

Implementation of Computer-Based Cognitive Assessment and Cognitive Training with Elementary School Students Lagging in Academic Performance

Background

In the spring of the 2017-18 school year, Riverside Elementary School in Evans, Georgia (Columbia County Schools), under the direction of Principal Kirk Wright, implemented BrainWare SAFARI cognitive skills training software with 3rd through 5th-grade students. Students were selected to participate in the program by their teachers based on the fact that they were struggling to various degrees with academic progress. While these students were struggling academically, none of them had an IEP; one student qualified for an IEP part way through the study.

The study used the Mindprint Cognitive Assessment before and after BrainWare SAFARI as an independent measure of cognitive performance to evaluate the impact of cognitive training on students' cognitive skills. It was also felt that data on students' cognitive strengths and weaknesses could help teachers better understand any non-instructional reasons for the students' difficulties and enable them to support students with more focused and personalized learning strategies.

A total of 50 students started in the program and completed the pre-test. Three students were not present at the time of the post-test so usage of BrainWare SAFARI and pre- and post-test data were analyzed for 47 students. The students were relatively evenly representative of the grades at 17, 14, and 16 students for 3rd, 4th and 5th grade respectively.

BrainWare SAFARI Usage

The recommended protocol for using BrainWare SAFARI is 3 to 5 times per week, for 30 to 45 minutes per session, over at least 12 weeks. The Riverside Elementary teachers implemented the program diligently, making sure that the students used the program as recommended, both in terms of sessions and duration but also ensuring that they moved around among the different exercises in the program. The average usage was similar in all three classrooms, with little variation between the lowest and highest usage, and an overall average of 35 sessions (Figure 1). As is typically the case, there was more variation in levels of the program completed, ranging from 68 to 152 levels with an overall average of 110 of the 168 total levels in the program. (Figure 2) The average number of levels completed was consistent with other implementations at these grade levels. It is important to note that the number of levels passed does not necessarily predict how much benefit a students will derive from cognitive training. The frequency and intensity of usage are more important in this regard.

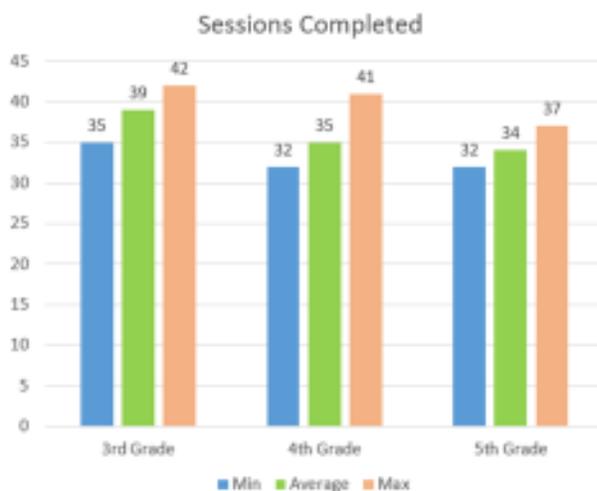


Figure 1

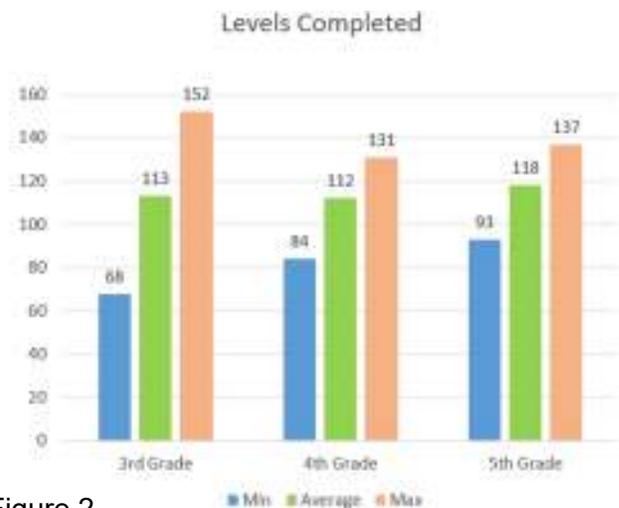


Figure 2

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Improvement in Cognitive Test Scores

The Mindprint Cognitive Assessment comprises ten subtests each of which is normed on gender and age. The analysis started with Z-scores (how many standard deviations above or below the mean the student scored) on each test for each student and compared the pre-test and post-test results.¹ The results here are expressed as percentile scores because percentiles are often easier to understand for educators. Figure 3 shows the average percentile rankings for the 47 students on the pre-test and post-test for each of the subtests. The average percentile ranking for all the tests is also shown. It should be noted that this average does not reflect an actual measure of percentile ranking or any composite score; it simply indicates that, on average, student performance moved from an average of the 31st percentile on the tests to an average of the 52nd percentile on the tests, a difference of 21 percentile points.

Average Percentile Rankings Before and After Using BrainWare SAFARI

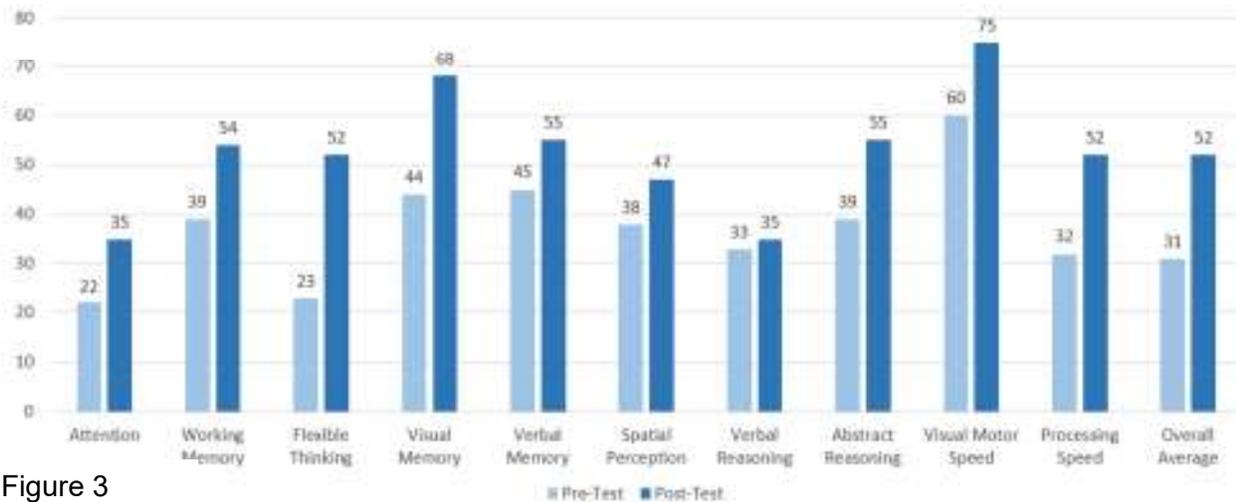


Figure 3

The areas of greatest improvement following cognitive training were Visual Memory and Processing Speed. While the gain on the Flexible Thinking test was greater, some of the gain is believed to be related to re-test since the students typically have not encountered anything like it before on the pre-test. The area of least improvement was Verbal Reasoning, a skill area that is not expressly developed in BrainWare SAFARI.

¹ If a student received an invalid score on a test, the score was set at -3 for the analysis. This level was chosen because it encompasses 99% of the population's performance on the test and where changes would be in the range of the degree of change seen on the tests in general. The average change on other tests was also compared to see if they were comparable; this was generally the case and the adjustment appears to be a reasonable representation of the students' performance and growth, if any. While an invalid score does not always indicate a low level of ability in that skill, it is a strong indicator that the student simply could not perform the tasks in the test.

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Another way to look at the extent of improvement for these students is to consider the number of test areas where substantial improvement was evidenced. Figure 4 shows the number of students gaining at least 0.5 Standard Deviation (SD) and on how many tests they improved by at least that much. On average, the students improved five of their ten test scores by at least 0.5 SD, and every student improved to that degree on at least one test.

Students Experiencing at least 0.5 SD Growth

Improved in at least # areas	Number of Students	% of Students
1	47	100%
2	46	98%
3	41	87%
4	36	77%
5	26	55%
6	18	38%
7	10	21%
8	6	13%

Figure 4

In addition to their improvement on multiple test areas, 26 students (55%) had average improvement of at least 0.5 SD across the ten subtests, with nine of those averaging more than 1.0 SD improvement on their scores.

The pre-test results for these students are consistent with their academic difficulties, with many of the students scoring in the Support Range (bottom 15% of the population) on one or multiple tests. Students scoring one standard deviation below the mean (bottom 16% of the population) based on national norms on any skill, are considered to be “at risk” for that particular skill. Such students will require support to overcome the potential academic and behavioral impact of that deficit. Students performing at one standard deviation above the mean are considered to have a strength in that skill. Students in the middle 84% are considered to be in the expected range of cognitive development relative to their same-age and same-gender peers.

A number of meaningful shifts occurred for this group of students relative to Support Range (bottom 16%) skills and Strength (top 16%) skills. It should be noted that every child is considered to have areas of cognitive strength and weaker areas; this analysis simply considers student performance at least one standard deviation below or above the mean.

As shown in Figure 5, the number of students who did not score in the Support range on any tests increased dramatically from 2 to 11, while the number of students with at least one test in the top 16% increased two-and-a-half fold, from 12 to 32. Thus, two-thirds (68%) of these struggling students demonstrated at least one area of significant strength on the post-test, performance that placed them at the 85th percentile or higher on that test or tests.

Impact on Support Range (At-Risk) and Strength Range Skills

Measure	Pre-Test	Post-Test
# of students with no tests in the Support (At-Risk) range (no bottom 16% scores)	2	11
# of students scoring in top 16% on at least one test	12	32
Average number of Support (At-Risk) areas (bottom 16% scores)	2.9	1.5
Average number of Strength areas (top 16% scores)	0.5	1.7

Figure 5

Figure 6 summarizes the impact of using BrainWare SAFARI cognitive training software on these students' performance on the Mindprint cognitive assessment

Summary of Impact

Pre-test to Post-Test Change	Number of Students	Percentage of Students
Students who gained at least 1.0 SD on average across test scores	9	19%
Students who gained at least 0.5 SD but less than 1.0 SD on average across test scores	17	36%
Students whose average gain was less than 0.5 SD but who had fewer at-risk scores and/or more strength scores	16	34%
Others	5	11%
Total	47	100%

Figure 6.

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While the students in the “Other” category experienced less average growth across the tests, a more detailed examination of their test results revealed areas of growth for each and the suggestion in one case, confirmed by discussion with the teachers that dramatic swings between pre- and post-test results for the student were likely related to having a “silly day,” rather than being reflective of that student’s actual skill levels on those tests. Information on these students is presented in Figure 7.

Students in “Other” Category

Student ID	Insights
6119	2 invalid scores on post-test cancelled out the significant improvements (5 tests improved at least 0.5 SD) in computing the average across all tests.
6078	Average improvement of 0.35 SD across all tests, four tests with improvement of at least 0.5 SD.
6085	Pre- and post-test results inconsistent, with large gains and drops. Teachers reported the student having difficulty settling down, being silly. Test scores likely do not reflect abilities or change in abilities.
6102	Two post-test scores at the exceptional strength range (top 5%) on post-test, up from strength, significant improvements in processing speed and verbal reasoning.
6099	Average improvement of 0.34 SD across all tests. Pre- and post-test results inconsistent four tests with improvement of at least 0.5 SD.

Figure 7

Conclusions

The principal and teachers at Riverside Elementary School conducted a highly successful cognitive training program for the students that they selected to participate. The overwhelming majority of the students experienced substantial growth in their cognitive skills in multiple areas and all students saw growth in at least some areas. The results of testing with the Mindprint assessment confirmed that there were non-instructional reasons for the difficulties these students were having with academic work, and their post-test results suggest that they have now developed their underlying cognitive skills to the level where they are more likely to be successful in their academic endeavors. In addition, the teachers now have specific strategies to support students in the areas where some still need support.