A Continued Evaluation of the Effectiveness of S.M.A.R.T.

Shanen Smith

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The following report is a continued assessment of the Supporting Math Anxiety and Resilience Together (S.M.A.R.T.) program offered by the Learning Disabilities Association of Niagara Region. For background information on mathematical learning disabilities and math anxiety, as well as for an overview of the program, please see the previous report entitled "Supporting Math Anxiety and Resilience Together: An Evaluation of a Program Targeting Math Learning Disabilities and Math Anxiety" (Smith, 2017).

Research Project

The goal of the current research project was to continue evaluating the effectiveness of the S.M.A.R.T. program with a new sample of participants. Children participating in this program were assessed at the beginning and end of the eight weeks. The assessment continued to measure oral counting, number magnitude, computation strategies and math application skills, with a few adjustments made to the original assessments. Furthermore, new parent and instructor reports were created to assess child math anxiety.

A total of 18 children participated in the Fall 2017 program, 12 of which completed both the pre- and post-assessment. An additional 19 participants from the earlier Spring sample were included in the analyses for the Oral Counting and Number Magnitude assessments, since these assessments were not adapted between samples. The majority of participants were in Grades 2 and 3, however a couple participants were in Grades 4 and 5. The participants' progress on the assessments is outlined below.

<div align="center">

**Results**

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Oral Counting

Children were asked to count up as high as they could until asked to stop (either at 1 minute or when they reached "100", whichever came first). Participants received a total score out of 100. 26 participants completed the oral counting task at both assessment times. Significant differences between pre- and post-assessments were found for oral counting total scores, $t(25) = -3.493$, $p = .004$. By the end of the program, children were able to count higher in under a minute than they did at the beginning of the program.

Significant Improvement on Oral Counting Assessment
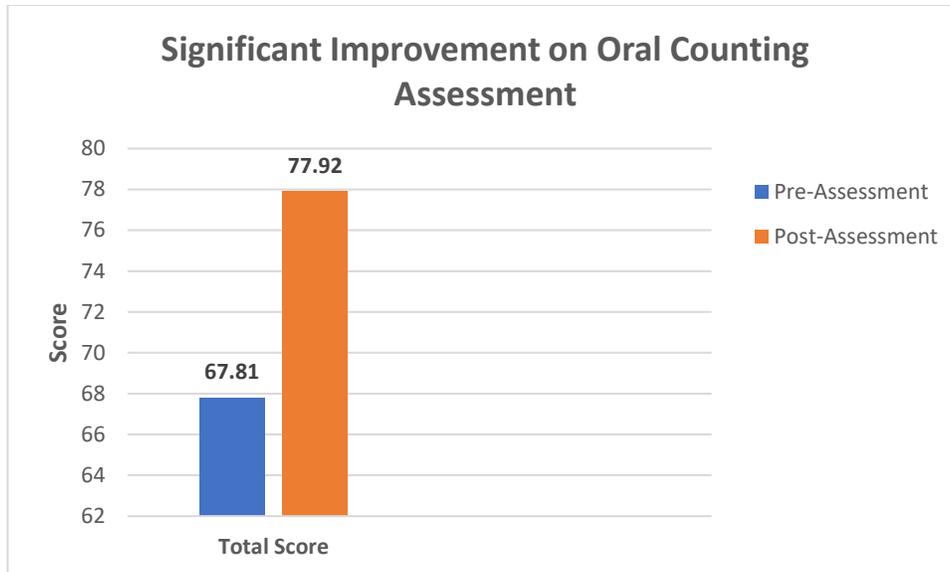
It is also important to note that there was a significant negative correlation between number of sessions missed and participants' oral counting score, r = -.549, p = .034. In other words, children who missed more sessions tended to score lower on the oral counting task during the post-assessment and vice versa.

Number Magnitude

Children were asked to identify which number out of a pair was the biggest. They continued until one minute was up, they made five mistakes in a row or they completed all the problems, whichever came first. A total score out of 36 was assigned for this assessment. 27 participants completed the oral counting task at both assessment times. Significant differences between pre- and post-assessments were found for number magnitude total scores, t(26) = -.8150, p = .004. Children were more often successfully identifying the greater of two numbers by the end of the program than they were at the beginning of the program.

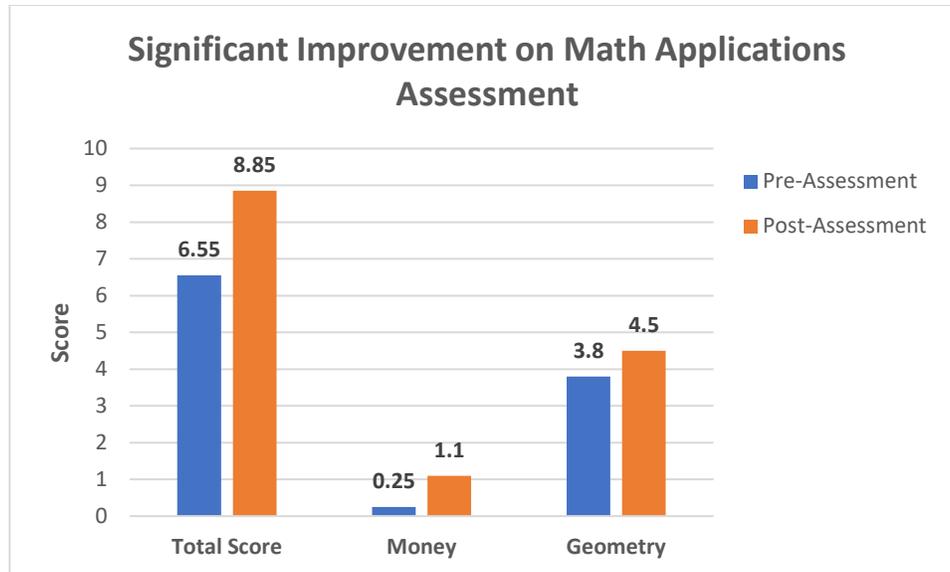**Significant Improvement on Number Magnitude Assessment**
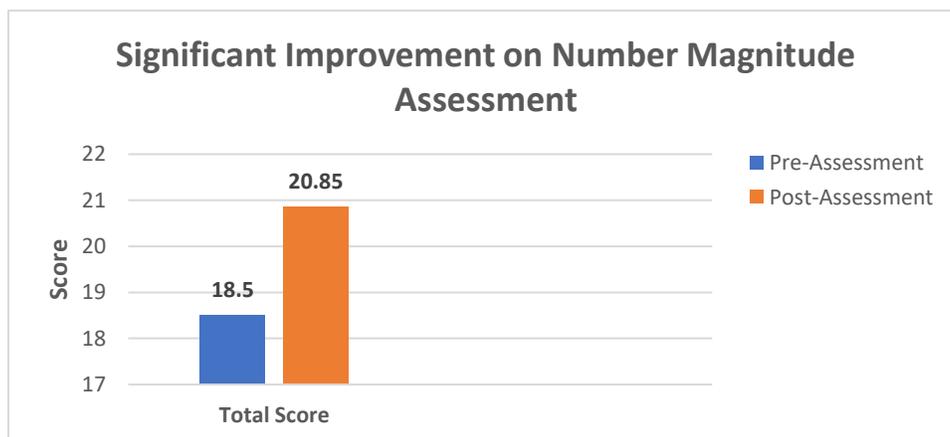
Computation Strategies

Children were asked to solve a series of math problems using whichever method was easiest for them. The strategy used to solve each problem, regardless of whether the answer was correct, was noted (i.e., manipulatives, verbal counting, adding on, retrieval or mixed/other strategy). Children received a total score out of 13. The assessment was adapted for the current sample, and 12 participants completed this assessment at both times. Significant differences were found for children's computation strategies total scores between pre- and post-assessments, $t(11) = -1.071$, $p = .007$. Children were successfully solving more math problems with the help of computation strategies at the post-assessment than they were at the pre-assessment.
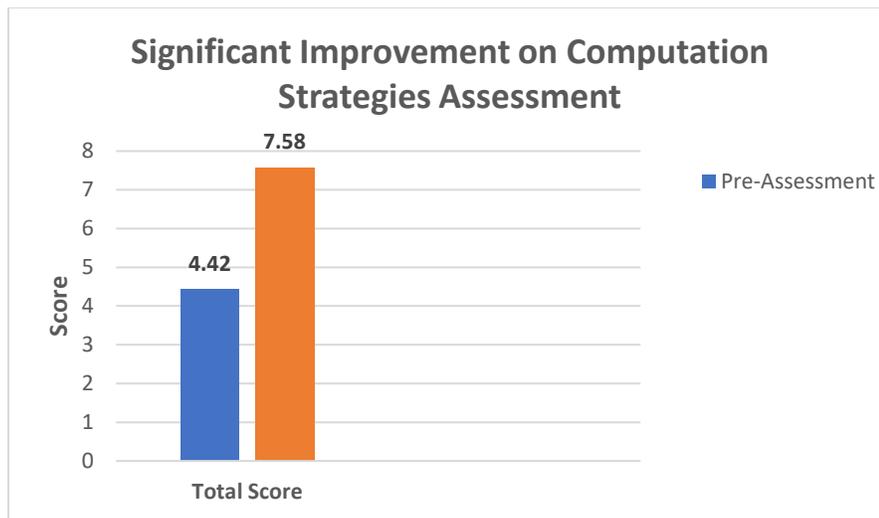

Math Applications

Children were asked to solve up to four problems for each of three different math applications: money (how much?), time (read the clock) and geometry (name the shape). Children received a total score out of 12 as well as a score out of 4 for each of the three math applications. The assessment was adapted for the current sample, and 10 participants completed this assessment at both times. Only marginally significant differences between pre- and post-assessment scores were found for the money and geometry scores, $t(9) = -2.047$, $p = .071$ and $t(9) = -2.090$, $p = .066$, respectively, while no significant differences were found for time scores. However, significant differences were found for total math applications' scores, $t(9) = -2.826$, $p = .020$. While participants did not show exceptional improvement in the individual categories, they were still performing far better at math applications overall at the end of the program than they did at the beginning of the program.

Significant Improvement on Math Applications Assessment

A bar chart titled "Significant Improvement on Math Applications Assessment" with a y-axis labeled "Score" ranging from 0 to 10. Three categories are shown on the x-axis: Total Score, Money, and Geometry. Each category has a Pre-Assessment (blue) and Post-Assessment (orange) bar.

- Total Score: Pre-Assessment 6.55, Post-Assessment 8.85
- Money: Pre-Assessment 0.25, Post-Assessment 1.1
- Geometry: Pre-Assessment 3.8, Post-Assessment 4.5

Math Anxiety

A different approach to measuring math anxiety was used for the current sample. Namely, both an instructor and a parent were asked to fill out a math anxiety assessment for each child in order to have a more accurate measure of math anxiety. These assessments broke math anxiety down into three categories: math confidence (e.g., positive attitude when completing math related tasks, etc.), coping skills (e.g., ability to cope with stress without becoming defiant/emotional, etc.) and active engagement (e.g., exerts best efforts at program, etc.). The instructor and parent rated the child on several statements under each of these categories, using a scale from 1 (not true of this child) to 5 (very true of this child). Each child participant received both a parent-rated and an instructed-rated score for each of the three categories. Total parent-rated and instructor-rated math anxiety scores were then calculated using these three categories. Higher scores reflect greater confidence, coping and engagement and therefore lower math anxiety.

Parent-rated math anxiety scores were calculated based on four math confidence and active engagement assessments and five coping skills and total math anxiety assessments. Significant differences between pre- and post-assessments were found for parent-rated math confidence, coping skills and total math anxiety, $t(3) = -3.431$, $p = .041$, $t(4) = -3.171$, $p = .034$ and $t(4) = -4.318$, $p = .012$, respectively.

Parent-Rated Math Anxiety
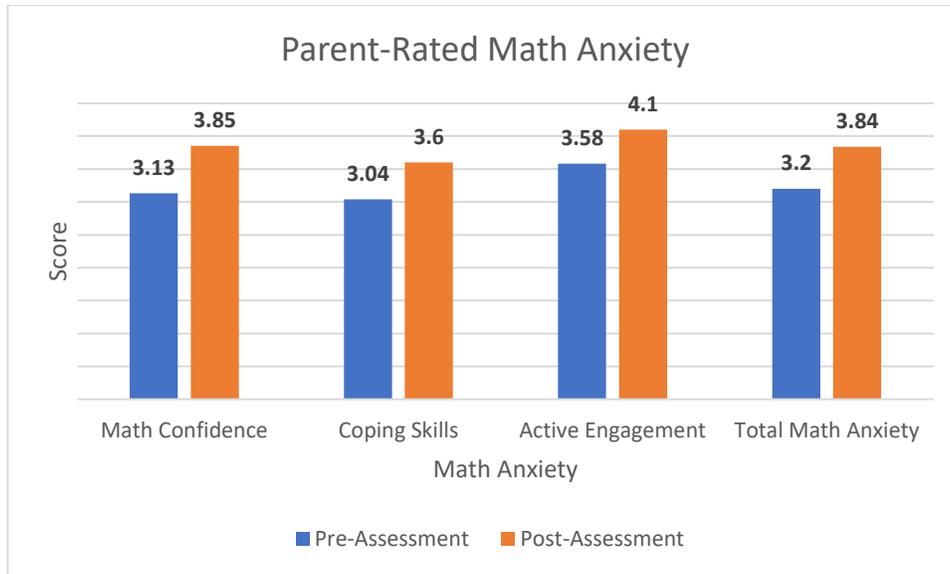
Instructor-rated math anxiety scores were calculated based on 12 math confidence, active engagement and total math anxiety assessments and 9 coping skills assessments. Significant differences between pre- and post-assessments were found for instructor-rated math confidence, active engagement and total math anxiety, $t(11) = -2.996$, $p = .012$, $t(11) = -2.855$, $p = .016$ and $t(11) = -3.483$, $p = .005$, respectively.

Instructor-Rated Math Anxiety
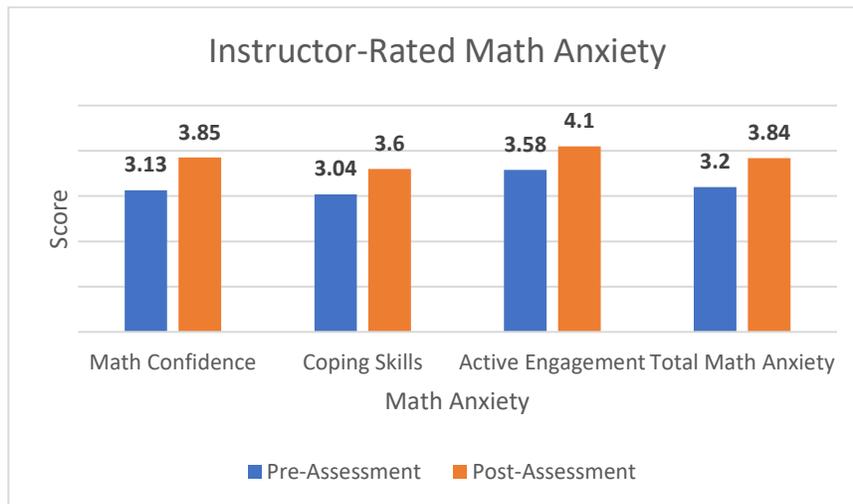
Parents felt that children were showing more math confidence and better coping skills at the end of the program than they did at the beginning of the program. On the other hand, instructors felt that children were showing more math confidence and active engagement by the end of the program than they showed at the beginning of the program. Both parents and
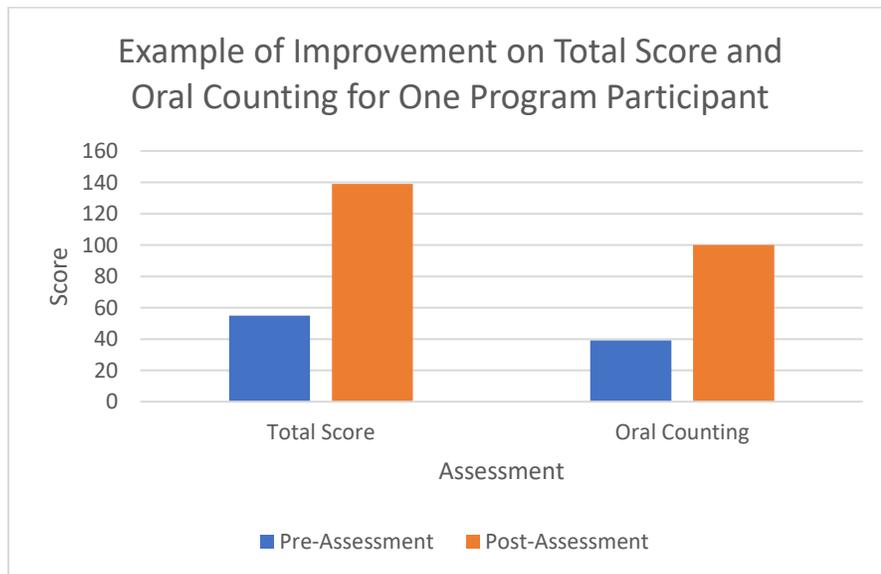
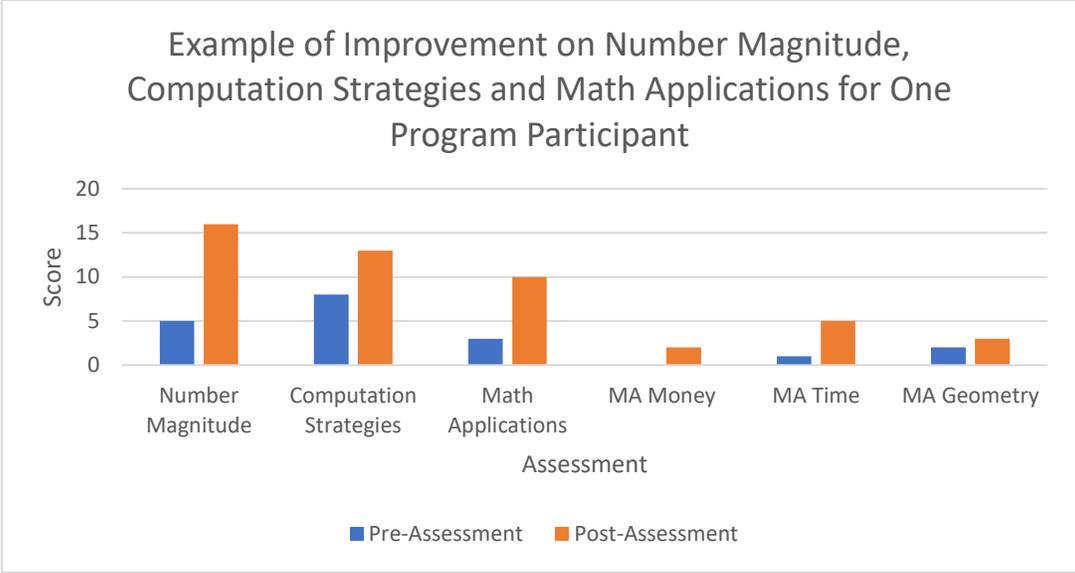instructors felt that children's overall math anxiety improved from the beginning to the end of the program.

Relation between Math Anxiety and Math Performance

A relation between participants' math anxiety and their overall performance on the math assessments was found. Specifically, there was a significant positive correlation between pre-assessment parent-rated math anxiety and participants' pre-assessment total math score, $r = .609$, $p = .047$. There was also a significant positive correlation between post-assessment instructor-rated math anxiety and participants' post-assessment total math score, $r = .585$, $p = .046$. At the beginning of the program, participants whose parents rated them as having higher math anxiety were more likely to do poorer on the pre-assessment overall. Similarly, at the end of the program, participants who were rated as having lower levels of math anxiety tended to score better overall on the post-assessment.

Example of One Participant's Progress

To provide a clearer picture of the S.M.A.R.T. program's success, below is an example of one participant's progress over the course of the program. The participant was in Grade 2 and only missed one session out of 16. Graphed below is their improvement on the math assessments.

Example of Improvement on Number Magnitude, Computation Strategies and Math Applications for One Program Participant

This participant also showed improvement on all areas of both the parent-rated and teacher-rated math anxiety assessments. Their pre- and post-assessment math anxiety scores can be seen below.

Example of Math Anxiety Improvement for One Program Participant
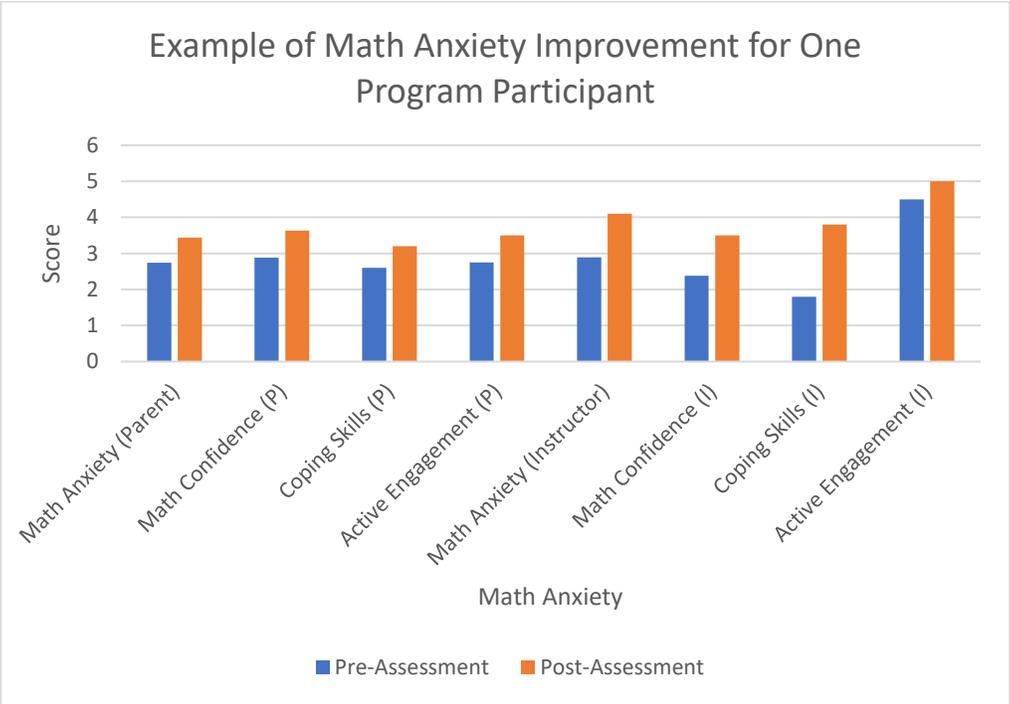
Conclusion

Despite a small sample size, the current study yielded many significant results in favour of the success of the S.M.A.R.T. program for both math performance and math anxiety. Participants from both the Spring and Fall cohorts were able to count higher in under a minute and correctly identify the larger of a pair of numbers more often by the end of the program than when the program began. Furthermore, participants from the current sample were able to answer more math problems correctly using computation strategies and were successfully applying math applications more often at the end of the program than at the beginning. Finally, significant improvement was found in participants' math anxiety, based on both instructor- and parent-rated assessments. Parents reported seeing more math confidence and better coping skills in their children by the end of the program. Similarly, instructors reported seeing more active engagement in the participants along with more math confidence by the end of the program. Finally, both parents and instructors reported improvement in participants' overall math anxiety by the end of the program. This is significant, as a relationship between math anxiety and overall performance on the math assessments was found both on the pre-assessments (with parent-rated math anxiety) and on the post-assessments (with instructor-rated math anxiety). These results support the conclusion that the Learning Disabilities Association of Niagara Region's S.M.A.R.T. program is successful in achieving its goals of improving math performance and decreasing math anxiety in children having difficulties in these areas.