# Research Report:
# Arrowsmith Program Academic Outcomes

ARROWSMITH

# Arrowsmith Program Overview

In the human brain, networks of neurons are set up to perform particular cognitive functions such as: processing information; seeing relationships and making the connections necessary for insight and conceptualization; forming and retaining memories; navigating in space; recognizing familiar faces; parsing speech; learning motor plans for reading and writing; discriminating speech sounds; visually retaining symbol patterns necessary for reading, spelling and visual template learning; interpreting emotions; and thinking non-verbally.

Enhancement of these cognitive functions that underlie learning in school and throughout life is possible through the targeted application of cognitive programs utilizing the principles of neuroplasticity. This is the basis of the Arrowsmith Program.

The Arrowsmith Program is a suite of cognitive programs that utilize the principles of neuroplasticity to target and strengthen cognitive functions of the brain. The Arrowsmith Program is highly specialized. This neuroplastic approach uses the principles of targeted differential stimulation, active sustained engagement, novelty and complexity and effortful processing.

The Arrowsmith Program has helped thousands of people over the last 40+ years to strengthen cognitive functions related to regions and networks of regions of the brain.

Arrowsmith Program Delivery Models utilized in these studies

> The Arrowsmith Full-Time Program involves participants working anywhere from a half to full day (four to eight 30-to-40-minute cognitive periods) five days per week on a series of specific cognitive programs designed to enhance each individual's cognitive profile. Each participant completes a cognitive assessment and the results of this assessment determine the cognitive programs they work on. Participants in this program have been identified as having learning disabilities or learning difficulties and were working in-person with their teacher.
>
> In the Whole Cohort Program all students in a grade work to enhance a specific cognitive function. A school may choose to have all grades working in this program or only selected grades. Arrowsmith has developed a sequence of developmentally appropriate cognitive exercises per grade based on the

learning demands that occur in each grade. Students work in-person with the teacher for 30 to 40 minutes per day five days per week on the specific cognitive program over the academic year.

The Symbol Relations Cognitive Intensive Program is a 6-to-10-week program, either online or in-person, in which participants engage in 4 or 5 hours of this cognitive program every day, five days per week.

In the Symbol Relations Cognitive Program students are engaged in the Symbol Relations cognitive exercise for approximately 4 hours per week over an academic year. The students in these studies were working in-person with their teacher.

*Arrowsmith's premise*: change the brain, change cognitive functioning, change the acquisition of academic skills, and change social-emotional well-being.

# Academic Research Outcomes of the Arrowsmith Program

Research on the Arrowsmith Program has demonstrated significant positive changes in:

- neural networks in the brain
- cognitive functioning
- acquisition of academic skills
- emotional intelligence and well-being

The research studies outlined in this Academic Outcomes report are by different investigators, in different schools and organizations implementing the Arrowsmith Program using different research frameworks. The research approach uses multiple designs and measures as recommended by the American Psychological Association in their paper *More than one way to measure*. These research studies all show similar results – that the Arrowsmith Program is effective, resulting in significant improvements.

It is important to note that most participants in the Full-Time Arrowsmith Program complete one period of English and one period of mathematics curriculum per day with the rest of the day being engaged in cognitive programs. Many participants have no academic curriculum as part of their program. The gains in academic skills and in learning are not due to engagement in academic curriculum but due to changes in cognition as a result of the Arrowsmith Program.

For information on the research measures used, See Appendix A: Research Measures Used.

For information on additional research, see Arrowsmith Research

# Rate of Learning

## Study 1: Rate of Learning

### Group

This study conducted in 2007, investigated the rate of acquisition of a series of academic skills for 60 students with learning disabilities in grade 3 to 9 in seven mainstream schools in the Toronto Catholic District School Board.

The academic skills measured were:

- word recognition (the ability to read words accurately)
- reading speed
- reading comprehension
- arithmetic

Prior to the start of the study, all of these students were receiving a full day of academic classes with special education academic remedial support. Standardized measures, on average, showed that these students were acquiring academic skills at a rate of .5 to .6 of a grade per year.

These students then enrolled in the Arrowsmith Program and over the course of the year of the study, engaged in cognitive exercises designed to strengthen their weak learning capacities for 50% of their school day and academic curriculum for the other 50% of the day. All students were working in-person.

Data was also collected on 50 of the original 60 students after two years in the Arrowsmith Program

### Measures

#### *Wide Range Achievement Test – Word Recognition*

An academic stills assessment which measures reading skills.

#### *Wide Range Achievement Test – Arithmetic*

An academic skills assessment which measures math skills.

### *Monroe-Sherman Achievement Test – Passage Comprehension*

An academic skills test that measures reading comprehension.

### *Monroe-Sherman Achievement Test – Reading Speed*

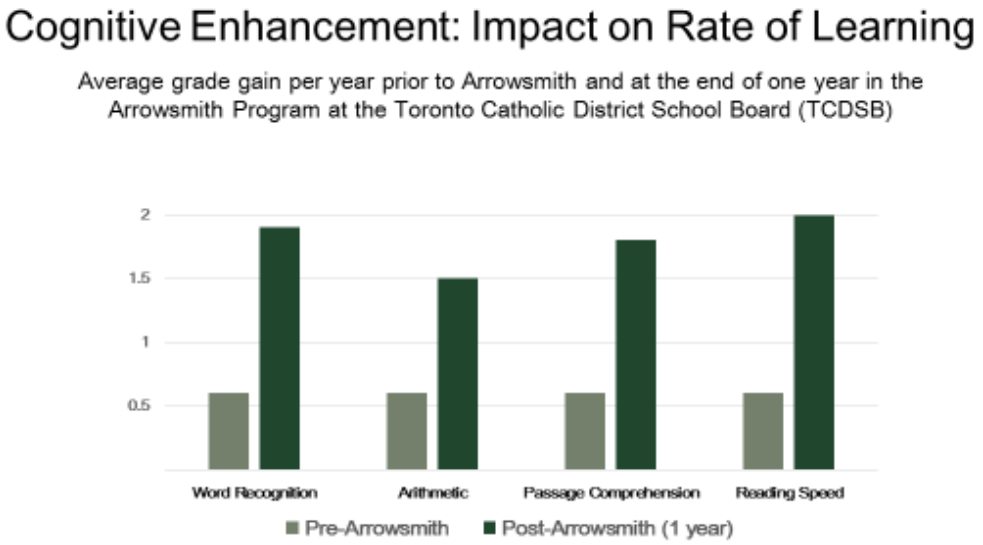
An academic skills test that measures reading speed.

## Results

Data was collected at the end of one school year, on standardized measures. The students' rate of learning doubled and, in some cases, tripled. For students who were in their 2nd year in the program, these gains in rate of learning continued.

The average increase in the rate of acquisition of specific academic skills for students from prior to participation in the Arrowsmith Program compared to the results after one to two years in the program was as follows:

- Word Recognition - 3 times faster
- Arithmetic - 1.5 to 2 times faster
- Reading Comprehension - 2 to 3 times faster
- Reading Speed - 2 to 3 times faster




Rate of learning accelerates after one year of Arrowsmith Program exercises
60 students in grades 3 to 9 (majority of students in grades 4 to 8)
Report on the Arrowsmith Program in the Toronto Catholic District School Board, 2007

## Additional Data

These gains on standardized academic tests were supported by student, teacher, and parent observations of improvement in these academic areas which appear in the extended report.

## Conclusion:

An increased rate of learning of acquisition of academic skills was demonstrated for students with learning disabilities who participated in the Arrowsmith cognitive program over the course of one and two academic years, despite exposure to 50% less academic curriculum.

## Research Report

Report on the Arrowsmith Program in the Toronto Catholic District School Board

# Academic Achievement

## Study 1: Academic Achievement

### Group

This study In August 2014, at Camperdown Academy in South Carolina, a school for students with dyslexia, had all students in grade 2 work on two cognitive programs, 40 minutes each per day five days per week over the academic year. These were the Motor Symbol Sequencing program, and the Symbol Relations program. All students were working in-person.

Motor Symbol Sequencing is involved in motor planning necessary for writing and reading. Symbol Relations is involved in understanding, comprehension, reasoning, and speed of processing ideas.

### Results

Over the course of the year, students showed improvement in a range of academic areas:

- Reading
- Spelling
- Writing
- comprehension.

Students also demonstrated improvements in cognitive areas critical to learning:

- attention
- memory
- planning
- goal setting
- self-organization.

# Whole Cohort Program – Grade 2

Motor Symbol Sequencing and Symbol Relations Cognitive Programs
Students Engaged in two 40-minute cognitive periods per day five days per week

Significant improvements in

| | | |
|---|---|---|
| Reading | Memory | Setting Goals |
| Spelling | Comprehension | Self-Organization |
| Writing | Attention | Planning |

Students receiving the cognitive program in grade 2, when tested in grade 3 on a math accuracy test, out-performed the grade 4 and 5 students and demonstrated a significantly greater willingness to tackle more difficult math problems

## Additional Data

The teacher implementing this program at Camperdown Academy commented, "There's something about Arrowsmith—it makes students excited to try something new." This work, by building cognitive resources gives students the capacity to be successful when trying something new.

Students who had worked on the cognitive programs in grade 2, when they were in grade 3, they outperformed grade 4 and 5 students on a math accuracy test and demonstrated more willingness to attempt more difficult math problems.

## Conclusion:

Improved academic achievement and an increase in several cognitive skills necessary for learning were demonstrated over the course of one academic year for students with dyslexia who participated in the daily Arrowsmith Whole Cohort cognitive program.

## Study 2: Academic Achievement

### Group

This study in 2014 examined the effects of Arrowsmith on academic performance over one school year for students identified as having learning disabilities enrolled at Arrowsmith School in Toronto. Dr. Brad Hale's research team in the Brain Gain Lab at the University of Calgary conducted the study. Each day the students received one period of English and one period of mathematics and six periods of cognitive programs to strengthen the weak cognitive capacities underlying their learning disabilities. All students were working in-person.

### Measures

#### *Woodcock-Johnson III Tests of Achievement*

The Woodcock-Johnson III Tests of Achievement is an individually administered, norm-referenced instrument that measures specific academic achievement areas in persons aged 4 to 90.

### Results

For students engaged in the Arrowsmith cognitive exercise program statistically significant gains were found in the following measures of academic achievement:

- word recognition
- reading fluency
- reading comprehension, word attack (blending sounds into words)
- math calculation
- math fluency
- quantitative concepts
- spelling
- writing fluency
- writing samples
- understanding directions

**Effects of the Arrowsmith Program on Academic Performance**

*Pre-Post Mean Differences on WJ-III Achievement Tests*

| Cluster | Subtest | | Mean (SS) | t | P |
|---|---|---|---|---|---|
| Reading | Letter Word Identification | Pre | 87.80 | 5.57 | < .001 |
| | | Post | 98.53 | | |
| | Reading Fluency | Pre | 81.50 | 8.48 | < .001 |
| | | Post | 90.14 | | |
| | Passage Comprehension | Pre | 85.53 | 8.85 | < .001 |
| | | Post | 96.20 | | |
| | Word Attack | Pre | 88.53 | 5.21 | < .001 |
| | | Post | 101.95 | | |
| Mathematics | Calculation | Pre | 82.47 | 11.69 | < .001 |
| | | Post | 94.13 | | |
| | Math Fluency | Pre | 72.47 | 6.61 | < .001 |
| | | Post | 84.07 | | |
| | Quantitative Concepts | Pre | 87.60 | 6.20 | < .001 |
| | | Post | 101.27 | | |
| Writing | Spelling | Pre | 81.93 | 5.40 | < .001 |
| | | Post | 91.00 | | |
| | Writing Fluency | Pre | 74.85 | 8.15 | < .001 |
| | | Post | 94.69 | | |
| | Writing Samples | Pre | 84.73 | 7.48 | < .001 |
| | | Post | 100.80 | | |
| Receptive Language | Understanding Directions | Pre | 95.07 | 4.62 | < .001 |
| | | Post | 98.02 | | |

**Significant Improvements in**

- ***Broad Reading***
- ***Mathematics***
- ***Writing***
- ***Receptive Language***

*Strengthening cognitive/ neuropsychological functions presumed to underlie academic achievement deficits improves reading, mathematics, and writing by targeting the cause (cognitive deficit) rather than the symptoms (achievement deficit).*

## Conclusion

The researchers at the University of Calgary Brain Gain Lab' conclusion for students enrolled in the Full-Time Arrowsmith cognitive program was: "*Strengthening cognitive/neuropsychological functions presumed to underlie academic achievement deficits improves reading, mathematics, and writing by targeting the cause (cognitive deficit) rather than the symptoms (achievement deficit).*"

## Presentation (Peer Reviewed)

The results of outcomes on academic measures on the Woodcock Johnson III Tests of Achievement were presented in a peer-reviewed poster session at the 2014 Canadian Psychological Association Conference in Vancouver, Canada.

Hanna A. Kubas, Jessica A. Carmichael, Kim R. Fitzer, James B. Hale. (2014, June). *Effects of the Arrowsmith program on academic performance: a pilot study* [Presentation]. Canadian Psychological Association Conference, Vancouver, B.C., Canada.

*Effects of the Arrowsmith Program on academic performance*

## Study 3: Academic Achievement

### Group

This study in 2016 investigated the academic outcomes for students identified as having learning disabilities in their first year of the Arrowsmith Program at three schools, one in the United States and two in Canada. Each day, these students were receiving two academic periods (one of English and one of mathematics) and six periods of cognitive programs designed to address their learning disabilities. All students were working in-person.

The research was conducted by Dr. Lara Boyd and Dr. Rachel Weber at the University of British Columbia.

### Measures

#### *Woodcock Johnson III Tests of Achievement*

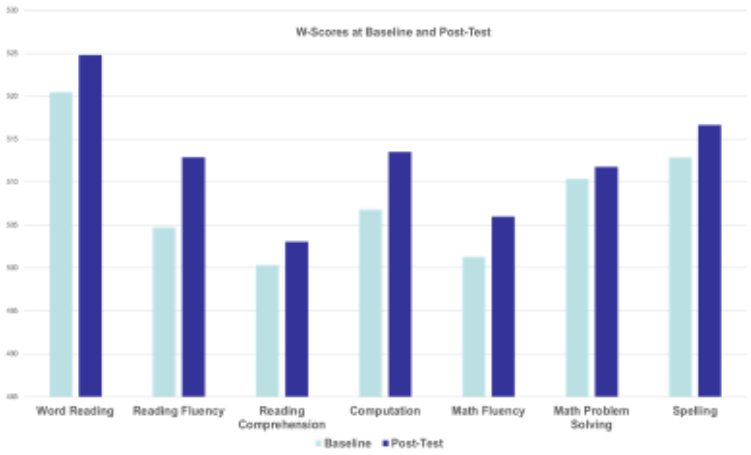
Student performance in September was compared to performance in May (one academic year).

### Results

Significant positive academic achievement gains were found on the following measures of academic achievement:

- Word Reading
- Reading Fluency
- Computation
- Math Fluency
- Spelling

**RESULTS –ACADEMIC ACHIEVEMENT IMPROVEMENT**




Significant:
Word Reading; Reading Fluency; Computation; Math Fluency; Spelling

## Conclusion

Significant gains in academic performance on a standardized measure was demonstrated for students with learning disabilities in three schools participating in the Full-Time Arrowsmith cognitive program over an academic year.

## Publication (Peer Reviewed)

Rachel C. Weber, Ronan Denyer, Negin Motamed Yeganeh, Rachel Maja, Meagan Murphy, Stephanie Martin, Larissa Chiu, Veronique Nguy, Katherine White & Lara Boyd (2019): Interpreting the preliminary outcomes of the Arrowsmith programme: a neuroimaging and behavioural study, *Learning: Research and Practice*, DOI: 10.1080/23735082.2019.1674908

Interpreting the preliminary outcomes of the Arrowsmith programme: a neuroimaging and behavioural study

## Presentation

This research was presented in a peer-reviewed poster session at the 2019 International Neuropsychological Society conference in New York City.

Lara Boyd and Rachel C. Weber. (2109, March). *Neurocognitive and behavioral outcomes of the Arrowsmith program*. [Presentation]. University of British Columbia, Vancouver, B.C.

Neurocognitive and behavioral outcomes of the Arrowsmith Program University of British Columbia Research Presentation March 2019

Greg Rose, Audreyana Jagger-Rickels, and Rich Collins. (2019, March). *Benefits of Arrowsmith training on brain connectivity and neuropsychological measures*. [Presentation]. University of British Columbia, Vancouver, B.C.

Benefits of Arrowsmith training on brain connectivity and neuropsychological measures University of British Columbia Research Presentation March 2019

**Presentation (Peer Reviewed)**

Megan Murphy, Ronan Denyer, Veronique Nguy, Lara Boyd and Rachel C. Weber. (2019, February). *Academic outcomes of the Arrowsmith program.* [Presentation]. International Neuropsychological Society Conference, New York City, N.Y., United States.

## Study 4: Academic Achievement

### Group

This study investigated the academic outcomes over the 2017-2018 school year for students identified as having learning disabilities. These students were in their first year of the Arrowsmith Program at two schools in Canada. Each day these students received one period of English and one period of mathematics, and six periods of cognitive programs designed to strengthen the weak cognitive capacities underlying their learning disabilities. All students were working in-person.

The study was conducted by Dr. Gregory Rose and Dr. Audreyana Jagger-Rickels of the University of Southern Illinois.

### Measures

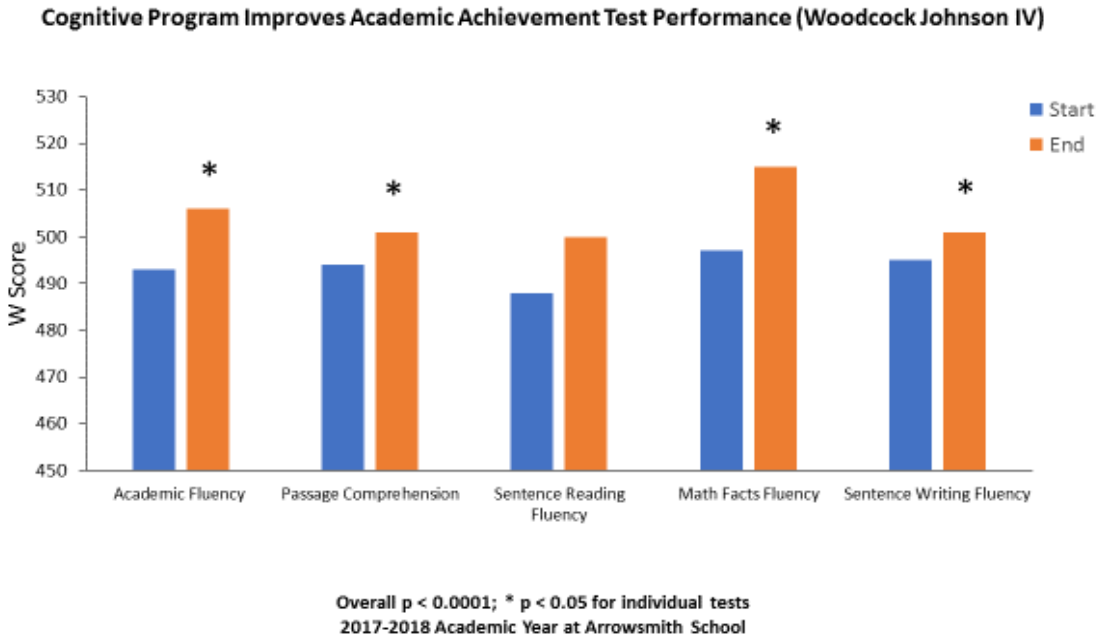
#### *Woodcock-Johnson IV Tests of Achievement*

Student performance in September was compared to performance in May.

### Results

Significant positive academic achievement gains were found on the following measures of academic achievement:

- Passage Comprehension
- Academic Fluency
- Math Facts Fluency
- Sentence Writing Fluency




Changes on all tests noted with an asterisk on the graph below were at statistical significance.

## Conclusion

Significant gains in academic performance on a standardized measure was demonstrated for students with learning disabilities in two schools participating in the Full-Time Arrowsmith cognitive program over an academic year.

## Presentation

Greg Rose. (2019, July). *Research studies of the effects of Arrowsmith training on brain connectivity and neuropsychological measures. [*Presentation]. Toronto, Canada.

[Effects of Arrowsmith training on brain connectivity and neuropsychological measures]

## Study 5: Academic Achievement

### Group

This study investigated the outcomes of implementing the Symbol Relations cognitive program in the 2018 and 2019 six-week Symbol Relations cognitive intensive program. There were 27 participants with learning disabilities or learning difficulties, comprised of 19 males and 8 females, with an average age of 13.4 and ranging in age from 9.4 to 18.4 years old. All students were working in-person.

### Measures

#### *Woodcock-Johnson IV Tests of Achievement*

#### *Parent Survey Questionnaire*

A questionnaire is completed by parents using a five-point rating scale to report on behaviours related to the Symbol Relation cognitive function. These behaviours are grouped into the following categories: oral comprehension; understanding concepts; engagement; emotional intelligence; and school performance.

### Results

#### *Woodcock-Johnson IV Tests of Achievement*

The academic achievement areas showing significant Improvement:

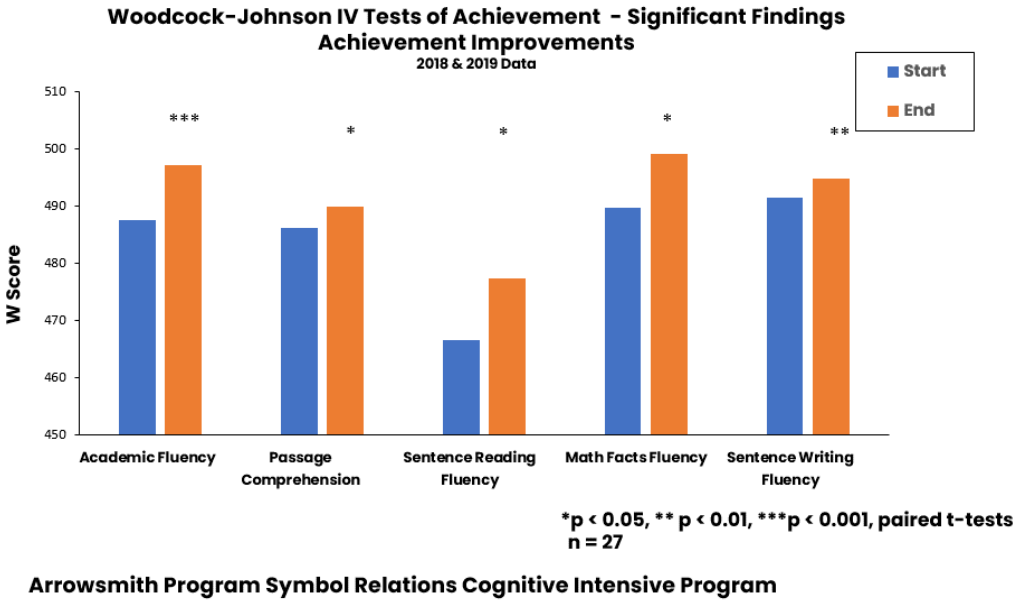
**Academic Fluency** - measures the ability to perform math and reading tasks quickly and accurately

**Passage Comprehension** - measures the ability to comprehend what is read

**Sentence Reading Fluency** - measures the ability to read sentences quickly and accurately

**Math Facts Fluency** – measures the ability to solve math fact computations (addition, subtraction, multiplication) quickly and accurately

**Sentence Writing Fluency** - measures the ability to write sentences quickly and accurately




*Parent Report Survey Questionnaire Results*

Three to six months after completion of the Symbol Relations cognitive program, parents of the participants completed a questionnaire. Significant improvement was reported in several behaviours which were grouped on analysis into the following categories, each of which showed significant improvement.

**Oral Comprehension** – able to grasp more quickly and accurately what is heard

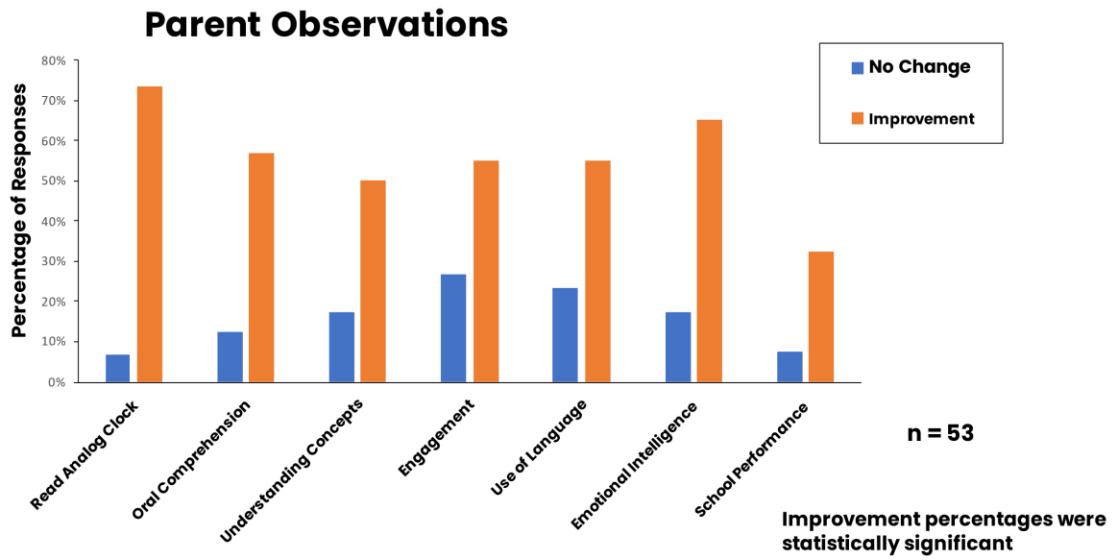
**Understanding Concepts** – enhanced logical reasoning, understanding rules, seeing the big picture

**Engagement** – greater focus, attention, and mental initiative

**Use of Language** – improved vocabulary and communication skills

**Emotional Intelligence** – more able to interpret and express emotions, to reflect on behavior and problem solve in social situations, to understand interpersonal relationships, and more willing to engage in social situations

**School Performance** – improved academic achievement




**Arrowsmith Program 6 Week Symbol Relations Cognitive Intensive Program**

Parents on the Survey reported:

- His comprehension/understanding is happening so much faster.
- She 'gets' math now and can show her understanding and reasoning behind her answers.
- She now enjoys reading as she understands what she reads.
- The questions he asks are more pertinent to the topic and demonstrate better understanding of the situation.
- She now understands concepts in class and can defend her position and rarely backs down now from a discussion.
- He is more able to remember what is taught in class and manage his homework.
- Reading is much easier.
- Her confidence, focus, perseverance and follow through have all improved.
- He can pay attention, remember, and understand more in class.
- He understands what to do the first time it is explained, working quicker, and achieving better than before.
- She is keeping up with her classwork and actually enjoying school for the first time.
- We have seen changes in her speech, her reading comprehension, her understanding of new concepts, her social confidence, even her sporting ability.

## Conclusion:

Significant gains on a range of academic achievement areas, based on standardized measures and based on parent reports, were demonstrated for students with learning disabilities participating in a 6-week Symbol Relations Cognitive Intensive Program.

## Publication (Peer Reviewed)

Negin Motamed Yeganeh, Rachel King, Lara A. Boyd, Gregory M. Rose & Rachel C. Weber (2021) Symbol relations training improves cognitive functioning in students with neurodevelopmental disorders, *Applied Neuropsychology: Child*, 11:4, 789-796, DOI: 10.1080/21622965.2021.1967154

Symbol relations training improves cognitive functioning Applied Neuropsychology Child 2021

## Presentation (Peer Reviewed)

Greg Rose. (2019, October). *A brief intensive learning intervention affects resting state connectivity and neuropsychological test performance* [Presentation]. Society for Neuroscience Conference, Chicago, IL, United States.

A brief intensive learning intervention affects resting-state connectivity and cognitive functioning 2019

## Study 6: Academic Achievement

### Group

In this study in the 2018-2019 academic year, there were 19 participants in the mainstream grade 6 to 12 classes at Gateway Crosspoint Christian School in Washington State, USA. This group of students engaged in the Symbol Relations cognitive program for 90 minutes every other day over 8 months. All students were working in-person. Students self-selected this program as an elective in addition to their mainstream academic curriculum.

### Measures

#### *California Achievement Test (CAT)*

An assessment of academic achievement that provides educators, students and their parents with a measure of achievement and comparison to U.S. national norms in reading, language, spelling, and mathematics.

#### *Measure of Academic Progress (MAP)*

A measure of academic achievement in reading and math. It measures a student's proficiency in those subjects, as well as their academic growth during the school year.

#### *Questionnaire of Academic Skills and Learning Behaviours*

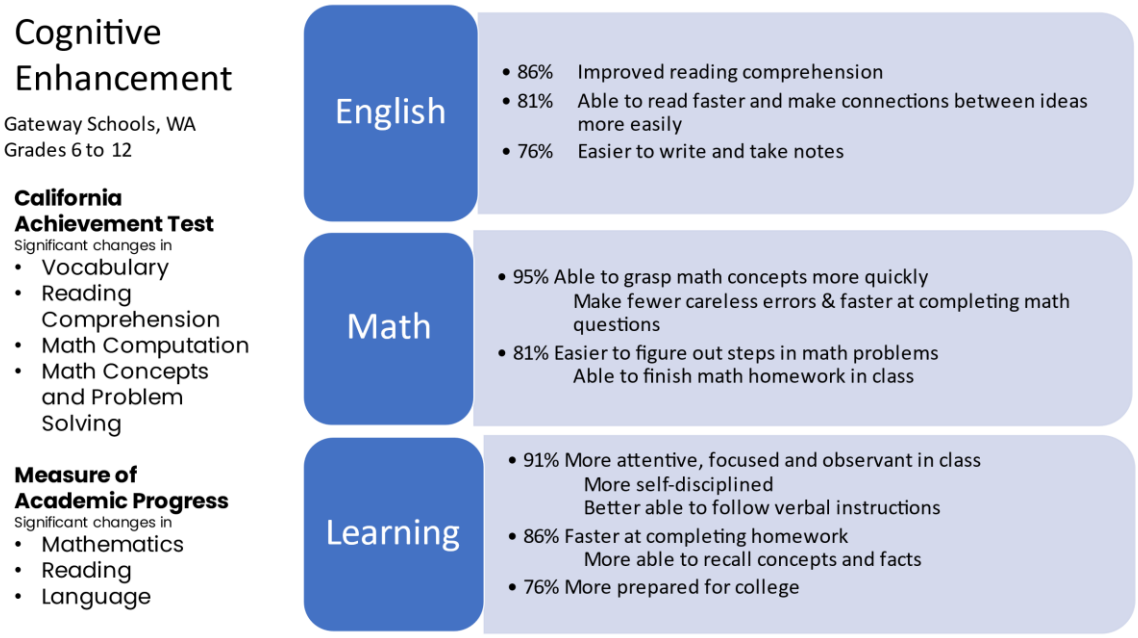
A questionnaire developed by the teachers at Gateway Crosspoint Christian School assessing a range of behaviours and skills identified as necessary for learning.

### Results

On standardized academic measures, significant improvements were measured in:

- Vocabulary
- reading comprehension
- reading
- language
- math computation
- math concepts and problem solving

Students reported significant change in academic skills related to English, mathematics, and general learning.




## Conclusion:

Significant improvements and change on both standardized academic measures and on self-report measures were demonstrated for students in mainstream classes participating in the Arrowsmith Symbol Relations cognitive program over 8 months.

## Study 7: Academic Achievement

### Group

In this study, in 2020-2021, 8 participants enrolled in a treatment program for drug and alcohol addiction in Australia were also enrolled in the Symbol Relations Cognitive Enhancement Program for 4 hours per week over 8 months.

### Measures

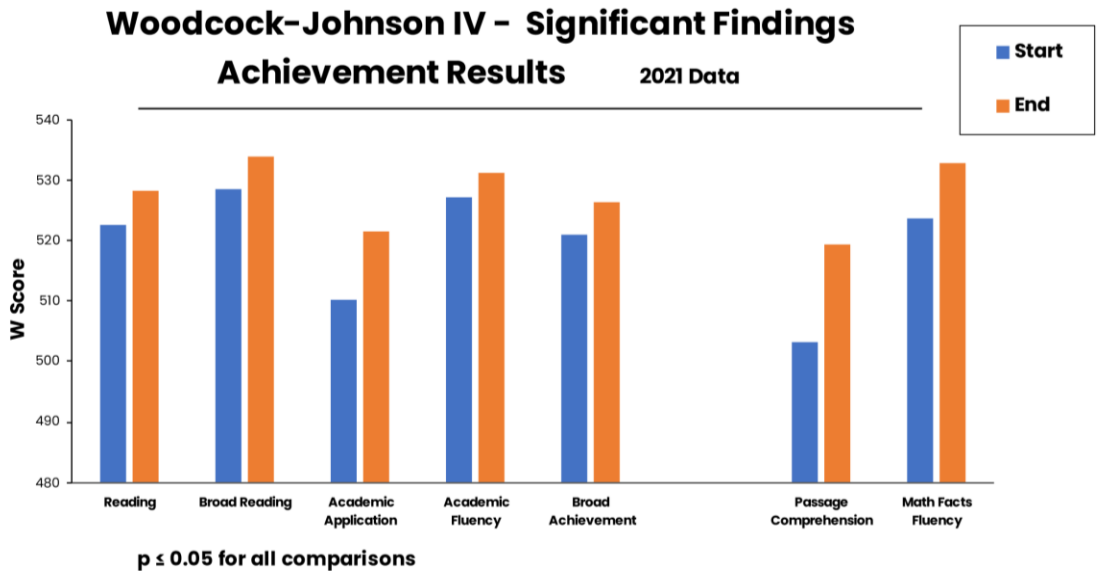
*Woodcock-Johnson IV Tests of Achievement*

*Self-Report Survey Questionnaire*

This is a survey questionnaire completed by participants 3 to 6 months after completion of the cognitive program of observed changes across a range of dimensions related to the Symbol Relations cognitive function.

### Results

*Woodcock-Johnson IV Tests of Achievement*



The academic achievement areas showing significant Improvement:

**Reading** - word identification, reading speed, comprehension

**Broad Reading** – a composite of letter-word identification, reading fluency and passage comprehension

**Academic Applications** – a composite of passage comprehension, applied problems and writing samples

**Academic Fluency** – speed and accuracy in reading, doing simple math calculations and writing sentences

**Broad Achievement** – word identification, word attack, applied math problems, calculation, comprehension, writing samples, spelling, sentence reading fluency, math facts fluency, sentence writing fluency

**Passage Comprehension** – reading comprehension

**Math Facts Fluency** – speed and accuracy in simple math computations

*Self-Report Survey Questionnaire*

Three to six months after completion of the Symbol Relations cognitive program, participants completed a questionnaire. Significant improvement was reported in several behaviours which correspond to the results noted above in changes in cognitive abilities. These behaviours were grouped on analysis into the following categories, each of which showed significant improvement.

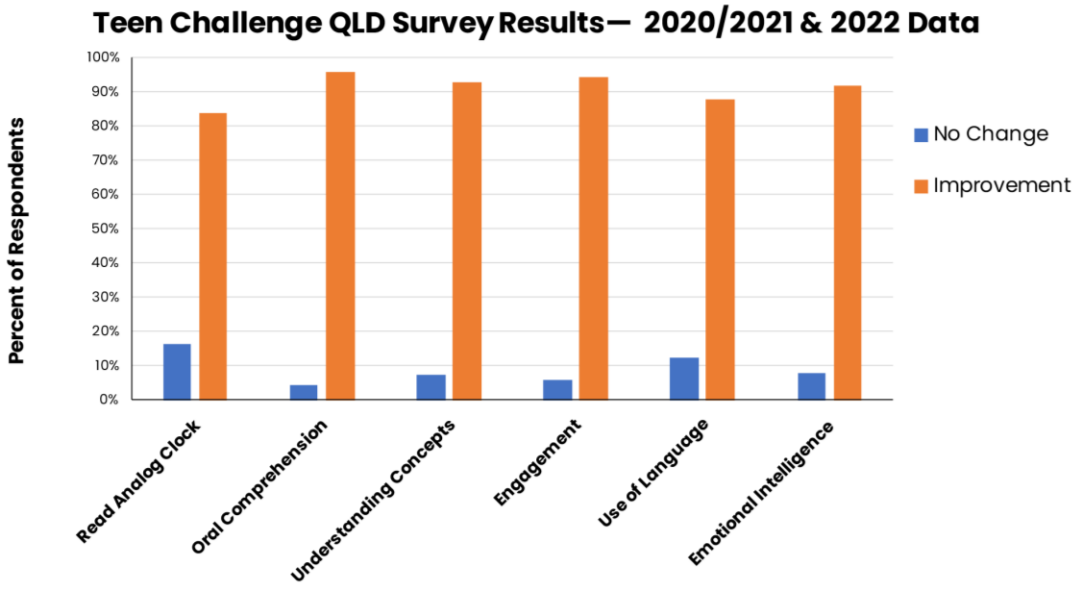
**Oral Comprehension** – able to grasp more quickly and accurately what is heard

**Understanding Concepts** – enhanced logical reasoning, understanding rules, seeing the big picture

**Engagement** – greater focus, attention, and mental initiative

**Use of Language** – improved vocabulary and communication skills

**Emotional Intelligence** – more able to interpret and express emotions, to reflect on behavior and problem solve in social situations, to understand interpersonal relationships, and more willing to engage in social situations




## Conclusion:

Significant improvement in academic achievement on both the standardized academic measure and on the self-report measure were demonstrated for participants in a treatment program for addiction who engaged in the Arrowsmith Symbol Relations cognitive program over 8 months.

## Research Report

Research Report: Teen Challenge Queensland treatment program: Outcomes of the Arrowsmith symbol relations cognitive program, February 2023

Teen Challenge Queensland treatment program: Outcomes of the Arrowsmith Symbol Relations cognitive program

## Study 8: Academic Achievement

### Group

In this study in the 2022 academic year in the Teen Challenge Tasmania Centre, there were 8 participants, comprised of 3 males and 5 females, with an average age of 13.1 and ranging in age from 8 to 20 years old. They worked on the Symbol Relations cognitive program for 4 hours per week over 8 months. This population of students have had significant negative impact on their cognition related to trauma, prenatal issues, childhood experiences and substance abuse.

### Measures

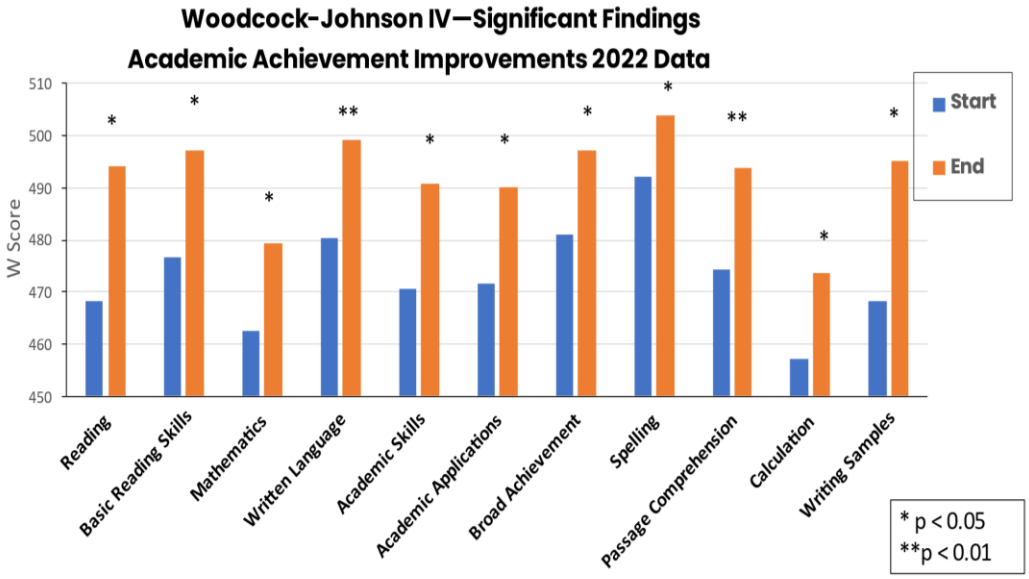
#### *Woodcock-Johnson IV Tests of Achievement*

#### *Parent Survey Questionnaire*

### Results

#### *Woodcock-Johnson IV Tests of Achievement*

The participants showed statistically significant gains on a standardized measure of academic achievement in several academic skills (Woodcock-Johnson IV Tests of Achievement).



The academic achievement areas showing significant Improvement:

**Reading** - word identification, reading speed, comprehension

**Reading Skills**- word identification and word attack (phonetics)

**Mathematics** – applied math problems and calculation

**Written Language** – spelling and writing samples

**Academic Skills** – word identification, spelling, calculation

**Academic Applications** - applied math problems, comprehension, writing samples

**Broad Achievement** – word identification, word attack, applied math problems, calculation, comprehension, writing samples, spelling, sentence reading fluency, math facts fluency, sentence writing fluency

**Spelling** - spelling

**Passage Comprehension** – reading comprehension

**Calculation** – math computation

**Writing Samples** – writing samples based on a verbal or picture cue

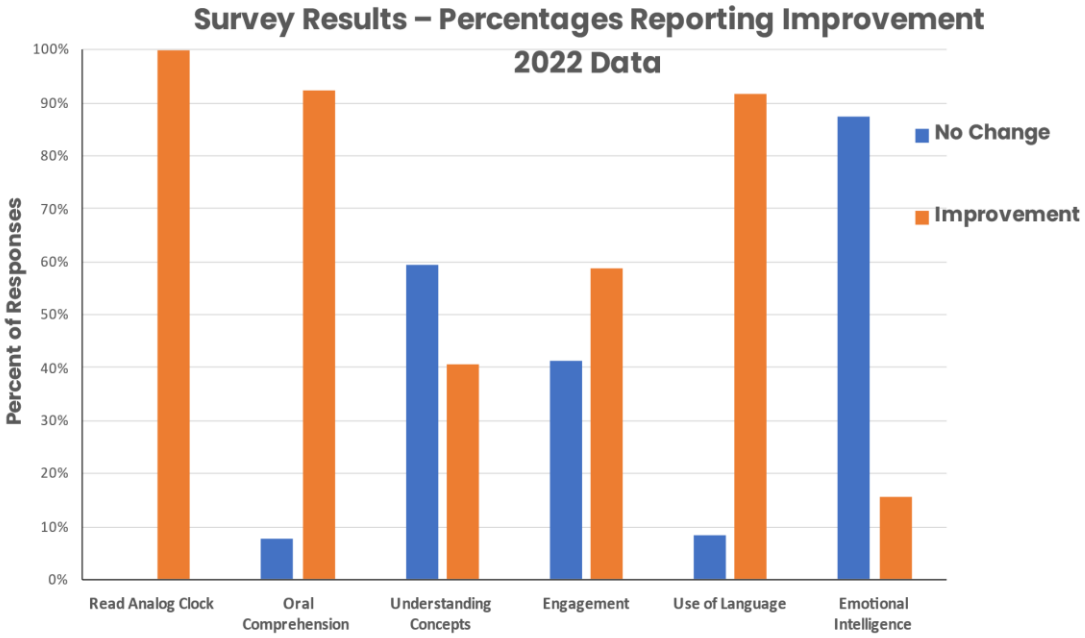
*Parent Survey Questionnaire*

Three to six months after completion of the Symbol Relations cognitive program, parents and/or guardians reported significant improvement on several behaviours which correspond to the changes noted above in cognitive abilities. These behaviours were grouped on analysis into the categories, the following of which showed significant improvement.

**Oral Comprehension** – able to grasp more quickly and accurately what is heard

**Engagement** – greater focus, attention, and mental initiative

**Use of Language** – improved vocabulary and communication skills




Parents/Guardians on the Survey reported:

- Now asks in-depth questions
- Vocabulary is much better
- More able to understand and comprehend during a conversation
- Better able to argue a point in a clear and thoughtful way
- School is reporting better behaviour
- Better learning outcomes at school and more settled in class
- Teachers report learning is getting better
- Improved understanding of the work in class
- Changes seen in English, Mathematics, Written Expression
- Spelling is better and essays make more sense
- Now enjoying schoolwork and learning new things
- Getting better grades
- Finds schoolwork easier and requires less help
- More eager and motivated to learn
- Getting work done on time and getting good grades
- Becoming confident to go places without me
- Thinking and strategies have improved
- More settled and able to regulate quicker in most situations

## Conclusion:

Significant gains on a range of academic achievement areas on a standardized measure were demonstrated for students who have experienced significant trauma and who are identified with learning disabilities or learning difficulties participating in the Arrowsmith Symbol Relations cognitive program over 8 months. The academic improvements were also reported by parents/guardians.

## Research Report:

Research Report: Teen Challenge Tasmania: Outcomes of the Arrowsmith Symbol Relations cognitive program, February 2023

Teen Challenge Tasmania: Outcomes of the Arrowsmith Symbol Relations cognitive program

# Academic Outcomes - Average Academic Growth

## Study 1: Average Academic Growth 2015

### Group

This study in 2015 investigated the average academic growth over a school year on academic measures for students identified as having learning difficulties in an Arrowsmith Program compared to those in mainstream academic curriculum. All students were working in-person.

Students at Holy Trinity Parish Schools in Australia each year undergo standardized testing on measures of Mathematics and Reading Comprehension. These measures, designed by the Australian Council for Education Research, are administered at the beginning and end of the school year for each grade. The average growth in academic skills is calculated for the students in each grade based on their performance over the course of one school year on these measures. The 'average academic growth' is the average gain these students make in each grade on these academic measures. The results over the course of the academic year for students in grade 3, grade 4 and grade 5 for students identified as having learning disabilities and enrolled in the Arrowsmith Program who received 50% less academic curriculum were compared to those of all students in the regular academic classes receiving full day academic curriculum.

### Measures

#### *PAT – Maths*

An achievement test developed by the Australian Council for Educational Research to assess mathematical ability and measure growth from Years 1 to 10, It is mapped to the Australian, Victorian and New South Wales curriculum.

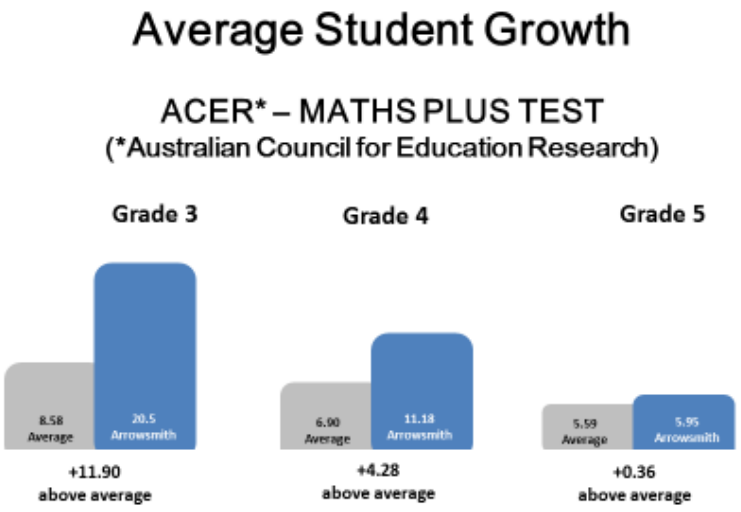
#### *PAT - Reading*

An achievement test developed by the Australian Council for Educational Research to assess reading comprehension and measure growth from Years 1 to 10, It is mapped to the Australian, Victorian and New South Wales curriculum.

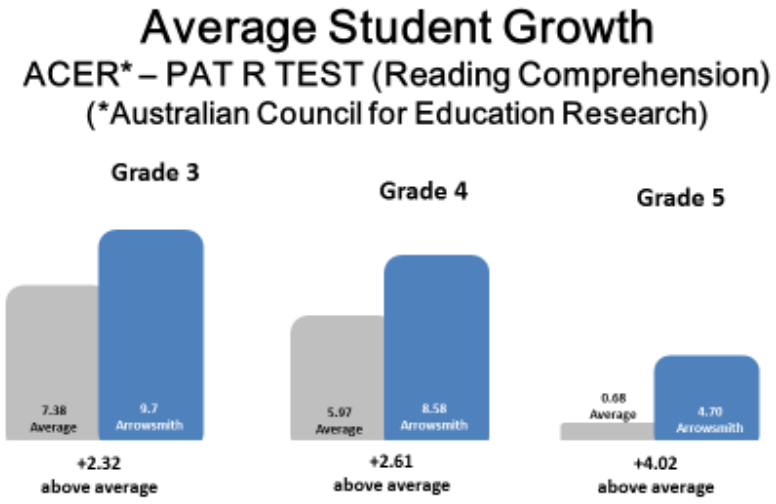
## Results

In each grade the students receiving the Arrowsmith cognitive programs showed greater average academic growth on the standardized measures of Mathematics and Reading Comprehension than students in the mainstream curriculum classes.

### *PAT – Maths*




### *PAT - Reading*



## Conclusion:

Greater than average academic growth in Mathematics and Reading Comprehension on standardized academic measures were demonstrated for students with learning difficulties participating in the Arrowsmith cognitive program over the course of an academic year compared to students in regular mainstream academic classrooms. The Arrowsmith group made these gains while involved in 50% less academic curriculum.

# Academic and Learning Behaviours

## Study 1: Academic and Learning Behaviours

### Group

A study in 2007 was conducted on students in the Arrowsmith Program in the Toronto Catholic District School Board (TCDSB). These students were in grades 3 to 9 in seven schools and all were identified by the school board as having learning disabilities. All students were working in-person.

### Measures

#### *TCDSB Survey Questionnaire*

A survey questionnaire was developed in collaboration with TCDSB research and education staff to measure academic and learning behaviours.

As part of the study, students, parents and teachers rated change on a range of student behaviours over the course of a year in the program.

### Results

The results on behaviours related to academic skills and general learning abilities appear in the following chart. The number of individuals rating each item appear beside each rater for that item.

Parents, students and teachers all reported noticeable change on:

Academic behaviours

- reading comprehension
- legibility of written work
- reads for pleasure
- understanding ideas
- remembering factual information
- willingness to attempt/complete homework
- understanding and following instructions
- telling time

General behaviours required for learning

- ability to focus
- listening skills
- organizational skills

| IMPROVEMENT RATING | | | | |
|---|---|---|---|---|
| | | **OF THOSE FOR WHOM THIS WAS A CONCERN** | | |
| | % Never A Concern | % No Change | % Noticeable Change | % Extremely Noticeable Change |
| **Ability to Focus** | | | | |
| Student Rating n=42 | 12% | 7% | 65% | 16% |
| Parent Rating n=62 | 5% | 11% | 60% | 24% |
| Teacher Rating n=55 | 13% | 7% | 53% | 27% |
| | | | | |
| **Understanding / Following Instructions** | | | | |
| Student Rating n=41 | 5% | 10% | 53% | 32% |
| Parent Rating n=54 | 4% | 9% | 67% | 20% |
| Teacher Rating n=55 | 7% | 0% | 62% | 31% |
| | | | | |
| **Listening Skills** | | | | |
| Student Rating n=42 | 14% | 10% | 55% | 21% |
| Parent Rating n=47 | 4% | 17% | 60% | 19% |

| | | | | |
|---|---|---|---|---|
| Teacher Rating n=54 | 18% | 2% | 54% | 26% |
| | | | | |
| **Organizational Skills** | | | | |
| Student Rating n=42 | 14% | 14% | 51% | 21% |
| Parent Rating n=45 | 2% | 22% | 56% | 20% |
| Teacher Rating n=55 | 11% | 4% | 56% | 29% |
| | | | | |
| **Willingness to Attempt/Complete Homework** | | | | |
| Student Rating n=42 | 10% | 7% | 50% | 33% |
| Parent Rating n=58 | 1% | 9% | 43% | 47% |
| Teacher Rating n=55 | 13% | 7% | 42% | 38% |
| | | | | |
| **Remembering Factual Information** | | | | |
| Student Rating n=42 | 10% | 10% | 47% | 33% |
| Parent Rating n=55 | 4% | 12% | 57% | 27% |
| Teacher Rating n=55 | 4% | 5% | 60% | 31% |
| | | | | |
| **Understanding Ideas** | | | | |
| Student Rating n=42 | 12% | 7% | 60% | 21% |
| Parent Rating n=58 | 5% | 10% | 57% | 28% |

| | | | | |
|---|---|---|---|---|
| Teacher Rating n=55 | 7% | 2% | 56% | 35% |
| | | | | |
| **Legibility of Written Work** | | | | |
| Student Rating n=42 | 5% | 12% | 50% | 33% |
| Parent Rating n=53 | 2% | 15% | 49% | 34% |
| Teacher Rating n=54 | 13% | 4% | 55% | 28% |
| | | | | |
| **Reading Comprehension** | | | | |
| Student Rating n=42 | 12% | 7% | 44% | 37% |
| Parent Rating n=57 | 14% | 7% | 58% | 21% |
| Teacher Rating n=54 | 2% | 7% | 41% | 50% |
| | | | | |
| **Reads for Pleasure** | | | | |
| Student Rating n=39 | 13% | 28% | 41% | 18% |
| Parent Rating n=54 | 7% | 39% | 34% | 20% |
| Teacher Rating n=54 | 7% | 20% | 43% | 30% |
| | | | | |
| **Telling Time** | | | | |
| Student Rating n=41 | 17% | 7% | 17% | 59% |
| Parent Rating n=51 | 14% | 18% | 31% | 37% |
| Teacher Rating n=54 | 4% | 7% | 37% | 52% |

## Conclusion:

Noticeable change in academic and general behaviours required for learning were demonstrated for students with learning disabilities participating in the Arrowsmith cognitive program as reported by students, parents and teachers on a self-report measure over the course of an academic year.

## Research Report

Report on the Arrowsmith Program in the Toronto Catholic District School Board

# Academic Outcomes - Written Proficiency

## Study 1: Written Proficiency

### Group

This study in 2016 investigated the outcomes of implementing the Arrowsmith cognitive program to improve motor planning (Motor Symbol Sequencing) over the course of one academic year with students in grade one in a public school in Australia who were all working in-person.

There were four grade 1 classes. One class completed 30 minutes per day five days per week over the academic year of the Arrowsmith Program Motor Symbol Sequencing program (MSS) designed to improve motor planning related to reading and writing. The other three grade 1 classes received traditional writing programs.

### Measures

#### *WOLD Sentence Copying Test*

A standardized measure that looks at writing proficiency. It was administered at the beginning and end of the grade 1 academic year. The study compared the number of students at or above grade level in terms of written proficiency based on test scores at the beginning of the year and at the end of the year.

### Results

The students receiving 30 minutes per day of the Motor Symbol Sequencing program showed the greatest improvement in written proficiency over the course of the year.

# Whole Cohort Program – Grade 1

**Comparison of results across four Grade One classes**

- 3 classes: traditional writing program
- 1 class: 30 minutes/day doing the Arrowsmith exercise for learning motor plans necessary for writing and eye-tracking in reading (Motor Symbol Sequencing)

| Classes | Arrowsmith Class | | Gifted Class | | Academic Class 1 | | Academic Class 2 | |
|---|---|---|---|---|---|---|---|---|
| Students at or above grade level | Pre Test | Post Test | Pre Test | Post Test | Pre Test | Post Test | Pre Test | Post Test |
| % | 10% | 95% | 30% | 70% | 35% | 45% | 5% | 45% |
| % Change | | **85%** | | **40%** | | **10%** | | **40%** |

Results based on the WOLD Sentence Copy Test

At Risk Readers

- 5 students in the study were identified as at-risk for reading problems in kindergarten; Reading Recovery program recommended for Grade 1
- All 5 students were placed in **Arrowsmith** class in Grade 1
- After 10 weeks in the program, all 5 students were reading at proficient level and no longer recommended as needing Reading Recovery program
- Public School in Australia

## Additional Data

Five students, identified in kindergarten as being 'at risk' for reading problems and requiring reading intervention, were enrolled in the class receiving the MSS program. After 10 weeks in the program their reading improved significantly, and they were no longer considered 'at risk' for reading problems.

## Conclusion:

Significant improvement in writing proficiency was demonstrated for students in grade one participating for 30 minutes per day in the Arrowsmith Whole Cohort cognitive program designed to improve motor planning related to writing and reading over the course of one academic year compared to students in grade one participating in regular academic programs.

## Study 2: Written Proficiency

### Group - Schools in Canada, Australia, and New Zealand

This study in the 2017-2018 school year investigated the outcomes of implementing the Arrowsmith cognitive program to improve motor planning (Motor Symbol Sequencing) over the course of one academic year with students in grade one in three schools (Pickering Christian School, Canada; Darling Downs Christian School, Australia; and Finlayson Park School, New Zealand). These students engaged in this cognitive program for 30 minutes per day five days per week. All students were working in-person.

### Measure

#### *The Children's Handwriting Evaluation Scale for Manuscript (CHES-M)*

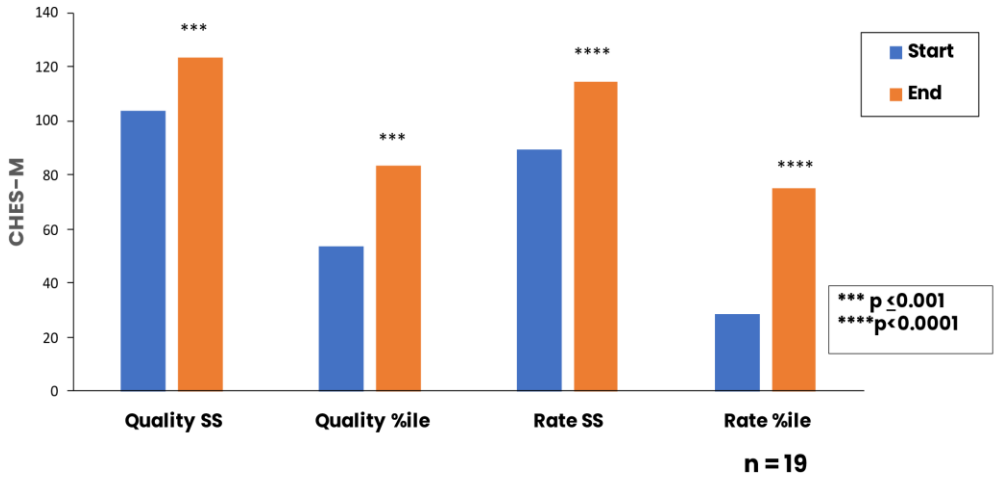
This measure evaluates two aspects of writing, writing speed/rate and quality of writing, for students in grades 1 and 2. This measure was administered at the beginning and end of the academic year.

### Results

On both writing speed/rate and quality of writing using the Standard Score (SS) and the Percentile Score (%ile) students at all 3 schools showed significant improvements over the 8 months engaged in the Motor Symbol Sequencing cognitive program.

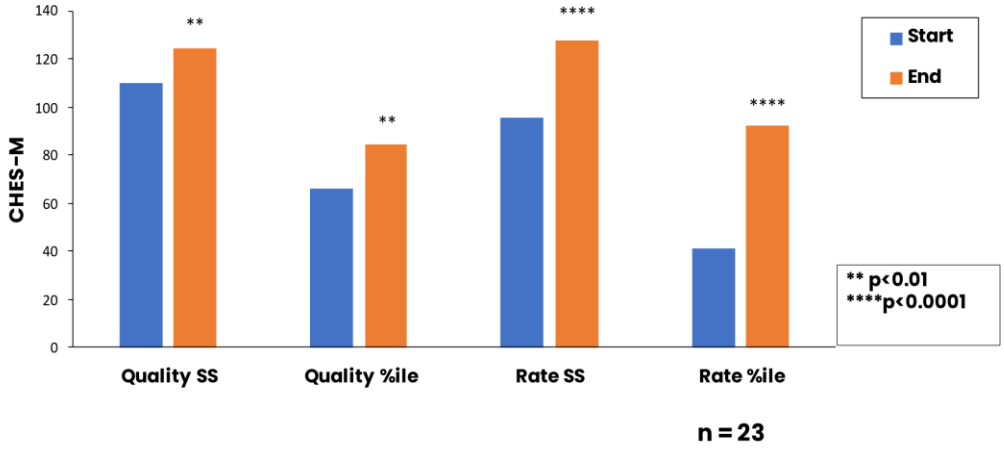
## Whole Cohort Program – Grade 1

Motor Symbol Sequencing Cognitive Program– Pickering CS



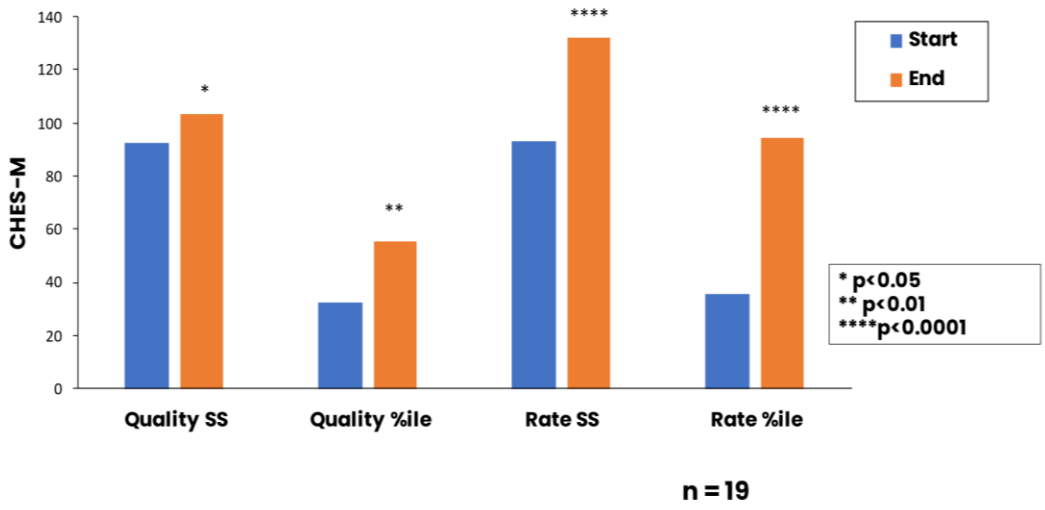

## Whole Cohort Program – Grade 1

Motor Symbol Sequencing Cognitive Program– Darling Downs CS



**Whole Cohort Program – Grade 1**

Motor Symbol Sequencing Cognitive Program– Finlayson Park School




## Conclusion

Significant improvement in writing proficiency was demonstrated for students in grade one mainstream class participating for 30 minutes per day in the Arrowsmith Whole Cohort cognitive program designed to improve motor planning related to writing and reading over the course of one academic school year.

## Summary of the Academic Research Results

The Arrowsmith Program is a suite of cognitive programs that utilize the principles of neuroplasticity to target and strengthen neural regions and networks of the brain set up to perform particular cognitive functions such as: processing information; seeing relationships and making the connections necessary for insight and conceptualization; forming and retaining memories; navigating in space; recognizing familiar faces; parsing speech; learning motor plans for reading and writing; discriminating speech sounds; visually retaining symbol patterns necessary for reading, spelling and visual template learning; interpreting emotions; and thinking non-verbally.

Enhancement of these cognitive functions that underlie learning in school and throughout life is possible through the targeted application of cognitive programs utilizing the principles of neuroplasticity. This is the basis of the Arrowsmith Program.

Research studies presented in this document have been conducted in different schools and organizations with different populations engaged in different delivery models using different research frameworks. These studies all show similar results – that the Arrowsmith Program is effective in significantly improving academic achievement for the participants.

The research has demonstrated:

- increased rate of learning in the acquisition of academic skills
- significant improvements in the academic areas of:
- reading – fluency, comprehension, word attack
- spelling
- writing – fluency, proficiency
- comprehension
- vocabulary
- math – fluency, calculation, quantitative concepts

- significant improvements in the areas critical to learning
  - attention
  - memory
  - planning
  - goal setting
  - self-organization
  - understanding direction and concepts

    - mental initiative
    - interpersonal relationships
    - emotional intelligence
- greater than average growth in Mathematics and Reading Comprehension

## Conclusion

The Arrowsmith cognitive program has significant benefit for individuals with learning disabilities/difficulties, students in mainstream classes, students whose learning has been impacted by trauma, adults recovering from addiction, and individuals who have experienced a traumatic brain injury. As the brain changes, there are positive cognitive gains which support learning and the acquisition of academic skills as well as social-emotional well-being.

*Arrowsmith's premise*: change the brain, change cognitive capacity, change the student's capacity to learn in all aspects of life.

# Appendix A: Research Measures Used

California Achievement Test

Measure of Academic Progress

Monroe-Sherman Achievement Test – Passage Comprehension and Reading Speed

Parent Survey Questionnaire

PAT - Maths and PAT - Reading

Questionnaire of Academic Skills and Learning Behaviours

Self-Report Survey Questionnaire

TCDSB Survey Questionnaire

The Children's Handwriting Evaluation Scale for Manuscript (CHES-M)

Wide Range Achievement Test – Word Recognition and Arithmetic

WOLD Sentence Copying Test

Woodcock-Johnson IV Tests of Cognitive Abilities and Achievement