

Research Overview June 2020

ARROWSMITH PROGRAM

questions@arrowsmithprogram.ca
www.arrowsmithschool.org



**Arrowsmith
PROGRAM**

Strengthening Learning Capacities®

Table of Contents

1. Introduction	3
2. The Arrowsmith Process.....	4
3. Research Results	5
4. Global Research Initiative.....	6
5. List of Research undertaken into the Arrowsmith Program since 1997	7
6. Research Frequently Asked Questions.....	9
7. Arrowsmith Research Updates.....	13
8. Quick Facts about the Arrowsmith Program	14

1. Introduction

Since 1997 there have been more than 20 research studies involving some 700 students across six universities and nineteen different educational organizations all evaluating the effectiveness of the Arrowsmith Program. Five of these studies have had control groups and eleven have been peer reviewed. There are another four research projects currently underway at three universities.

Among these studies are two published peer reviewed research papers, both from University of British Columbia: the 2019 Neuroimaging and Behavioral study and the 2017 study into individuals with Acquired Brain Injury.

These studies are by different investigators, in different schools and educational organizations, 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*](#).

Significantly they all show very similar results– that the Arrowsmith Program is effective for students with learning difficulties resulting in significant improvement in:

- cognitive abilities critical for learning including long-term memory, verbal-auditory learning, inductive reasoning, processing speed, verbal fluency, working memory, cognitive efficiency, and vigilance – a form of sustained attention; and
- academic results, with the biggest changes occurring in word reading, reading fluency, spelling, math fluency and computation.

2. The Arrowsmith Process

Most programs designed to help children with learning difficulties identify weaknesses, teach to strengths and tailor content to suit abilities. They measure results in terms of improved academic performance.

Arrowsmith works differently. By using cognitive programs, the goal is to target the brain itself.

Through cognitive programs, using repetitive exercises that work the brain like a muscle in the gym, the goal is to get the brain to work where it has not been working effectively. The cognitive programs focus on those core cognitive abilities that underpin literacy and numeracy, as well as a host of emotional intelligence and practical everyday competencies.

The results are measured in academic outcomes and cognitive outcomes as well as through brain imaging to show how the student's brain has changed, showing improved connectivity. Importantly changes in children's wellbeing - their happiness, confidence, and enjoyment of learning - are measured.

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

3. Research Results

The research results demonstrate that for individuals with learning disabilities, Arrowsmith's cognitive programs lead to changes in:

- brain activation and connectivity
- cognitive functioning
- academic achievement
- rate of learning in the acquisition of academic skills
- social emotional well-being
- activities of daily living
- growth mindset (seeing one as an agent of change in one's life)
- stress levels (as measured by reduction in cortisol)

For individuals with Traumatic Brain Injury, Arrowsmith's cognitive programs lead to changes in:

- brain activation and connectivity
- cognitive functioning
- social emotional well-being
- successful return to work

For elementary aged students without learning disabilities, Arrowsmith's cognitive programs lead to changes in:

- cognitive functioning
- academic achievement

4. Global Research Initiative

In February 2019, a research collaborative was formed comprised of researchers from the University of British Columbia, Southern Illinois University, Universidad Camilo José Cela, and Tallinn University.

The researchers are meeting on a regular basis to collaborate on further research investigations into the outcomes of students in the Arrowsmith Program.

Arrowsmith's vision is to create a research institute to further these investigations in the fields of learning disabilities, cognitive enhancement, education and acquired brain injury.

5. List of Research undertaken into the Arrowsmith Program since 1997

Research into Academic Outcomes

1998	Results of Arrowsmith Program at St. Patrick's Secondary School - Toronto Catholic District School Board (Canada)
2000	Treatment Outcome for a Motor Symbol Sequencing Dysfunction (Canada)
2000	Evaluation of the Implementation of Arrowsmith in the TCDSB - Toronto Catholic District School Board (Canada)
2003	Arrowsmith Program Evaluation Report – UBC & Vancouver School Board
2003	Report on the TCDSB Study of the Arrowsmith Program - Toronto Catholic District School Board (Canada)
2004	TCDSB Learning Disabilities Review - Toronto Catholic District School Board (Canada)
2005	Outcome Evaluation of the Arrowsmith Program – Donner Foundation (Canada)
2007	Rate of Learning - Toronto Catholic District School Board (Canada)
2007	Academic and Learning Behaviours - Toronto Catholic District School Board (Canada)
2013	A Case Study of Learning Disabilities – University of Saskatchewan (Canada)
2014	Academic Achievement - University of Calgary (Canada)
2015	Average Academic Growth - Holy Trinity Parish Schools (Australia)
2016	Written Proficiency - Motor Symbol Sequencing Whole Cohort Study (Australia)
2016	Academic Achievement - University of British Columbia (Canada)
2017/18	Academic Achievement - University of Southern Illinois (United States)

Research into Cognitive Outcomes

2004	TCDSB Learning Disabilities Review - Toronto Catholic District School Board (Canada)
2005	Outcome Evaluation of the Arrowsmith Program – Donner Foundation (Canada)
2013	A Case Study of Learning Disabilities – University of Saskatchewan (Canada)
2014	Cognitive Outcomes - University of Calgary (Canada)
2016	Cognitive Outcomes - University of British Columbia (Canada)
2016	Cognitive Outcomes - Universidad Camilo José Cela (Spain)
2017/18	Cognitive Outcomes - University of Southern Illinois (United States)
2018	Cognitive Outcomes - University of Southern Illinois (United States)
2019	Cognitive Outcomes - University of Southern Illinois (United States)

Research into Social, Emotional and Behavioural Outcomes

2007	Social, Emotional and Behavioural Outcomes - Toronto Catholic District School Board (Canada)
2016	Social, Emotional and Behavioural Outcomes - University of British Columbia (Canada)
2017	Social, Emotional and Behavioural Outcomes – University British Columbia (Canada)

Brain Imaging Outcomes

- 2016 Efficiency of Processing - University of British Columbia (Canada)
- 2016 Activation of the Prefrontal Cortex - University of British Columbia (Canada)
- 2016 Connectivity Within and Between Brain Networks – Southern Illinois University (United States)
- 2016 Connectivity Changes - Southern Illinois University (United States)
- 2018 Connectivity Changes - Southern Illinois University (United States)

Outcome Research:

- 2017 Individuals with Acquired Brain Injury - University of British Columbia

Other Research:

- 1997 Correlates of a Test of Motor Symbol Sequencing – University of Toronto (Canada)

6. Research Frequently Asked Questions

6-1. Is the Arrowsmith Program grounded in research?

The work of the Arrowsmith Program is grounded in research - that of Alexander Luria who identified the function or job of different regions and networks of the brain and that of Mark Rosenzweig at University of California, Berkeley looking at 'activity-dependent neuroplasticity' in rats. Activity-dependent neuroplasticity means that external stimulation that places a demand on the brain over a sustained period results in change to the brain.

Based on Luria and Rosenzweig's research, the following question was posed by Barbara Arrowsmith-Young in 1978 – "Can specific cognitive exercises stimulate and improve specific cognitive functions?"

The research conducted on Arrowsmith Program demonstrates that yes, specific cognitive exercises are leading to changes in the brain along with cognitive, academic, and social emotional well-being changes.

6-2. What is research?

Research is a form of systematic investigation with the intention of adding knowledge to a field. It takes a variety of forms, including studies using different research designs such as single subject designs, observational studies, longitudinal designs, surveys, randomized control designs.

6-3. Which research designs have been used?

The American Psychological Association Journal article, *More than one way to measure*, <https://www.apa.org/monitor/2010/09/trials> argues for multiple research approaches to evaluate outcomes of interventions and outlines the pitfalls of randomized clinical trials. Arrowsmith, in 2010, consulted Dr. Alan Kazdin, who is quoted in this article, on the appropriate research design to evaluate Arrowsmith Program outcomes and he advised that single subject design or n-1 design would be the best approach. This research design uses a form of experimental reasoning called baseline logic to demonstrate the effects of the independent variable (in the case of Arrowsmith – the cognitive exercises) on the behavior of individual subjects. Given it is often difficult to match control groups in education research this is a frequently used research design. In this design, students' progress over time is measured against their starting point and if progress exceeds what is expected, it is considered

significant. Designs with control groups have also been used in which differences on outcome measures between the groups are analysed for significance.

This design is discussed here: https://en.wikipedia.org/wiki/Single-subject_design In this design, it is argued that if the research demonstrates common outcomes across multiple studies using different subjects and with a range of measures, then that the intervention is the probable factor leading to the outcomes. All the independent research on Arrowsmith show similar outcomes.

6-4. What are the statistics on research evaluating the Arrowsmith Program?

- 20 independent studies
- 700+ students
- 6 universities
- 19 different educational institutions
- 4 countries
- 11 of these studies have been peer reviewed
- 2 have been published
- 5 of these studies have had control groups
- These studies have been conducted by different researchers using a variety of research designs and measures.

6-5. Has brain imaging been used to evaluate the Arrowsmith Program?

5 studies at 2 universities have used various forms of brain imaging to investigate the impact of the Arrowsmith Program. The brain imaging results have shown:

- changes in brain activation and connectivity
- more efficient processing
- increased activation in the prefrontal cortex and executive control network
- strengthened network connectivity, both within and between networks

6-6. What are the academic outcomes?

Studies at three universities found significant changes on the following academic measures:

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

-
- Quantitative Concepts
 - Math Fluency
 - Written Expression
 - Writing Fluency
 - Receptive Language
 - Academic Fluency

Studies in several elementary schools found significant changes over an academic year on:

- rate of acquisition of the skills of reading, reading comprehension, spelling, arithmetic
- amount of academic growth over an academic year on reading comprehension and mathematics
- writing speed and accuracy

6-7. What are the cognitive outcomes?

Studies at four universities found significant changes on the following cognitive measures:

- Cognitive Efficiency
- Processing Speed
- Perceptual Speed
- Auditory Processing
- Attention
- Fluid Reasoning
- Visual Auditory Learning
- Working Memory
- Verbal Fluency
- Short Term Memory
- Long Term Memory
- Phonemic Awareness
- Planning (Executive Functioning)
- Visual Spatial Reasoning

6-8. What are the social-emotional well-being outcomes?

- greater sense of happiness & well being
- increased sense of locus of control (view self as agent of change in one's life)
- increase in incremental theory of mind ([Carol Dweck](#))
- increase in social skills, adaptability, and leadership
- increase in attention, listening well, staying focused

-
- reduction in feelings of depression, anxiety, aggression
 - reduction in hyperactivity
 - reduction in cortisol (stress hormone)

6-9. Are there control groups?

Five studies have compared the results of students in the Arrowsmith Program with students not receiving the Arrowsmith Program (controls). What is important to note is that in the studies with control groups, the students receiving the Arrowsmith cognitive exercises all showed significant academic and/or cognitive gains over the control groups who did not receive Arrowsmith intervention.

6-10. Is the research independent?

The researchers from the various universities conducting research on the outcomes of the Arrowsmith Program do this work independently of Arrowsmith. As they require, from time to time, the researchers consult with Arrowsmith on various questions related to the Arrowsmith methodology and theory. All researchers that conduct research on the Arrowsmith Program have full access to the methodology from our written documentation to observations of the program in action and to training in the methodology.

6-11. Are there peer reviewed studies?

Eleven of the research studies have been peer reviewed and two have been published in peer reviewed journals. All the studies presented at conferences go through a peer review process before being accepted for presentation.

7. Arrowsmith Research Updates

For updates on the research being conducted on the Arrowsmith Program, visit the Research page on the Arrowsmith website: <https://arrowsmithschool.org/research/>

8. Quick Facts about the Arrowsmith Program

- Since 1997 there have been over 20 research studies involving some 700 students looking into the effectiveness of the Arrowsmith Program. There are another four research projects currently underway at three universities.
- Among these studies are two published peer reviewed research papers including the latest from UBC. Significantly they all show very similar results– that the program is effective for students with learning difficulties.
- Somewhere between 10 to 20% of the population has learning difficulties. What is clear is that, while the traditional approaches often have benefit in increasing academic achievement in the skill areas targeted, these methods are not getting to the root cause.
- Over the past 20 years there have been many independent studies of the Arrowsmith Program and all of them point to the same conclusion; that the program works and that children and young people have benefited.
- There is now a global research initiative made up of researchers at Universities in Canada, the United States, and Spain all studying the outcomes of this work and Arrowsmith welcomes researchers from around the world to join this initiative.
- Arrowsmith Program, founded in 1978, now operates in 90 Arrowsmith Program sites worldwide, including in Canada, the United States, Australia, New Zealand, Thailand, Malaysia, South Korea, Spain, the Cayman Islands and Switzerland
- More than 10,000 students world-wide have achieved success with the Arrowsmith Program