a 0 for the control group and a 1 for students

who participated in the CL intervention program and attended at least 30 and 40 sessions in Math.

For answering both the research questions, ANCOVA analyses were conducted to compare the means of the two comparable groups by controlling for their pretest scores as covariates and to assess if a significant difference in scores existed between them, and if yes, what is the extent to which the difference existed between the two groups (effect size). The analysis was conducted at 95% confidence interval which meant that the significance was measured at $p < 0.05$.

The detailed results of the below analyses can be found in the Appendix. An overall analysis without any breakouts of data was conducted, followed by a comparison of only students who scored 60th percentile or below in their pretest. Another set of analysis was also performed for a combination of below 60th percentile students and students who had met the attendance threshold sessions set by Catapult Learning which is at least 30 sessions for Math intervention in an academic year.

Results:

Research Question 1:

Is there a difference in student outcomes between the students who participate in the Catapult Learning intervention program and those who do not?

This set of analyses focuses on the students who are enrolled in CL intervention program and scored 60th percentile or below in the Fall (BOY) assessment. The results are grouped as K-2.

Table 2

Effect of Student Participation on the student Spring 2024 NWEA MAP Scaled Scores in Math:

	N CL	N Non-CL	Adj. Mean CL	Adj. Mean Non-CL	Hedge's g	Sig (p)
Grade K-2	615	1100	175	174	0.12	**0.02**

Student participation in the Catapult Learning Math Intervention program showed a statistically significant and positive effect on the student post-test 2024 NWEA MAP scaled (RIT) scores in the early elementary grades of K-2. The adjusted mean of CL students' scaled scores was higher than that of the non-CL students and therefore, students in CL intervention program outperformed students who did not participate in the program, when controlling for student achievement on the pretest scores. The effect size of 0.12 indicates the impact of participation on Spring overall scores in MAP.

Research Question 2:

Does participation in and meeting the minimum attendance threshold of the CL Intervention program affect student outcomes among the K-8 students in non-public schools?

Analysis was also conducted by considering student participation and meeting CL attendance threshold as criteria for CL enrolled students and students not participating in the CL intervention program were considered the control group. Here too, the students who scored below 60th percentile in the initial Fall (BOY) MAP test were considered. The analysis showed that student participation and meeting the recommended attendance threshold had statistically significant and positive impact on student Math Spring test scores in NWEA MAP in K-2 grade level.

The slightly higher effect size of ~0.13 shows that there is increased positive impact of student participation on NWEA MAP Spring scores when students participate to meet the CL Intervention attendance threshold of 30 days or more in Math.

Table 3

Effect of Student Participation and Duration of Participation on the student Spring 2024 NWEA MAP Scaled Scores in Math:

	N CL	N Non-CL	Adj. Mean CL	Adj. Mean Non-CL	Hedge's g	Sig (p)
Grade K-2	298	1100	175	174	0.13	**<0.05**

Conclusion:

Findings from this evaluative study show that students in the elementary grade level K-2 who scored 60th percentile or below in their pretest and who participated in the Catapult Learning Math Intervention programs scored higher on average in their Spring 2024 NWEA MAP scaled (RIT) scores with small to medium effect size of practical impact, when controlling for their pretest Fall scores.

Further analysis showed that these students who participated in the intervention program and met the attendance threshold for duration of participation in the Catapult Learning Math intervention programs had higher average Spring 2024 scores than students who did not participate in the program along with a higher effect size, reiterating that when students are enrolled in the CL intervention program they not only showed higher average Spring scores but there was also a higher impact when they meet the recommended CL attendance threshold in Math.

Appendix

Table 1

Effect of Student Participation on the student Spring 2024 NWEA MAP Scaled Scores in Math:

60th Percentile or below on Fall 2023	N CL	N Non-CL	Adj. Mean CL	Adj. Mean Non-CL	R sq.	F value	Hedge's g	Sig (p)
Grade K-2	615	1100	175	174	0.61	5.35	0.12	**0.02**

Table 2

Effect of Student Participation and Duration of Participation on the student Spring 2024 NWEA MAP Scaled Scores in Math:

60th Percentile or below on Fall 2023, Met Attendance Threshold	N CL	N Non-CL	Adj. Mean CL	Adj. Mean Non-CL	R sq.	F value	Hedge's g	Sig (p)
Grade K-2	298	1100	175	174	0.61	3.94	0.13	**<0.05**

*Adj. Mean CL is the adjusted marginal mean RIT Spring Score of students enrolled in Catapult Learning intervention program;

*Adj. Mean Non-CL is the adjusted marginal mean RIT Spring Score of students not enrolled in Catapult Learning intervention program;

*Sig(p) is the significance at 95% confidence.