Report on the Effectiveness of Mathnasium Learning Center Teaching on Student Performance on Standards-based Mathematics Tests

Report on 2018 Student Testing Data

Prepared by

Watson Education
San Diego, California.

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Introduction

Mathnasium is a learning center which students may attend after school to boost their math skills. The center is highly specialized, teaching only math. The program is designed for students in grades 2 through 8 and high school. Students attend the center once or twice a week, for about an hour. Like a gym or health club, members pay a monthly fee and can drop–in anytime. The goal as described by literature the learning center provides is to significantly increase a student's math skills, understanding of math concepts, and overall school performance, while building confidence and forging a positive attitude toward the subject.

Mathnasium has sought to determine the effectiveness of its program and has commissioned this quantitative study.

This study was conducted using results of 2018 school year paired pretest and posttest data for Mathnasium students across its over 900 learning centers. Using a single group non-experimental pretest-posttest design, this study was to determine whether there exists a positive treatment effect on mathematics testing performance of elementary and middle school children as a result of their attending the Mathnasium teaching center for an average period of 3 months.

The Study

To see whether students' performance on tests of math skills are improving as a result of Mathnasium tutoring, two math tests were given to students, one at the beginning of the study period (pretest), and one at the end (posttest).

The students who participated in this study attend local elementary, middle, or high school, and receive additional math learning support by attending a Mathnasium learning center nearest to their home. The student group represents a broad cross-section across all centers located in the United States.

Students are placed at a specific learning level within the Mathnasium curriculum based on an initial interview at the Mathnasium Center, a review (if possible) of recent testing results from school, and whether or not they are able to pass a pretest at the level one lower than their current grade. These data are used to place the student at the level where they begin the Mathnasium learning process. This is the level where the subject's pretest and posttest are given.

The math tests used in this study are the Mathnasium assessment tests. These tests have been aligned to math standards from all States in which Mathnasium operates, including the State where Mathnasium is headquartered, California. The pretests and posttests are equivalent, containing the same level and number of questions and testing the same exact skills.

Between the two tests, each student attended the Learning Center a few times per week for mathematics tutoring. The treatment period averages several months between pretest and posttest.

The design of this statistical study is a 'Single Group Pretest-Posttest Design' (Figure 1). This design compares the same group of participants before and after the program. The purpose of the single group pretest-posttest design is to determine if participants improved after receiving the program. As is common with most any statistical work, there are limitations and threats to this design which are noted in the Conclusions section of this report.

Students at the Mathnasium Learning Center form a single group. The group receives the treatment, X, for an average length of several months. O represents the pretest and posttest.

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Figure 1. Single Group Research Design based on Kerlinger (1973)

The null hypothesis of this study is that attending the Learning Center will have no causal effect on posttest performance. A two-tailed *t-test* comparing matched pairs of pre- and posttest results was used to statistically determine if there is a significant difference between the two test scores across the study population.

Test Name	N	Pretest mean	Posttest mean	Mean of differences	df	t	p-value
Mathnasium Assessment 1	1,500	61.23	89.14	-27.91	-68.69	1,499	<0.05
Mathnasium Assessment 2	1,579	62.34	86.32	-23.98	-73.47	1,578	<0.05
Mathnasium Assessment 3	1,968	58.31	82.52	-24.21	-83.69	1,967	<0.05
Mathnasium Assessment 4	1,469	54.96	77.08	-22.13	-68.44	1,468	<0.05
Mathnasium Assessment 5	1,525	56.07	79.74	-23.68	-73.55	1,524	<0.05
Mathnasium Assessment 6	1,178	61.83	82.63	-20.81	-60.91	1,177	<0.05
Mathnasium Assessment 7	944	60.65	80.36	-19.71	-51.99	943	<0.05
Mathnasium Assessment Algebra Readiness	868	51.32	74.50	-23.17	-49.89	867	<0.05
Mathnasium Assessment Algebra I A	523	44.39	72.50	-28.12	-42.22	522	<0.05
Mathnasium Assessment Algebra I B	188	36.35	71.58	-35.23	-23.41	187	<0.05
Mathnasium Assessment Geometry Readiness	333	48.90	78.07	-29.17	-42.41	332	<0.05
Mathnasium Assessment Geometry w/Proofs	52	35.64	69.14	-33.49	-13.68	51	<0.05
Mathnasium Assessment Geometry	26	34.53	69.73	-35.20	-11.15	25	<0.05

Table 1. Statistical results

Preparation and Analysis

Mathnasium Learning Centers combined and matched student pairs of pretest and posttest data collected in the course of learning center operations and submitted these for this analysis in Excel format. These data were loaded into a MySQL relational database management system.

In an attempt to reduce the potential impact of regular math instruction at school on the results, the Mathnasium student testing data used in this study was filtered to attempt to

isolate student records used in this analysis to summer months in 2018 when learning center visits fell between pretests and posttests. The filtering of provided data was achieved by preparing a analysis matched-pairs pretest and posttest table of student results where the following conditions exist:

1. Students whose pretest and posttest fall between April, 2018 and September, 2018, and
2. Student must have participated in center tutoring for 1 month up to 4 months.

This information was then sorted by test level. The data set contained 58,784 records of individual students who have taken matched pretests and posttests over a timeframe spanning 12 months. After filtering to isolate the test and treatment period, the final data set contained 12,153 records. Only groups of students numbering 20 or more within each testing level were included in the statistical analysis.

The *t-test* analysis was performed on the data collected. The calculations were run using the "R" statistics package with a RMySQL add-in library in order to access the MySQL paired pretest and posttest data. A statistically significant difference in the testing scores between pretest and posttest is shown at the 95% confidence level (Table 1) at all testing levels. The p-value is not displayed in the table as all are significantly smaller than 0.05 (all were smaller than 0.0000000000000002).

Conclusions

The statistical results show a positive treatment effect across all grades analyzed. The mean improvement between pretest and posttest percentage correct across all test levels analyzed ranges from 19.7 to 35.2. The students performed significantly better on a math posttest after receiving instruction through the Learning Center (refer to Figure 2).

While these results show a positive treatment effect, there are a number of threats to the statistical results. The study is not experimental in design, and could benefit from a more controlled environment. This research is designed to supplement other studies to determine the effectiveness of the learning center. This design has inherent limitations, namely participants may improve over time without intervention of any kind, and these changes can be mistakenly attributed to the program under evaluation. This design could not indicate whether the program solely caused improvement in participants; as there is no way to distinguish between changes over time due to other factors and effects specific to the program. As a single group design, this study was easier to implement and less expensive study than experimental design, but did not include a control group, which could isolate the treatment effect and bias.

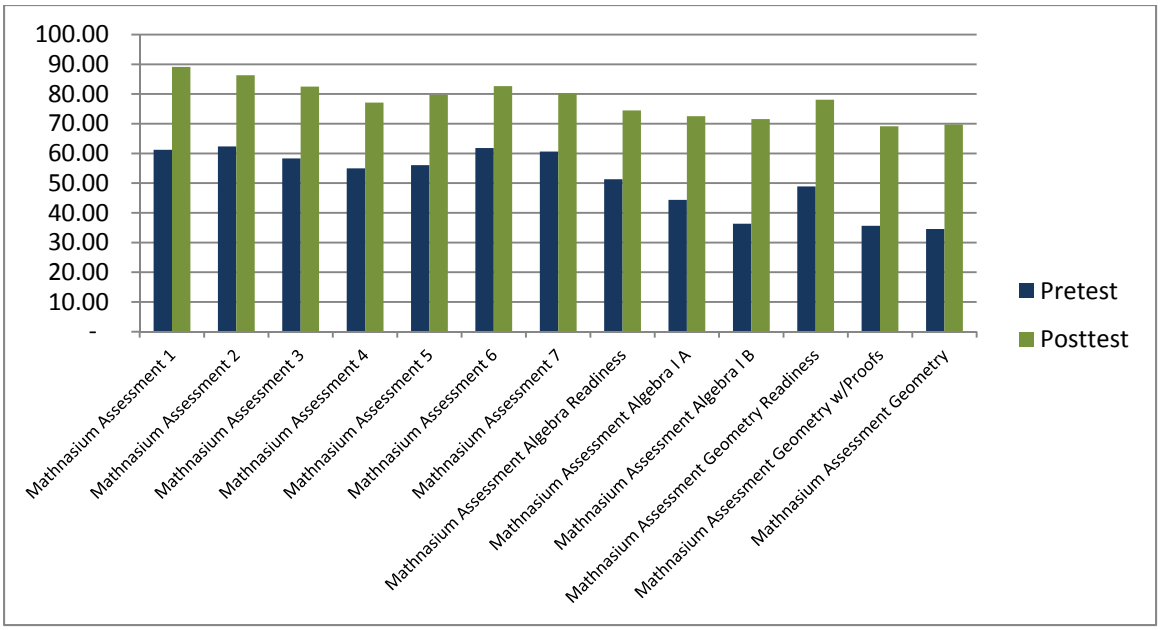

Figure 2: A visual representation of average pretest and posttest results at each test level.

Another threat is the position of student treatment effect in the school year. This study has the average length of time between pretest and posttest of 3 months. While an attempt was made to isolate the data to the summer months when school instruction is likely not occurring, some of the students may have been participating in summer math classes, or might be attending year-round schools.

While there are limitations to the statistical results in this study, there are important strengths. The results of this study are reasonably consistent across all grades, and average improvement in student test scores is positive.

Appendix A: References

American Educational Research Association (AERA), American Psychological Association (APA), and National Council on Measurement in Education (NCME). (1999). *The Standards for Educational and Psychological Testing*.

Kerlinger, F. M. (1973). Foundations of behavioral research. New York: Holt Rinehart & Winston.

Mathnasium, LLC. (2004). Results of Parent Satisfaction Survey. (Web Site) URL: www.mathnasium.com.

Trochim, W. (2000). The Research Methods Knowledge Base, 2nd Edition. Atomic Dog Publishing, Cincinnati, OH.

Trochim, W. and Land, D. (1982). Designing Designs for Research. The Researcher, 1, 1, 1-6.