

Executive Function Gains from Comprehensive Integrated Cognitive Training in Students with Strong Reasoning Skills and Low Academic Performance

Background

Research has shown that weak executive functions are associated with lower academic performance than would be expected based on students' intelligence and reasoning skills. During the 2022–23 school year, Maple Crest Middle School in Kokomo, IN, decided to focus on a group of students who were identified, based on cognitive assessment, as having strong reasoning skills and weak executive functions, and who were not performing at proficiency on academic measures. Thirty-seven students participated in comprehensive integrated cognitive training (CICT™), based on the selection criteria. MindPrint was used as the cognitive assessment and BrainWare SAFARI was used for the cognitive training intervention.

Sufficient MindPrint pre- and post-test data were available for 29 students. Academic performance data were collected via iReady (35 students) and ILEARN (31 students), providing a view of both cognitive and academic impact.

Cognitive Assessment

The MindPrint Cognitive Assessment measures ten cognitive skills across four domains:

- **Executive Functions:** Attention, Working Memory, Flexible Thinking
- **Memory:** Visual Memory, Verbal Memory
- **Complex Reasoning:** Verbal Reasoning, Spatial Perception, Abstract Reasoning
- **Speed:** Visual Motor Speed, Processing Speed

Baseline data (Figure 1) showed that students were performing below the middle of the expected range in all three executive function areas, with average scores for Attention, Working Memory and Flexible Thinking at or below the 25th percentile. In contrast, average scores on the complex reasoning tests were at the 59th percentile or higher (69th percentile or higher for nonverbal reasoning scores).

This type of cognitive profile—strong reasoning paired with weak executive functions—is often overlooked and often leads to assumptions that the students are lazy because they are behind academically despite high intellectual potential. Rather than laziness or motivation, the cause is frequently underdeveloped executive functions which can significantly hinder academic performance in otherwise capable learners.

In fact, despite their strong reasoning skills, the year prior to their participation in the cognitive training program, none of these students performed at or above proficiency on

the English Language Arts (ELA) or Math scores on the Indiana state standardized assessment, ILEARN. And only a quarter of the students or less scored in the ranged defined as approaching proficiency (21% for ELA and 25% for Math).

Average Percentile Rankings Selected Middle School Students in Kokomo IN

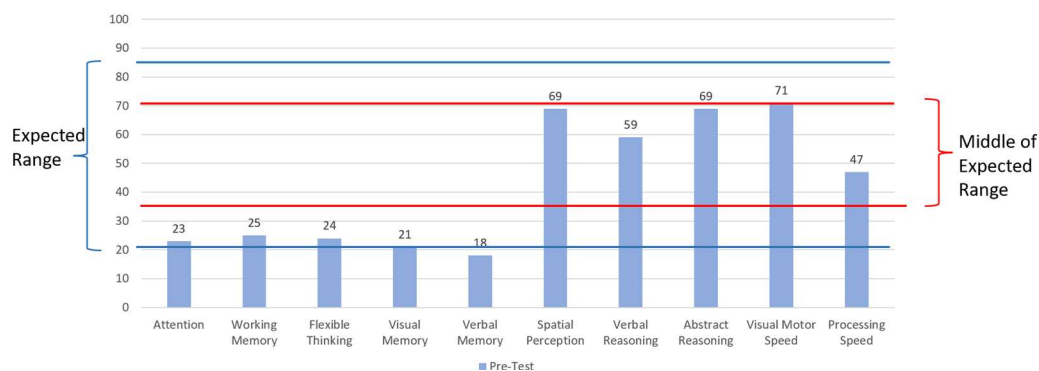


Figure 1. Baseline Cognitive Assessment Scores

Cognitive Training

Students engaged in BrainWare SAFARI, a comprehensive integrated cognitive training software that develops 43 cognitive skills through an engaging video-game format. The recommended protocol is 3–5 sessions per week for 12–14 weeks.

At Maple Crest:

- **Average sessions completed:** 32 (range: 16–41)
- **Average levels completed:** 73 (range: 23–123)

Cognitive Gains

Following training, students demonstrated significant cognitive growth, as shown in Figure 2, with average improvement of 15 percentile points (.42 Standard Deviation) on the three executive function tests and 9 percentile points (.26 Standard Deviation) across all of the cognitive skills measured. In addition to the substantial gains on executive functions, students on average also experienced meaningful gains on the visual memory test, in addition to stronger performance on their already high abstract and visual-spatial reasoning scores.

Average Percentile Rankings Before and After Using BrainWare SAFARI

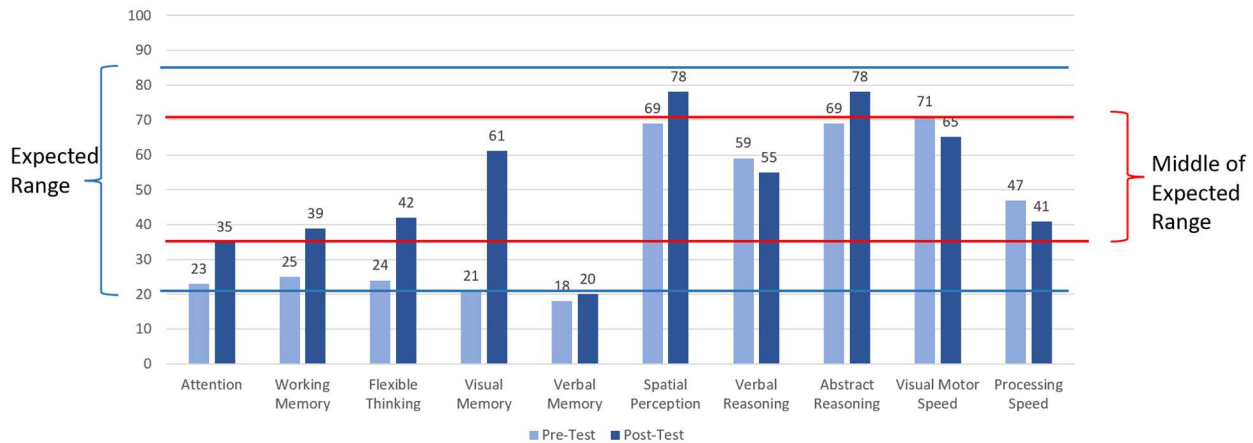


Figure 2. Pre- and Post-Assessment Cognitive Data

Academic Impact

The students in this study took their Spring academic assessments soon after they had completed their cognitive training leaving a limited amount of time for them to have applied their stronger cognitive skills to academic activities. Academic gains, including those that would exceed expected growth, were observed. It is particularly important to help students who are significantly behind, as these students were, to make more than expected growth in order for them to make meaningful progress toward grade-level performance.

On the iReady ELA and Math diagnostic tests in the spring, the students in the study made greater growth in both subjects on average compared to their targets. In math, students achieved an average of 141% of their growth targets; in ELA they achieved an average of 114% of their targets. 40% of the students met their stretch targets in at least one subject and 20% met their stretch targets in both subjects. Stretch targets represent ambitious growth goals beyond expected progress. Meeting these targets indicates accelerated learning and readiness to close academic gaps.

Improvements were also seen in students' performance on their annual ILEARN assessments following their cognitive training. 80% of the students improved their proficiency (moving up a proficiency level or getting closer to the cut score for the next proficiency level). Figure 3 displays the change in percentage of students at proficiency levels before and after their cognitive training.

Maple Crest ILEARN 2023 vs 2022

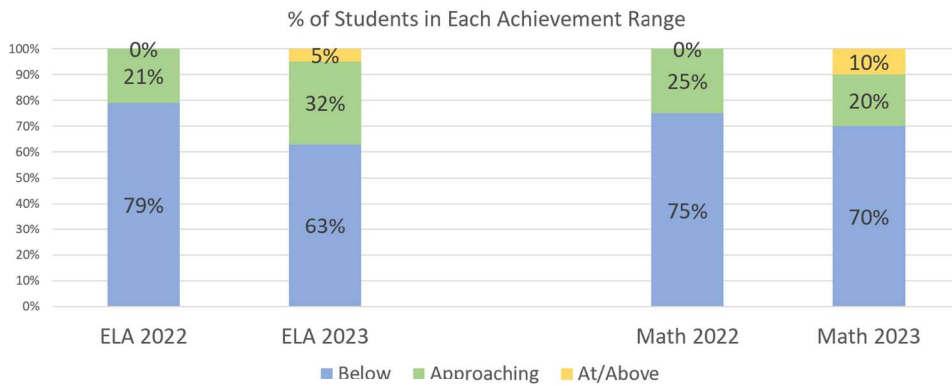


Figure 3. ILEARN Performance

Conclusions

Maple Crest Middle School implemented the BrainWare SAFARI cognitive training program with reasonable fidelity to the recommended protocol with the student selected to participate in the program during the 2022-2023 school year. Students demonstrated significant cognitive growth, especially in executive functions following their cognitive training. They also showed academic improvements indicative of closing the gap to grade-level proficiency on both iReady and ILEARN assessments, in both Math and English Language Arts.

These results suggest that comprehensive integrated cognitive training can be a powerful lever for uncovering academic potential and success for students whose executive function challenges mask their true capabilities.