BRAINFUTURES

Brain Fitness and Executive Function

Evidence-Based Interventions
that Improve Student Outcomes

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Executive Summary

THE CHALLENGE AND THE NEED

Despite many reforms in the U.S. education system, efforts to educate and prepare our nation's youth for the future are falling short. In 2015 the Organisation for Economic Co-operation and Development (OECD) assessed the academic proficiency of 15-year-old students from 35 countries across the globe, ranking our students 19th in science, 20th in reading, and 30th in mathematics. In this global economy, these results are a clear warning of the social and economic costs we will pay if problems in our education system are left unaddressed.

Simultaneously, stress and depression are rising at startling rates among students, and research has demonstrated a resulting negative impact on learning. Poverty and other adverse childhood experiences affect nearly half of all U.S. children, significantly impacting the achievement gap and often resulting in lifelong deficits in academic performance, employment, and overall well-being.

If we do not promptly and effectively address this educational and mental health crisis, our nation risks losing even more ground as a global leader.

APPLYING ADVANCES IN NEUROSCIENCE IN THE CLASSROOM

Scientific understanding of the brain has changed in recent years, and this new knowledge offers powerful tools to combat the challenge. We now know that the brain is highly malleable and continues to grow and change throughout our lives. Over the past decade, research has shown that brain fitness activities stimulate cognitive development and prime the brain for learning by improving key executive function skills of working memory, self-control, and cognitive flexibility. These skills are also inextricably linked to social emotional learning (SEL).

Effective brain fitness interventions during childhood and adolescence produce striking results in improving the executive function skills and prosocial behaviors that are more accurate predictors of academic readiness and life success than IQ or any other performance markers—offering affordable and effective solutions to today's educational challenges.

RESULTS THAT MATTER

This brief presents a vetted set of brain fitness programs that meet the evidence-based standards of the federal Every Student Succeeds Act (ESSA) that schools can adopt to support students' academic and social emotional development. We focus on classroom-based opportunities because they can help children with executive functioning deficits the most without stigmatizing them, since all students in a class participate together and benefit from the interventions.

Types of interventions profiled include cognitive training, mindfulness, and executive function skills curricula. Outcomes for the 10 programs that met our full criteria include significant:

- increases in proficiency on state-mandated tests for math and reading
- improvements in school-administered tests of core subjects
- reductions in disruptive classroom behaviors
- increases in prosocial behaviors

Results that early adopter schools are achieving are compelling and warrant serious attention:

A 2018 study of a cognitive skills training program for students at a high-poverty urban elementary school produced the following outcomes after just 10 hours of training:

- 80% pass rate on state standardized reading tests versus a 20% rate in the control group
- 60% pass rate in state standardized math tests versus a 10% rate in the control group

Studies conducted in 2012 and 2013 of a mindfulness program for students at economically diverse elementary schools found:

- 28% higher grades in reading, math, and science
- 15% increase in average G.P.A.
- 60% decrease in behavioral issues
- 43% decrease in teacher stress

CALL TO ACTION

Our society has a clear problem: many children's brains are not primed for learning, which reduces their cognitive and emotional skills. Youth brain fitness will inform the future academic, social, and economic outcomes of our country.

Adoption of the vetted programs highlighted in this report has risen by more than 40% over the past four years to 7,200+ schools, demonstrating a nationwide momentum toward brain-based approaches to improving student outcomes.

The U.S. cannot afford complacency. Schools do not need to wait for solutions to be developed and tested. Neuroscience-based programs that improve the outcomes of our youth are readily available. The power to take action and support the health, well-being, and intellectual development of our youth is within the reach of every school in the nation. Policymakers, education leaders, and faculty champions have the capacity to come together to radically improve the learning outcomes and social-emotional landscapes of their students—and of our country's next generation.

The evidence is clear: every school in the U.S. should adopt an executive function program and executive function training should be a standard component of teacher certification programs.

In every cultural movement there is a tipping point—a time when sufficient and convincing evidence influences the population to make a change in a social norm. We believe education in the U.S. has reached this critical point.

Our nation's students are waiting.

Introduction

BrainFutures is a national nonprofit dedicated to improving human outcomes by assessing and advancing the practical application of neuroscience research. As a citizen advocacy organization, BrainFutures offers rigorous assessment of—and education about—brain-based interventions that target various segments of society, including K-12 education, the workforce, and aging populations. We work to meaningfully advance policy and systems reform through the promotion of neuroscientific innovation.

BrainFutures was launched in 2015 by the nation's second oldest mental health advocacy organization, the Mental Health Association of Maryland (MHAMD). For more than 100 years, MHAMD has addressed the mental health needs of Marylanders of all ages through programs that educate the public, advance public policy, and monitor the quality of mental health care services.

In 2015, the Kennedy Forum—an institutional partner of BrainFutures—issued a report titled, "Promoting Brain Health and Brain Fitness: A National Call for Action" (McCormack, O'Brien, Kennedy, Harbin, Carneal, & Alfred, 2015). The paper highlighted limitations in the U.S. educational system's efforts to educate and prepare our nation's youth for the future. It reviewed the history of education in the U.S., addressing challenges and barriers such as socioeconomic gaps, Adverse Childhood Experiences (ACEs), and the impacts of federal testing on education efficacy. The report made the case for bringing brain fitness interventions into elementary and secondary schools to improve students' capacities to learn.

Building on the Kennedy Forum's report, this brief presents a vetted set of brain fitness programs that meet the evidence-based standards of the federal Every Student Succeeds Act (ESSA) that schools can adopt to support students' academic and social emotional development.

Despite many changes in our education system over the past century, a significant disconnect remains between the comprehensive cognitive and emotional needs of students and what they actually learn and experience in school. Student levels of stress and depression have been climbing at an alarming rate (Twenge, Cooper, Joiner, Duffy, & Binau, 2019), and science shows the negative effects of such states of mind and emotions on learning (Willis, 2015). Yet teachers and administrators have often been hamstrung in addressing these distinct classroom challenges because they have needed to focus on improving test scores and graduation rates to secure federal funding.

There is hope, however. Over the past decade, research has shown that brain fitness interventions greatly support and improve outcomes for students— offering affordable and effective solutions to today's educational challenges. Neuroscience advances continue to spur technological innovations that focus on improving brain development. Digital applications of brain fitness interventions are becoming more available for the classroom and the home. Yet despite these advances, information about scientifically valid programs is not widely available to educators and policymakers in a way that allows for efficient and wise choices to be made regarding program selection and adoption.

BrainFutures aims to change that. This brief first defines brain fitness and and its connection to some of the ongoing challenges in the current education environment. It then explores Executive Function (EF)—the keystone in the arch of brain fitness as applied to academic learning and social and emotional intelligence—including what it is, how it works, and how it is measured. This paper also highlights important developments in related research since the release of the Kennedy Forum brief, and provides an overview of the types of brain fitness interventions used in schools.

Throughout the brief, we share data from several of the programs profiled in our *School-Based Executive Function Program Guide* as examples of how evidence-based brain fitness programs can improve a range of academic and social emotional learning (SEL) outcomes.

From this foundation, we introduce the rubric criteria that we used to determine an evidence-based standard for vetting programs. Based on experiences from exemplar schools that have already adopted brain-targeted interventions, this brief offers suggestions for their successful implementation to encourage future adoption across the entire U.S. education system.

Finally, we offer a summary of existing K-12 brain fitness programs for the consideration of educators and administrators. The programs presented in the *Program Guide* have met or exceeded our evidence-based threshold for inclusion. Each program summary highlights studies that validate the intervention and identifies other important considerations for potential adopters, including program cost, required training, and frequency of program sessions in the classroom.

The volume of research validating the individual programs in this brief, and their broader intervention types, meet an evidence base that is superior to what has typically been applied in the process of curriculum adoption. The Common Core State Standards (CCSS), for example, a recent mass-adopted curricular and skill-building canon, uses (inter)national benchmarks to set standards for student learning goals, but does not require evidence-based practices for curriculum delivery. The CCSS was developed from existing state standards and teacher and public feedback (Common Core State Standards Initiative, 2019). This is not to diminish the value of CCSS, but to point out that core elements of U.S. educational standards are not supported by evidence-based research. The programs described herein, in contrast, have research and evidence validating their efficacy.

Our goal in issuing this brief is to make a valuable contribution toward the positive development of individual students—and the U.S. educational system as a whole—by offering a resource guide for educators, district administrators, state boards of education, policy makers, and the public.

What is Brain Fitness?

Brain fitness is an action and an outcome. The *action* of engaging in brain fitness activities—in the mind and in the body— stimulates cognitive development that leads to positive cognitive outcomes. These actions create better habits of mind and prime the brain for learning through repetitive, and increasingly challenging, practices or behaviors that have been scientifically determined to create specific beneficial changes in the brain. As an *outcome*, brain fitness is the state where changes in cognitive capacity have been accomplished and identified by measurable improvements.

What makes the actions of brain fitness work, and drives the outcomes by improving executive function (EF), are the processes of *neuroplasticity* and *neurogenesis*. New understandings of neuroplasticity reveal that the brain's neurocircuitry is highly malleable, continuing to grow and change for the duration of our lives. This means the brain is capable of "reprogramming" itself using a wide variety of inputs, including sensations, emotions, thoughts, beliefs, environmental and physical stimuli, relationships, experiences, and even metacognition— what the brain thinks of itself.

Neuroplasticity is the capacity of the brain to rewire itself and build new circuitry—or connections— between neurons (brain cells). These connections are how the brain organizes itself to process information. Neuroplasticity would not be possible without the malleable traits of neurons (the cells responsible for carrying information throughout the brain and

then on to the muscles and organs of the body), nor without synaptic pruning, as described below (National Institute of Neurological Disorders and Stroke, n.d.)

New understandings of neuroplasticity reveal that neurocircuitry in the brain is highly malleable, continuing to grow and change for the duration of our lives. This means the brain is capable of "'reprogramming" itself.

A neuron generates electrical-chemical charges as it signals to other neurons (Oberman & Pascual-Leone, 2013). This transmission of information between neurons happens over *synapses*, the tiny gaps where chemicals called neurotransmitters are released to transfer information between cells (Pereda, 2014). The more synaptic pathways used, the stronger the communication between neurons (Sukel, 2011). These neural pathways are ultimately responsible for learning, and must be regularly reinforced to remain active (Pereda, 2014).

In adapting to new environments, the brain undergoes *synaptic pruning* to dispose of unused neural connections while strengthening and

preserving frequently used connections. This rewiring capacity allows the brain to build neuropathways when new processes and information are regularly revisited (Noggle & Santos, 2011). This means students can rewire their brains for optimal performance through ongoing EF skills development.

In addition to the brain's ability to develop new neural networks, it can also grow new brain cells, a process called *neurogenesis.* Recent research explains how neuroplasticity and neurogenesis work in coordination to (re)build more efficient neural connections (Bergland, 2017). Both neuroplasticity and neurogenesis are influenced by external and internal stimuli: when effectively stimulated either by environment or intervention, they can rewire brain circuits to help ameliorate the negative impacts of poverty, ACEs, and learning challenges.

A key developmental period for creating foundational brain circuitry is in school-aged youth. Introducing EF skill-building during optimal windows of brain plasticity, particularly in childhood and adolescence, can produce striking results. EF skills, and the prosocial behaviors they promote, are more accurate predictors of academic readiness and life success than IQ or any other performance

marker (Alloway & Alloway, 2009; Bierman, Nix, Greenberg, Blair & Domitrovich, 2008; Blair & Razza, 2007; Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Duckworth, Quinn, & Tsukayama, 2012; Duckworth & Seligman, 2005; Friedman, Haberstick, Willcutt, Miyake, Young, Corely, & Hewitt, 2007; Hawkins, Kosterman, Catalano, Hill, & Abbott, 2008; McClelland, Morrison, & Holmes, 2000; Moffitt, Arseneault, Belsky, Dickson, Hancox, Harrington, & Caspi, 2011; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014; Titz & Karbach, 2014). Intervening to support the development of EF skills is an investment in students' academic success and lifelong trajectory of achievement.

Intervening to support the development of executive function skills is an investment in students' academic success and lifelong trajectory of achievement.

READING AND COGNITIVE TRAINING PROGRAM - OUTCOMES EXAMPLE 1

Academic gains for students at an urban elementary school included reading comprehension scores that were **4 times greater** for typically developing students and **28 times greater** for students with dyslexia, compared to students who did not receive the training.

For details, see Program Outcomes on pp. 25-28

Why Brain Fitness Matters

Since research confirms the positive effects of improving brain fitness for students, our society should strive to maximize the impact of these findings. If we continue on our current course without adopting brain fitness interventions, the stakes for our youth are tremendously high. Poverty and other Adverse Childhood Experiences (ACEs), such as household abuse, neglect, violence, substance use, divorce, and family member incarceration or death, are at alarming levels, and affect nearly half of all U.S. children, significantly widening the achievement gap (Anda, Butchart, Felitti, & Brown, 2010; McCormack et al., 2015).

Over the past decade, research has show that brain fitness interventions greatly support and improve outcomes for students— offering affordable and effective solutions to today's educational challenges.

Chronic stress and adversity, often experienced by children growing up in poverty, can significantly impair the development of areas of the brain responsible for EF skills. As a result, many of these students have difficulty controlling impulses, focusing attention, and/or organizing goal-oriented thinking (Blair & Raver, 2012). The negative effects of

FIGURE 1: ADVERSE CHILDHOOD EXPERIENCES PYRAMID
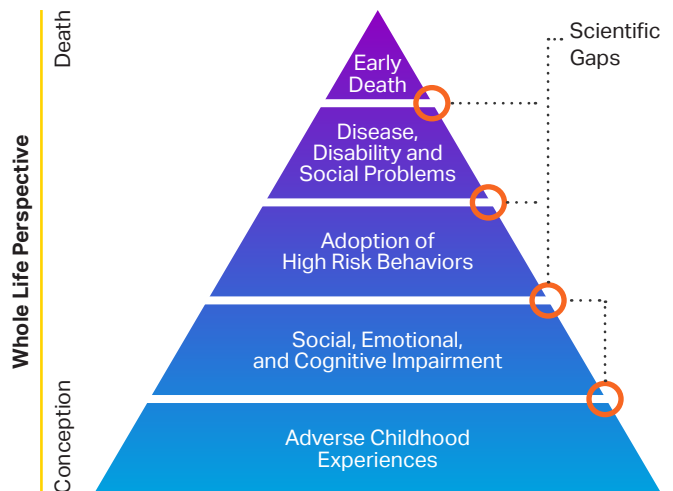
Source: U.S. Department of Health & Human Services, Substance Abuse and Mental Health Services Administration (SAMHSA) ("About the CDC-Kaiser ACE Study |Violence Prevention |Injury Center | CDC," 2019)

FIGURE 2. CYCLE OF TRAUMA

EARLY CHILDHOOD	CHILDHOOD	ADOLESENCE	ADULTHOOD
ACES	Complex Trauma Interpersonal/External	Risk Taking Survival Behavior	Delinquency, Criminal Behavior, Chronic Victimization
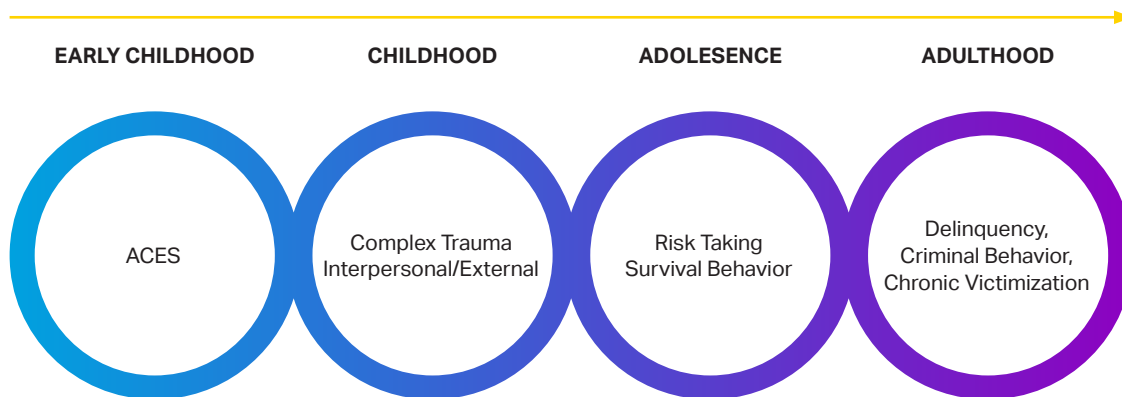
Source: Rodriguez, G. (2016) *The Impact of Early Childhood Trauma on Risk Taking, Delinquency and Victimization*. [PowerPoint Slides] Forensic Mental Health Association of California. Retrieved from http://fmhac.org/uploads/1/2/3/9/123913996/castrorodriguez_slides.pdf

these traumas and stressors have serious implications for our country's educational, economic, and social health.

Dr. Brooke Stafford-Brizard, a Director of Education at the Chan Zuckerberg Initiative, describes the challenge:

> *When students face adversity and stress in their home environment and/or fail to access a quality early childhood education, the development of cognitive and social-emotional skills and mindsets is at risk. Thus, K-12 design must ensure that instruction, supports and assessments are in place to address this potential skill gap in school-age students... All students, regardless of socioeconomic background, need these cognitive and social-emotional skills and mindsets to engage and thrive in school. (Stafford-Brizard, 2016).*

Corollary and compounding effects of low socioeconomic realities—including poor nutrition, limited interactions with caregivers, and language and cultural barriers for non-natives—can negatively impact a child's cognitive and emotional development. Children from poorer, less-educated families tend to have thinner sub-regions of the

prefrontal cortex—the part of the brain strongly associated with higher order processing—than children from wealthier, better-educated families (Noble, Houson, Brito, Bartsch, Kan, & Kuperman, 2015). In fact, 15 to 20% of the achievement gap between high- and low-income children may be explained by differences in brain development (Hair, Hanson, Wolfe, & Pollack, 2015).

Globally, one billion children aged 2–17 years were estimated to have been victims of violence in 2014 (Hillis, Mercy, Amobi, & Kress, 2016), and UNICEF estimates that more than 34 million children currently living through conflict and disaster lack access to protection or child protection services (UNICEF, 2019).

Children affected by poverty and other ACEs are less likely to get the type of brain stimulation at home or in school that promotes healthy cognitive development during critical periods. Many of these students also experience higher sustained toxic levels of the stress hormone cortisol, which causes cell death and atrophy in the hippocampus, a brain region associated with memory and emotion regulation (McEwen, 2003).

Students with multiple ACEs are more likely to show cognitive and social/emotional impairment and to engage in unhealthy behaviors than those without multiple ACEs (Felitti, Anda, Nordenberg, Williamson, Sptiz, & Edwards, 1998; Sacks, Moore, & Murphey, 2014). These negative outcomes can translate to lifelong deficits in academic performance, employment, earning potential, social integration, and physical well-being (Friedman et al., 2007; Moffitt et al., 2011).

If we do not promptly and effectively address this educational and mental health crisis, our nation risks losing even more ground as a global leader. Already there are clear signs of other countries significantly pulling ahead of the U.S. in global education rankings. The Organisation for Economic Co-operation and Development (OECD) produces a triennial educational assessment of subject proficiency in 15-year-old students from across the world in its Programme for International Student Assessment (PISA). In 2015, approximately 540,000 students completed the assessment: among 35 participating member countries, U.S. students ranked 19th in science, 20th in reading, and 30th in mathematics (DeSilver, 2017). These results are an urgent harbinger of a less globally competitive U.S workforce, and a predictor of the increasing social and economic costs if we do not target youth brain fitness.

Government, industry, and community institutions have a vested interest in reversing this trend. Ground zero for implementing change is in the classroom. Children with stronger EF skills engage more effectively with classroom learning activities (Nelson, Nelson, James, Clark, Kidwell, & Espy, 2017) and have higher reading and math achievement in elementary school than those with weaker EF skills (Best, Miller, & Naglieri, 2011; Cantin, Gnaedinger, Gallaway, Hesson-McInnis, & Hund, 2016; Christopher, Miyake, Keenan, Pennington, DeFries, & Wadsworth, 2012; Duckworth et al., 2012; Yeniad, Malda, Mesman, van IJzendoorn, & Pieper, 2013).

In December 2015, the Every Student Succeeds Act (ESSA) passed into law, replacing the No Child Left Behind Act (NCLB). This reauthorization of the Elementary and Secondary Education Act (ESEA) of 1965 raised the bar for school interventions from *research-based* in NCLB to *evidence-based* through ESSA's "Evidence of Effectiveness" criteria. With the advent of ESSA, more schools may be able to procure federal funding to implement brain fitness programs that meet the evidence-based criteria.

We believe that the twin enterprises of neuroscience and public education are best poised to tilt the scales in favor of our youth and country. Science, in alliance with education, offers pathways to reliable and scalable advancements and interventions for cognitive and behavioral improvements.

COGNITIVE TRAINING PROGRAM - OUTCOMES EXAMPLE 2

Eighth grade students who received enhanced cognitive training achieved **2.5 times greater** reading comprehension mastery on state standardized tests than students who did not receive the training. Math mastery was **2.7 times greater**. Science and social studies mastery each **increased by 50%**.

For details, see Program Outcomes on pp. 25-28

Understanding Executive Function

Executive function (EF) is the higher-order neural processing in the brain that takes place in the prefrontal cortex (PFC), the frontmost part of the brain near the forehead. EF is crucial to learning, planning, reasoning, problem-solving, goal-directed action, and self-motivation. (Diamond & Lee, 2011). It is the target of brain fitness interventions because it is the main building block of cognitive capacity and EF deficits are often at the core of students' learning challenges. No matter how talented the teacher, if a student's EF capacities are underdeveloped, a sole focus on subject matter instruction may not be effective or helpful.

The prefrontal cortex:

1. Comprises the most extensive and complex neural network connections throughout the brain
2. Undergoes rapid change during adolescence
3. Is the last region to fully develop, continuing into early adulthood
4. Supports the cognitive complexity that separates humans from all other life forms in terms of intelligence (Ball et al., 2011)

The PFC networks manage the planning and execution of complex thoughts, emotion expression, decision-making, perspective taking, impulse control, strategic memory, focus, anticipation of consequences, abstraction, and other information-processing related tasks needed to thrive in our constantly changing world (Diamond, 2013).

The PFC is where three foundational brain functions perform interdependently: working memory,

inhibitory control, and cognitive flexibility (Zelazo, Muller, Frye, & Marcovitch, 2003). Additionally, PFC brain networks facilitate integrated brain functions that give rise to higher-order skills, including reasoning, problem solving, innovation, fluidity of ideas/solutions, and planning (Chen, Abrams, & D'Esposito, 2006). These higher-order integrated skills build upon the three foundational functions, but do not account for the full capabilities of executive function (Motes, Gamino, Chapman, Rao, Maguire, Brier, Kraut, & Hart, Jr., 2014).

FOUNDATIONAL EXECUTIVE FUNCTIONS

Working Memory involves the ability to hold attention on a concept or task long enough to complete an association or to generate a conclusion or new thought (Smith & Jonides, 1999). The term describes a combination of cognitive processes for managing information, integrating new information with existing information, and collating results into new information (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005). Working memory is critical for making sense of anything that unfolds over time and for reasoning. It is essential for many key academic tasks, including making mathematical calculations without the use of a calculator, considering alternative solutions to a problem, and making connections between seemingly unrelated things (Diamond, 2013).

Inhibitory Control "involves being able to control one's attention, behavior, thoughts and/or emotions to override a strong internal predisposition or external lure" (Diamond, 2013). It includes resisting unwanted

thoughts or memories, resisting temptation, and being able to stay on task despite distractions.

Cognitive Flexibility is the ability to shift from one mind state or task to another, often responding to environmental stimuli—like a teacher's instruction—or to new social demands. It is necessary for re-organizing priorities and thinking creatively about a problem (Davidson, Amso, Anderson, & Diamond, 2006). It is believed to build upon both working memory and inhibitory control and includes the skills of attention shifting and attention control (Jones, Bailey, Barnes, & Partee, 2016). It is also essential for considering another person's perspective.

Since these three foundational EF skills help make learning possible, EF interventions are not usually focused on specific academic subjects, but rather on addressing the underlying cognitive skills that can be applied to a variety of subjects.

HIGHER-ORDER EXECUTIVE FUNCTIONS

The three foundational EFs highlighted above represent the basic cognitive processes that are more localized to specific cortical (brain) regions. Building on these fundamental cognitive processes, the higher-order cognitive skills orchestrate dynamic interactions across brain networks or lobes (e.g., frontal, temporal, and parietal cortices) to support performance on complex cognitive tasks (Chen, et al., 2006; Vas, Chapman, & Cook, 2015). These skills include, but are not limited to:

1. abstracting meanings and principles from vast amounts of information
2. creating new knowledge
3. processing and analyzing at deeper levels
4. seeking novel applications of knowledge acquisition
5. continuously updating information
6. exploring new solutions to social challenges
7. developing insight and self-awareness to improve actions when unsuccessful

Higher-order EFs are critical to both academic success and navigating the complexities of social and emotional contexts, particularly in adolescence and beyond. (Chapman, Cook, Vas, & Robertson, 2019; Chapman & Mudar, 2014; Chen & D'Esposito, 2010; Gamino et al., 2014; Kandalaft et al., 2012; Yang, Allen, Holmes, & Chan, 2017).

Executive function is crucial to learning, planning, reasoning, problem-solving, goal-directed action, and self-motivation.

The combination of foundational EF skill training with higher-order EF cognitive skill development helps make learning possible and improves social-emotional exchanges. EF interventions focus on addressing the underlying cognitive skills that can be applied to all subjects, rather than only focusing on specific academic content needed to pass a test. The benefit of such an approach is that it equips students with a cognitive toolkit to approach *any* academic area or social-emotional challenge with greater adeptness. A developing mind is trained to go beyond concrete facts to create new knowledge, while students retain information better and generalize this success to other academic areas (Gamino et al., 2014). Learning and thinking can be greatly improved when these executive processes are honed.

Additionally, focusing on EF skill development helps level the playing field by enhancing the trajectories of all students, regardless of socioeconomic status or exposure to ACEs—thereby helping close the achievement gap (Alloway & Alloway, 2009; Blair & Razza, 2007; Duckworth & Seligman, 2005; McClelland & Homes, 2000; Bierman et al., 2008; Diamond et al., 2007; Nesbitt et al., 2013; Williams and Hazell, 2011) The federal Executive Function Mapping Project distinguishes between EF and effortful controlled (EC) skills, both of which involve

self-regulation and self-control and are foundational to learning: EF skills are based in the cognitive domain whereas EC skills are based in the emotional domain (see Figure 3).

SOCIAL EMOTIONAL LEARNING AND EXECUTIVE FUNCTIONING

Since EF skills have both cognitive and affective impacts, it is important to understand how social emotional learning (SEL) skills relate to EF. SEL is the ability to understand and manage emotions— self-regulation, empathy, perspective-taking, and social harmony—and maintain attention to task.

School achievement data is often highly focused on quantitative outcomes, such as test scores and graduation rates. This can lead to an assumption that students only need to develop academic skills, and that it is only the teacher's ability to deliver and manage subject-based content that produces results. However, just as EF skills are not specific to an academic subject but rather help the brain to think more effectively, SEL research shows that the ability to practice self-regulation, manage emotions, and relate to others is at least *equally influential* on academic performance and quantitative outcomes as subject matter instruction. The development of SEL skills requires EF capacities, and programs that focus on SEL development often show EF improvements (and vice versa).

SEL and EF are inextricably linked. EF skills enable the PFC to play a regulating role when a student is faced with an emotional trigger and/or when a student needs to discern the appropriate response in a given context. For example, inhibitory control helps students pause before reacting to an upsetting situation, and working memory enables them to remember a parent's or teacher's advice on how to effectively respond. Additionally, cognitive flexibility allows students to have empathy for another's perspective and/or acknowledge their part in a conflict (McCormack et al., 2015).

SEL-focused programs can be effective in helping students practice the types of EF skills necessary in social interactions and which also translate to academic activities. Fortunately, SEL programs for educators have already been extensively vetted. The Collaborative for Academic, Social, and Emotional Learning (CASEL), an organization dedicated to the ongoing practice, research, and policy related to SEL interventions, created the *CASEL Program Guide* (CASEL, 2015). To avoid duplicating CASEL's efforts, SEL programs are excluded from the scope of this review. That said, we endorse the adoption of evidence-based SEL interventions, and some of the programs assessed in this brief have SEL components that work in conjunction with the EF intervention highlighted in this brief.
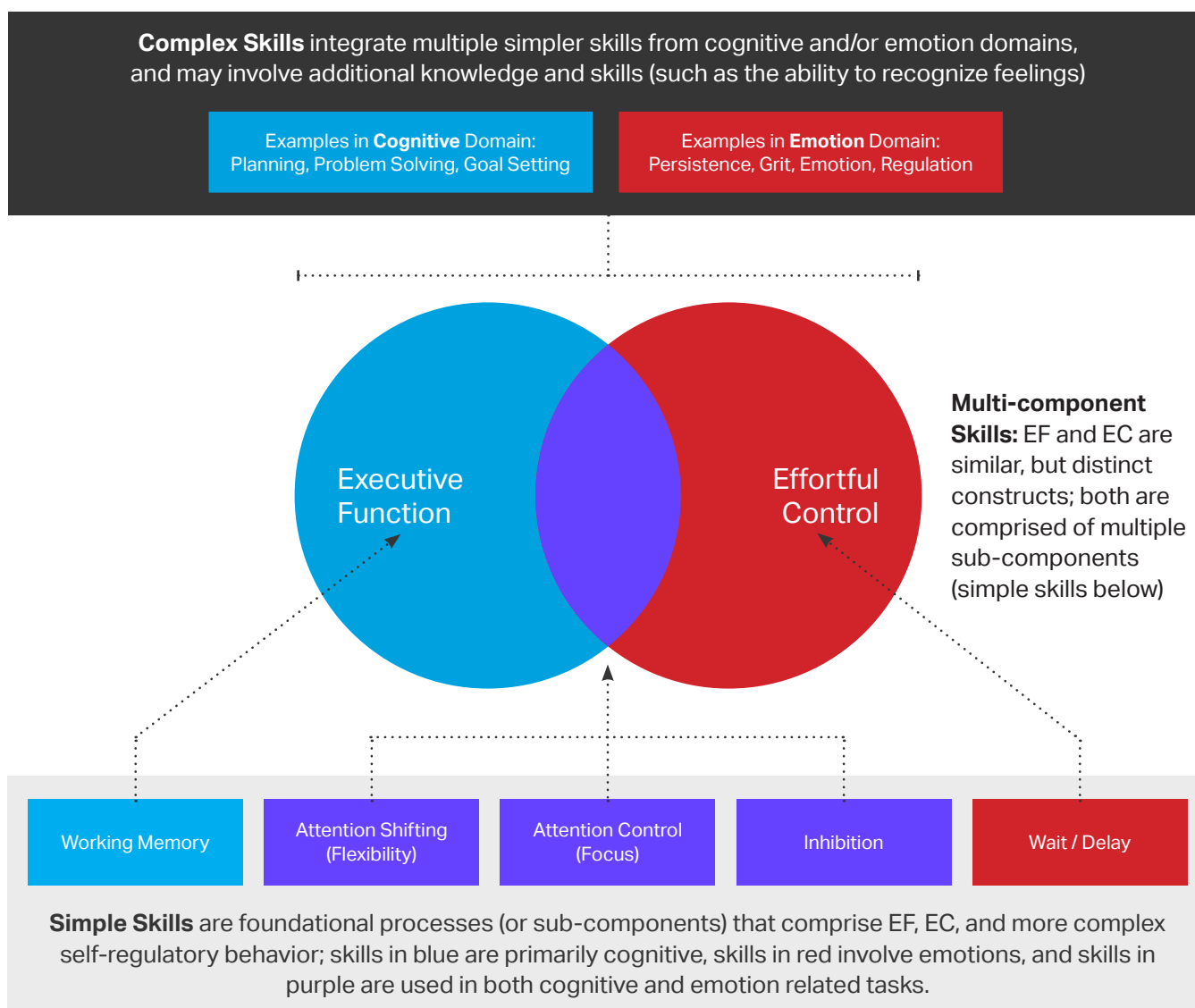

MINDFULNESS PROGRAM - OUTCOMES EXAMPLE 3

A mindfulness program for students at economically diverse elementary schools yielded **28% higher** grades in reading, math, and science, a **15% increase** in average GPA, a **60% decrease** in behavioral issues, and a **43% decrease** in teacher stress.

For details, see Program Outcomes on pp. 25-28

FIGURE 3: MAP OF EF AND REGULATION-RELATED SKILLS

Umbrella Skills refer broadly to this area of development and may be used to refer to many diverse skills (simple and complex, emotional and cognitive, plus others not listed here). Examples include: self-regulation, self-control.

Complex Skills integrate multiple simpler skills from cognitive and/or emotion domains, and may involve additional knowledge and skills (such as the ability to recognize feelings)

Examples in **Cognitive** Domain:
Planning, Problem Solving, Goal Setting

Examples in **Emotion** Domain:
Persistence, Grit, Emotion, Regulation

Executive Function

Effortful Control

Multi-component Skills: EF and EC are similar, but distinct constructs; both are comprised of multiple sub-components (simple skills below)

Working Memory

Attention Shifting (Flexibility)

Attention Control (Focus)

Inhibition

Wait / Delay

Simple Skills are foundational processes (or sub-components) that comprise EF, EC, and more complex self-regulatory behavior; skills in blue are primarily cognitive, skills in red involve emotions, and skills in purple are used in both cognitive and emotion related tasks.

Source: Jones, S. M., Bailey, R., Barnes, S. P., & Partee, A. (2016). *Executive Function Mapping Project Executive Summary: Untangling the Terms and Skills Related to Executive Function and Self-Regulation in Early Childhood.* OPRE Report # 2016-88, Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Categories of Brain Fitness Interventions

Outlined below are the main types of brain fitness interventions available for classroom use. Some of these interventions are EF-specific, meaning they are focused on improving EF primarily for the purposes of academic outcomes; others have also been proven to develop EF skills, but may be adopted for their affective and/or physiological benefits as well.

Each intervention category is supported by significant research that validates the modality more broadly. Studies specific to each program are noted in the *School-Based Executive Function Program Guide* included in this report. Some of the programs highlighted use more than one of the intervention types.

Executive Function-Specific Training:
EF-specific training includes tasks that develop the three core mental processes that underlie all learning, as well as practices that develop more complex EF thought processes, such as attention, prioritization, planning, analyzing, goal persistence, decision making, and problem solving.

- **Cognitive Training:** *Non-subject-related tasks aimed at improving working memory, inhibitory control, and cognitive flexibility by targeting the regions of the brain controlling those skills.* These interventions are often available in Computerized Cognitive Training (CCT) formats that resemble games—and therefore appeal to students—and are designed to stimulate brain development. Many programs automatically assess growth in a student's capacity and continuously recalibrate difficulty levels based on performance.

- **EF Curriculum:** *A pedagogical approach that trains teachers how to layer EF skill-building activities into subject-based curricula throughout the school day.* This is not a curricular add-on, but instead a method of teaching any school subject with EF development woven into the methodology of content delivery.

- **Subject-Specific Comprehension with Cognitive Training:** *Programs that primarily target a student's acquisition of subject-based skills (e.g., literacy) and include cognitive training activities.*

Mindfulness: *The practice of maintaining a moment-by-moment awareness of thoughts, feelings, bodily sensations, and surrounding environment without (or with limited) attachment and judgment as a way of down-regulating disruptive emotions and directing brain activity to higher-order processing and EF.* While the term mindfulness can be associated with Buddhist practices, it has a secular application as a core brain fitness exercise. The concept of paying attention in the present is central to many brain fitness practices that seek to achieve emotional regulation and the ability to direct attention and focus.

Neurofeedback: *Any reflective activity or technology that provides external feedback about brain activity to the participant in a skill-building context.* For example, sensors with biofeedback information displayed

graphically enable the participant to witness, in real time, their brain activity. The participant can then use the feedback to achieve and maintain intended brain states, such as increased attention, focus, or regulated emotion, thereby ultimately developing EF and other cognitive abilities in the process.

Social Emotional Learning: *The process through which children and adults understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.* We recommend the *CASEL Program Guide* (CASEL, 2015) for those looking specifically for SEL interventions.

Brain Literacy: *Learning about the brain biologically—the different parts, what they are called, how they function, and how they work together to create ideal conditions for learning.* Research has shown that metacognition—the act of thinking about how we think—can improve learning (Bialik, 2015). When students have a higher level of brain literacy, intervention-based improvements in EF are more likely, and they can better understand the relevance of the intervention.

METHODS OF DELIVERY

Each type of intervention requires a method for it to be optimally shared with students in a school setting. The delivery method has implications for training, class time, costs, and scheduling.

- **Teacher-assisted:** A teaching professional is required to partially, or in-full, deliver the intervention to the student or class. These interventions may be integrated into the existing curriculum or be implemented as curricular add-ons.

- **Autonomous use:** A student can utilize the intervention without the aid of a teaching professional. These interventions are usually self-paced programs, whether delivered electronically or in hard-copy format.

- **Clinician-dependent:** A licensed clinical professional is required to administer the intervention in a school-based setting.

ASSESSMENT

Because EF-dependent skills cover a broad range of cognitive abilities, an assortment of assessment instruments have been developed to measure different EF capacities. Various programs focus on particular EF skill development, and often offer pre-, mid-, and post-assessments to demonstrate the results of a program's adoption.

When preparing to deliver academic content, educators use pre-assessment to identify a student's baseline knowledge and needs. In the same way, pre-assessing the baseline EF capacity of students, individually and/or by classroom or schools, provides the opportunity to implement level-appropriate interventions, track progress, and, in some cases, adapt intervention protocols to maximize effectiveness. The most sophisticated pre-assessment instruments identify foundational EF deficits and

COMPUTERIZED COGNITIVE TRAINING - OUTCOMES EXAMPLE 4

Elementary students who received computerized cognitive training achieved **4 times greater** math proficiency and **3 times greater** reading proficiency on state standardized tests as compared to those who did not receive the training.

For details, see Program Outcomes on pp. 25-28

strengths. These data can provide educators a more comprehensive picture of students' current learning capacities and influence how a teacher might individualize cognitive training practices or curricular scaffolding to best meet students' brain development needs.

Some computerized interventions have validity tests built into the assessment process to account for oddities in any student's testing performance and to help ensure integrity of the data. For example, if a student quickly clicks through a testing assessment program just to finish, without taking the necessary time to consider each question or challenge, the results will be flagged, notifying the teacher to allow for a monitored make-up opportunity. Initial performance baselines and subsequent progress reports provide information about the impact of the intervention.

These programs also offer built-in computerized scoring, giving teachers and administrators real-time results without the need to crunch the numbers and analyze findings themselves. Other programs offer teacher-report, parent-report, or even student self-report pre- and post-assessment surveys to log the observable EF-related behaviors and capacities of a student or class, in order to compare performance and determine growth in EF skills following the intervention.

If an intervention does not offer its own assessment protocols, or if schools want to increase the number of assessments being used to track an intervention's effect, school staff can visit the National Institutes of Health (NIH) *Toolbox for Cognitive Measures* (HealthMeasures, n.d.) There they will find age-appropriate recommendations for instruments based on the type of cognitive skill(s) a school wishes to assess. If EF assessment measurements are not part of a program's offering, the NIH tools, though costly and time-intensive, can offer objective data on an intervention's success rates, and therefore may be worth the investment.

By using a recommended instrument to establish the baseline of a student's EF abilities, and then reassessing at key points during the implementation of an intervention, teachers can have additional confirmation that the intervention is having its intended impact. EF assessment practices also bring an evidence-based standard to a school's culture, a trend that is increasing with the onset of the federal Every Student Succeeds Act (ESSA) regulations.

MINDFULNESS PROGRAM · OUTCOMES EXAMPLE 5

Elementary students' math grades **increased 15%** by the end of the year, self-reported a **20% increase** in well-being, and reported a **24% decrease** in aggressive behaviors among their classmates.

For details, see Program Outcomes on pp. 25-28

A Rubric
for Success

Working with an advisory board comprised of neuroscientists, psychologists, psychiatrists, educators, and other stakeholders, we culled and reviewed school-based brain fitness interventions that specifically address EF. The team developed a rubric to classify the most promising EF interventions based on criteria chosen to meet academic and scientific rigor, and to distill a class of programs that would have higher chances of procuring funding under ESSA guidelines.

We also interviewed education leaders at the state and local levels to identify which factors they consider when deciding to adopt a classroom-based program. While programs that pull students out of class for brain fitness training exist, and some of the programs listed in Appendix 3 can be implemented in a 1:1 setting, we focused on classroom-based opportunities because they can benefit children with EF deficits the most without stigmatizing them (since all students in a class participate in the intervention together).

The process we undertook to identify, review, and evaluate the most promising brain fitness interventions is set forth below. We first conducted a literature review and sought recommendations from advisors to identify programs that claim to increase EF skills in students. We identified and classified more than 40 programs by type.

IDENTIFYING EFFECTIVE PROGRAMS

Reviewed program descriptions to determine whether they met the following criteria:

A. Can be used by students in at least one grade from K-12

B. Can be implemented as a classroom-based intervention

C. Has been used by "typically developing" students (i.e., not solely for those with ADHD and/or learning disabilities)

D. Has research available that studies the specific program, not simply general research about the benefits of the type of intervention

Reviewed the research for each program that met the above criteria and determined if they also met all of the following evidence-based standards.

A. At least one randomized control trial (RCT) or quasi-experimental study with sample size of 10+ published in a peer-reviewed journal

B. At least one classroom-based implementation

C. EF outcomes in at least one study

D. Typically developing students in at least one study

Scope

- K-12 classroom program

- Used by all students in a class

Research & Implementation

- One randomized control trial (RCT) or quasi-experimental study in a peer-reviewed journal with 10+ sample size

- Classroom-based implementation in at least one study

- Executive Function outcomes in at least one study

- Typically developing students in at least one study

OUTCOMES FOR THE PROFILED PROGRAMS

1. Increases in percentages of students meeting proficiency on state-mandated tests for math and reading

2. Reductions in disruptive classroom behavior

3. Increases in prosocial behavior toward self and others

4. Statistically significant improvements on:

   - NIH-recommended executive function tests

   - School-administered tests of core subjects

For more information about specific program outcomes, see the *School-Based Executive Function Program Guide* on p. 39.

We focused on classroom-based opportunities because they can help children with EF deficits the most without stigmatizing them, since all students in a class participate in the intervention together and the intervention benefits everyone.
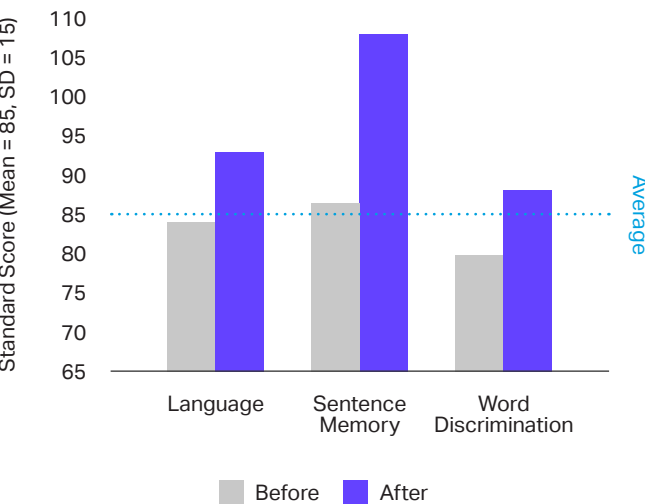
Program Outcomes: Facts & Figures

The following data from several of the programs that met our full rubric criteria illustrate how evidence-based executive function programs can significantly impact a range of academic and SEL outcomes.

PROGRAM 1

Program Type: Reading Comprehension with Cognitive Training **Student Population:** 1st-8th grade students in high-poverty urban schools

IMPROVED COGNITIVE AND LANGUAGE SKILLS

Before / After bar chart with Standard Score (Mean = 85, SD = 15) on the y-axis ranging from 65 to 110, categories: Language, Sentence Memory, Word Discrimination. Average line at 85.

ORAL LANGUAGE

Students' scores improved, on average, from the 14th to the 30th percentile

WORD DISCRIMINATION

Students' scores improved, on average, from the 8th to the 22nd percentile

MEMORY

Students' scores improved, on average, from the 19th to the 64th percentile

Student achievement assessed with the Oral and Written Language Scales (OWLS), the Test for Auditory and Perceptual Skills (TAPS), and standardized language assessments.[1]

PROGRAM 2

Program Type: Computerized Cognitive Training **Student Population:** Students at a high-poverty urban elementary school

% PASS ENGLISH LANGUAGE ARTS (ELA)

% PASS MATH
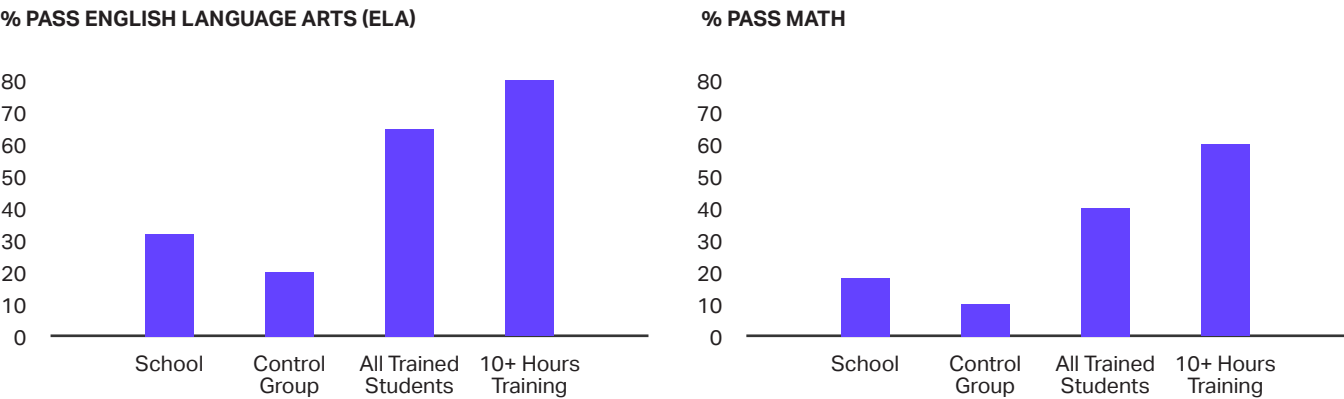
Student achievement assessed on standardized state tests for math and reading.[2]

READING

4X greater proficiency for trained students than for those in comparison classes

MATH

6X greater proficiency for trained students than for those in comparison classes

PROGRAM 3

Program Type: Mindfulness **Student Population:** 1st-5th grade students at economically-diverse elementary schools

28% higher grades in reading, math, and science

15% increase in average GPA

60% decrease in behavioral issues

43% decrease in teacher stress
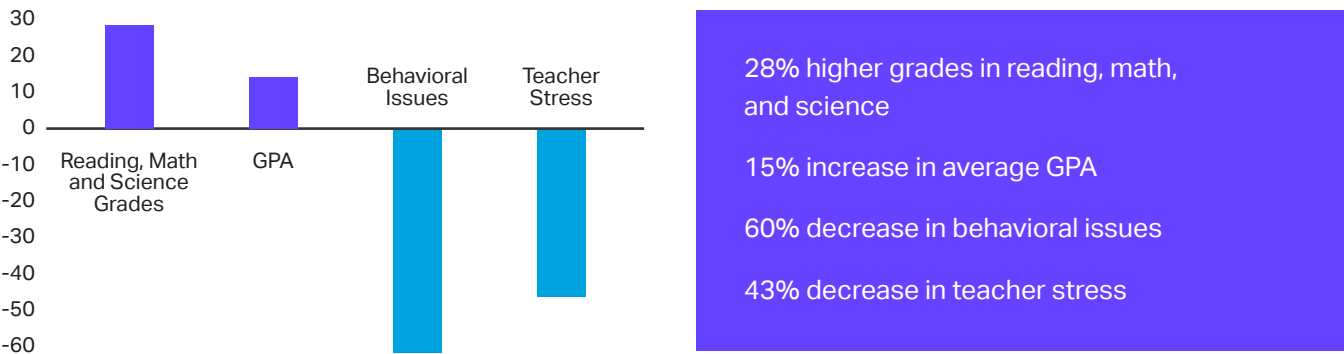
Student achievement assessed by grades, teacher-report, self-report, peer-report.[3]

PROGRAM 4

Program Type: Reading Comprehension with Cognitive Training **Student Population:** 2nd and 3rd grade students at an urban elementary school

IMPROVEMENT IN READING SPEED

IMPROVEMENT IN READING COMPREHENSION

IMPROVEMENT IN PHONOLOGICAL PROCESSING

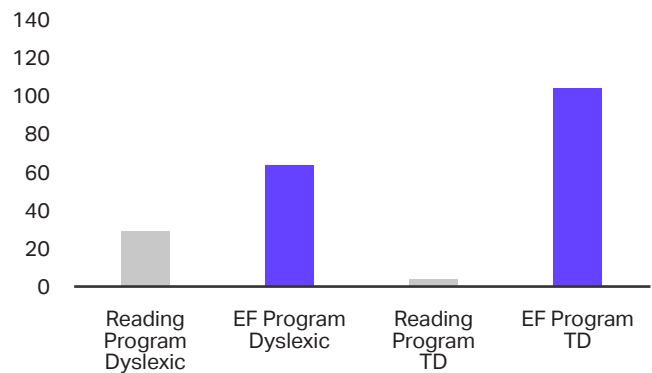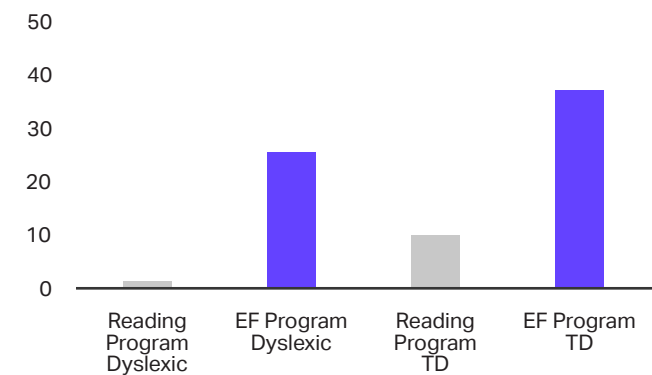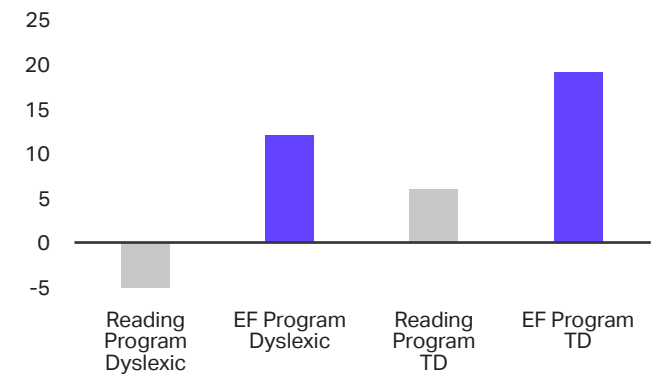Both typically-developing (TD) and dyslexic students had greater gains using the cognitive training program than the control group, which used a computerized reading program:

- **Reading speed:**
  20X average improvement for TD students as compared with TD control group; 3X average improvement for dyslexic average as compared with dyslexic control group

- **Reading comprehension:**
  4X average improvement for TD students as compared with TD control group; 28X average improvement for dyslexic students as compared with dyslexic control group

- **Phonological processing:**
  2.5X average improvement for TD students as compared with TD control group; 19X average improvement for dyslexic students as compared with dyslexic control group

Student achievement assessed by the Gray Oral Reading Comprehension Standard Score Percentile, the Comprehensive Test of Phonological Processing (CTOPP), and Computer-Based Reading Speed Assessment.[4]

PROGRAM 5

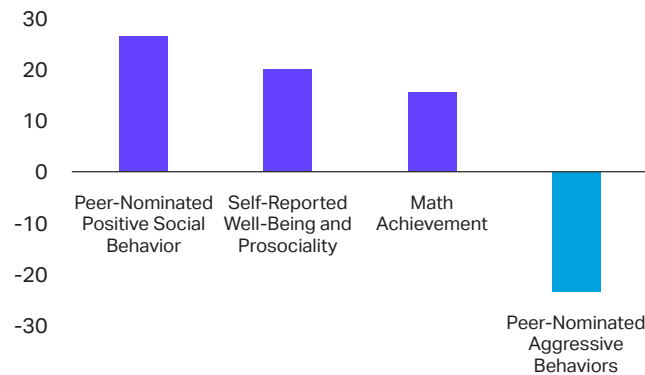**Program Type:** Mindfulness **Student Population:** 4th and 5th grade students at a suburban elementary school

SEL AND ACADEMIC GAINS

Student achievement assessed by grades, teacher-report, self-report, and peer-report. Researchers calculated Cohen's U3 "improvement" index to reflect the average difference between the percentile rank of the mindfulness program and comparison group.[5]

15% increase in end of year math grades

24% gain in prosocial behaviors, as assessed by each student's classmates

20% in self-reported well-being

24% decrease in aggressive behaviors, as assessed by each student's classmates

PROGRAM 6

Program Type: Cognitive Training **Student Population:** 8th grade students at low-income urban middle school

PERCENTAGE OF COMMENDED STANDARDIZED TEST SCORES

Untrained   Cognitive Training Group
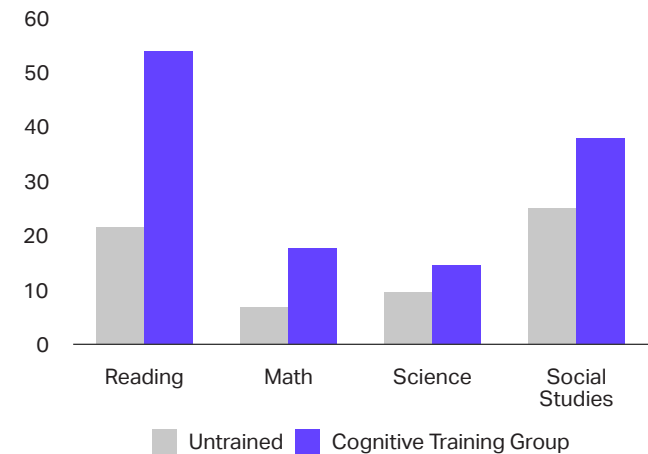
Student achievement assessed by state standardized tests.[6]

Reading: 52% achieved mastery scores on the state reading comprehension assessment, compared with 21% from same school who did not receive the training

Math: 19% achieved mastery scores, compared with 7% from same school who did not receive the training

Science: 12% achieved mastery scores, compared with 8% from the same school who did not receive the training

Social Studies: 39% achieved mastery scores, compared with 25% from same school who did not receive the training

Solutions We Cannot Afford to Ignore

Our society has a clear problem: many children's brains are not primed for learning, which reduces their cognitive and emotional skills. Youth brain fitness, whether achieved by default or design, directly influences the future academic, social, and economic outcomes of our country—and it is not being adequately addressed.

One of the most effective solutions is equally clear: developing EF skills in students as a way to foundationally undergird effective learning and emotional well-being. Every school in the nation can take steps to improve student performance and behavior by adopting programs to develop EF. This can help move schools toward improved academic results, a more positive school climate, better teacher retention, and higher graduation numbers—all of which will immensely benefit young people.

As summarized by developmental cognitive neuroscientist Dr. Adele Diamond: "… improving EFs early may have increasing benefits over time and may reduce needs for costly special education, societal costs from unregulated antisocial behavior, and the number of diagnoses of EF disorders [e.g., ADHD and conduct disorder]" (Diamond et al., 2007).

Developmental psychologist Dr. Kimberly Turner Nesbitt reinforces this idea, "The results provide support for the importance of targeting executive skills and intervening early in efforts to improve academic performance in young children. Moreover, the findings suggest that improving

FIGURE 4: U.S. YOGA AND MEDITATION ADOPTION RATE

U.S. Adults Aged 18 and Over
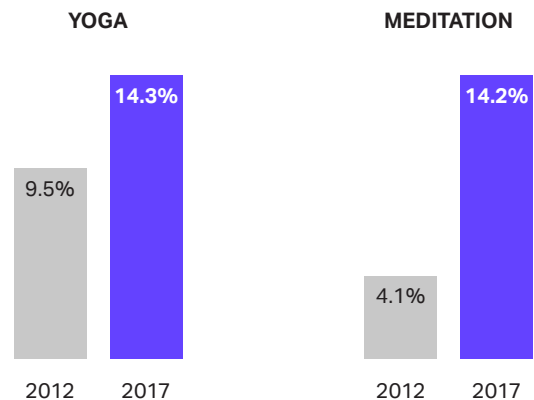
Source: Clarke, T., Barnes, P., Black, L., Stussman, B., & Nahin, R. (2018). *Use of Yoga, Meditation, and Chiropractors Among U.S. Adults Aged 18 and Over*. NCHS Data Brief, no. 325. 1-8. Hyattsville, MD: National Center for Health Statistics.

Youth brain fitness, whether achieved by default or design, directly influences the future academic, social, and economic outcomes of our country—and it is not being adequately addressed.

executive function may mitigate the impact of social risk factors on academic achievement." (Nesbitt et al., 2013).

The level of innovation occurring in the field of brain fitness is generationally significant, with a global market for brain health applications projected to reach more than $6 billion by 2020 (SharpBrains, 2013). The variety of interventions has never been more robust, and access to these interventions has never been easier. Moreover, with the new ESSA requirement for evidence-based programs, including for Title I School Improvement Grants eligibility, these interventions are within reach for far more schools.

Thanks to recent scientific discoveries, the brain fitness adoption curve is quickly rising as interventions are applied throughout industries, from business to athletics to medicine and healthcare. As a society, we have rapidly moved from the early adopters (experiencing the benefits of brain fitness interventions just a few years ago), to an early majority (now leveraging these resources at a time when the need to address cognitive and emotion-regulation deficits is critical). A telling example comes from a recent National Institutes of Health (NIH) study that found meditation, a core mindfulness practice, was the fastest growing health trend between 2012 and 2017 (see Figure 4).

With many families aware of the benefits brain-based strategies and products have on well-being and overall performance, this is an opportune time for schools to implement brain fitness programs that have rigorous scientific support. Indeed, an increasing number of schools have been adopting one of the vetted programs highlighted in this paper (see Figure 5), demonstrating nationwide momentum toward adoption of brain-based approaches to address the academic and emotional challenges found in today's classrooms.

FIGURE 5: EF PROGRAM IMPLEMENTATION IN U.S. SCHOOLS
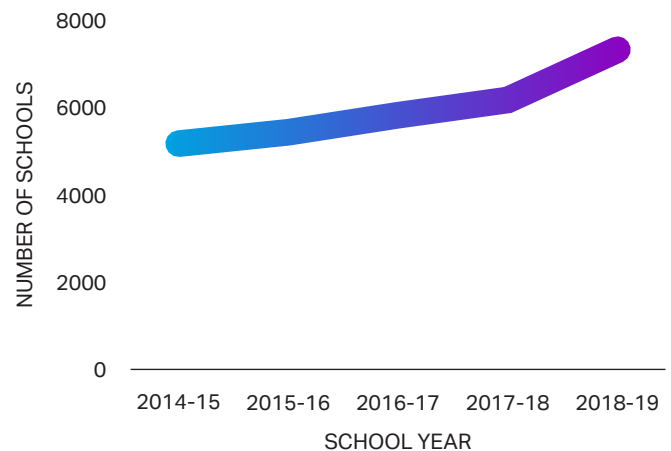
These data are aggregated from ACTVATE™, Fast ForWord®, Inner Explorer™, Master Mind, MindUP, PATH to Reading, and SMART. The 10 programs that met our full rubric criteria were invited to provide this information. Instead, the Mindfulness in Schools Project provided the number of teachers trained and Tools of the Mind shared the number of U.S. classrooms implementing their programming. Cogmed Working Memory Training® declined to provide either set of data.

One of the most effective solutions is equally clear: developing executive function skills in students as a way to foundationally undergird effective learning and emotional well-being.

NEW RESEARCH WILL CONTINUE TO INFLUENCE EDUCATION PRACTICES

The 2015 Kennedy Forum report highlighted many scientific studies validating the categories of EF interventions covered in this paper. Since its release, additional studies have propelled the industry forward, further underscoring the usefulness of EF training. We know more than ever before how the brain works and learns, how it is influenced by its environment, how it affects self-regulation, how it is impacted by stress and trauma, and how its key functions can be restored through neuroplasticity.

Newly unfolding research further underscores how schools and students benefit from more integrated approaches to creating optimal learning environments.

Epigenetics

The science of epigenetics shows why EF-improving interventions are not only important to today's children, but to future generations. Epigenetics is a relatively young field of study that examines the biological mechanisms of DNA that turn genes on and off—the "software" in our bodies that activates or deactivates genetic expression. Epigenetic tags in cells act as a software code, informing gene activity and expression by telling DNA hardware what to do (British Society for Cell Biology, n.d.).

Not only do individuals exposed to adverse events experience trauma and stress, that trauma and stress is also "coded" into tags that can be passed onto future generations.

Every cell has its own epigenetic-informed pattern of expression. Though DNA remains the same throughout life, our epigenetic tags change based on biological factors (such as puberty) as well as environmental influences (such as lifestyle choices and ACEs).

Scientists are increasingly coming to understand how these epigenetic tags not only affect our gene expression, but can also be passed down to our offspring. This has significant implications for the potential impacts of trauma and stress responses. Not only do individuals exposed to adverse events experience trauma and stress, that trauma and stress is also "coded" into tags that can be passed onto future generations (Callaway, 2013). Brain fitness interventions and complementary SEL programs are critical levers in helping to reverse these detrimental trends and stopping an inheritance of cognitive and emotional impairment.

Trauma-Informed Schools

With a persistent national achievement gap (Hansen et al., 2018), ACEs affecting almost half of US children, and a staggering 52% national rise in adolescent major depressive episodes from 2005 to 2017 (Twenge et al., 2019), more states and school districts recognize the need for a holistic view of the connections between trauma, stress, and learning.

An increasing number of states, including California, Massachusetts, Missouri, Oregon, Pennsylvania, Tennessee, and Washington, have taken steps toward bringing trauma-informed (also known as trauma-sensitive) practices into the classroom or are in the process of reviewing related legislation (Hopper, 2018; Missouri Department of Elementary and Secondary Education, n.d.; Oregon School-Based Health Alliance, 2019; Prewitt, 2014; Trauma Sensitive Schools, n.d.).

According to the Center for Parent Information and Resources, "In a trauma-informed school, the adults in the school community are prepared to recognize and respond to those who have been impacted by traumatic stress. In addition, students are provided with clear expectations and communication strategies to guide them through stressful situations." (Center for Parent Information and Resources, 2018) This usually means that disciplinary interventions start with asking what is bothering the student prior to doling out a punitive recourse for poor behavior, as well as eliminating school suspension policies that further isolate and alienate youth. Because interventions that develop a student's EF help to improve resiliency and well-being, they reinforce a trauma-informed approach.

While this ideal environment for a developing child may not be possible in all schools or communities, it is encouraging to see awareness growing and new programs utilizing this model. Taking the first step toward implementing EF interventions now can positively impact many of the cognitive and affective challenges that students face.

Holistic Educational Frameworks

National initiatives such as Together for Healthy and Successful Schools—a collaboration between America's Promise Alliance, Child Trends, and Healthy Equity Works—are using scientific findings to promote holistic, evidence-based school reform frameworks. The Centers for Disease Control and Prevention (CDC) and the Association for Supervision and Curriculum Development (ASCD) have designed the Whole School, Whole Community, Whole Child (WSCC) model to "strengthen a unified and collaborative approach designed to improve learning and health in our nation's schools" (See Figure 6). These efforts reflect the understanding that students need to be seen and attended to relative to the larger contexts in which they live and learn.

With an awareness of the role of epigenetics and of the challenges many students currently face, more schools may be encouraged to adopt trauma-informed practices and the aspirations illustrated in the WWCC model.

FIGURE 6: CDC'S WHOLE SCHOOL, WHOLE COMMUNITY, WHOLE CHILD MODEL

The child in the center is at the focal point of the model; the child is encircled by the "whole child" tenets in green: being "healthy, safe, engaged, supported, and challenged."

The white band emphasizes the alignment, integration, and collaboration needed among the school, health, and community sectors to improve each child's learning and health.

Represented in the blue, the multiple school components surround the child, acting as the hub that provides the full range of learning and health support systems to each child, in each school, in each community.

The community, represented in yellow, demonstrates that while the school may be a hub, it remains a focal reflection of its community and requires community input, resources, and collaboration in order to support its students.

Source: CDC, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention Division of Adolescent and School Health, https://www.cdc.gov/healthyyouth/wscc/pdf/wscc_fact_sheet_508c.pdf

Recommendations

New approaches sourced from a more integrated and scientific framework are needed. Fortunately, schools no longer need to wait for solutions to be developed and tested since neuroscience-based programs are proven and readily available. Science and technology have made the adoption of these interventions accessible and scalable today.

Every School Should Adopt an Executive Function Program

The U.S. cannot afford complacency. The power to take action and support the health, well-being, and intellectual development of our youth is within the reach of every school in the nation. School leaders have the capacity to come together to radically improve the learning outcomes and social-emotional landscapes of their students, and of our country's next generation. Whether an educator or administrator is looking to impact classroom cognitive development, student mental health, or school climate, the answer starts with the evidence-based step toward improving all of these areas: EF skills development.

Pathways for adoption of EF programs are clear and proven by the pioneering school leaders who stepped forward early to help define the steps for success. The most important step is the first step—to start. Whether adoption begins within a classroom, a school, or district-wide, the process is one that improves with practice. Educator leaders do not need to be EF experts to launch a program, as there are significant resources to help maximize effective implementation. Early adopters have demonstrated that sustainable change is possible, and that the resources that help all schools advance best practices, collaborations, and outcomes are well within reach.

The U.S. cannot afford complacency. The power to take action and support the health, well-being, and intellectual development of our youth is within the reach of every school in the nation.

District leaders, principals, and teachers who have successfully implemented one of the programs profiled in this report recommend:

1. A context-specific approach that considers a school's setting, demographics, and culture, and looks for programs that have previously succeeded in similar environments

2. Preliminary planning to consider items such as timelines, potential calendar adjustments, a stakeholder working group, and favorable timing that support faculty teaching considerations

3. Development of on-site local experts and community-builders who can lead the implementation and become trusted advocates and advisors for their colleagues, students, and students' families

4. Pre-, mid-, and post-assessment metrics that demonstrate to all constituents the gains achieved comparable to intended targets, while providing teachers with invaluable data about students' current cognitive strengths and deficits

5. Funding options that are aligned with the capacity of the school and that consider any necessary equipment and training costs. For those schools with limited funds, ESSA monies are now more readily available for evidence-based interventions. Additionally, partnering with researchers to test an intervention can also significantly reduce adoption and implementation costs.

(For additional insights from district leaders and school administrators, see Appendix 1).

Executive Function Training Should Be Required in Teacher Certfication Programs

In addition to providing information that helps current teachers and administrators see the value and imperative of adopting EF skill-building programs, we believe it is equally important to start this effort earlier in an educator's training. Schools of Education spend considerable time ensuring that future teachers are knowledgeable not only in the content of their subject(s), but also in classroom management, learning expectations, lesson planning, safe and reflective learning environments, assessment, adjustments to practice, and consideration of diverse student needs.

With science validating EF skills as foundational to all other learning, EF training should be part of teacher certification curricula. Learning how to become an effective teacher should include the understanding that a student's challenges with taking in and assimilating new content are not likely a matter of inherent capacities, but of present and past circumstances, and that focusing on EF development (rather than more subject content) can be a critical first step toward improving academic outcomes.

The Time is Now

In every cultural movement there is a tipping point—
a moment when sufficient and convincing evidence
influences the population to make a change in a social norm.
We believe education in the United States has reached this
critical point.

Advancing access to, and uptake of, effective executive
function programs identified in this brief require a
commitment from education leaders and policy makers.
We urge them to adopt these evidence-based solutions.

Our nation's students are waiting.

School-Based Executive Function Program Guide

Note: This issue brief is intended to advance the adoption of evidence-based EF interventions in schools for the betterment of students. BrainFutures has no financial relationship with any program provider mentioned. Programs that are connected to a member of the BrainFutures Advisory Board or Operating Board are noted as such.

We have made reasonable efforts to identify and assess school-based programs that met the above criteria at the time the reviews took place. We acknowledge that with the speed at which the brain fitness industry is developing, there may be programs on the market today that meet our rubric criteria but were not included herein. We recommend that readers use the above metrics of success to assess programs of interest that are not noted in this guide. Program providers can contact us at info@brainfutures.org to submit an intervention for consideration. We will review all submissions for eligibility to be added to our online program profiles and for inclusion in future publications.

Program Profiles

Educators want to help their students succeed. Yet, most teachers and administrators have to address the pressing and immediate needs of large class sizes and curricular requirements with limited resources and time. This leaves little opportunity for researching and identifying best-in-class, evidence-based interventions that are accessible, affordable, and effective.

We view the implementation of scientifically and technologically sound brain fitness interventions as the missing link in today's education system and a critical component for successfully addressing the many challenges students face. To support educators in identifying the right program(s) for their schools and classrooms, we reviewed more than 40 EF programs. Of these, 10 met the rigorous criteria established by our advisory group and are summarized in the *Program Profiles Summary* chart that follows. For each of these 10 programs, summary narratives

follow and include: important program features, an overview of the key scientific studies conducted on the program, as well as how to find more information. Each program was invited to provide graphics and/or data on their outcomes.

In addition to the 10 programs that passed all criteria, 19 programs had promising results and are profiled in Appendix 3. For example, if a program has mass adoption with demonstrated effects in the classroom, but not an RCT or a quasi-experimental study, it did not meet our rubric criteria; however, it is still worthy of consideration. A summary of these programs is in Appendix 3, "Promising Programs."

(If reviewing any of these programs relative to ESSA's tiers of evidence guidelines, see Appendix 4 or Appendix 5. By checking the sample size, settings, and student demographic associated with a study, the reader can make a case for an evidence tier.)

Program Profiles Summary

	Activate	Cogmed Working Memory Training	Fast ForWord	Inner Explorer	Master Mind
GRADE LEVELS	K-8	1-12	Pre-K-12	Pre-K-12	4-5
DURATION AND FREQUENCY	10 hours plus 5 hours of exercise breaks across 10 weeks: 20 min. per day, 3 days per week plus 5-min. exercise breaks twice a day	21 hours across 5 to 13 weeks: five 50-min. sessions per week for 5 weeks can be spread out across up to 13 weeks	150 min. per week until desired levels are complete	50 min. per week recommended: 10 min. daily	6 hours and 15 min. total: 15 min. daily for 5 weeks
TECH REQUIREMENTS	One computer or laptop for each educator. Internet access, projector, and speakers	Each student using the program at the same time needs a computer or tablet/iPad, headphones, internet access	Each student using the program at the same time needs a computer or tablet/iPad, headphones, internet access	Educator needs a computer or mobile-enabled device with speakers. If no internet access, can download sessions in advance for offline use	One computer for each educator with internet access
TEACHER ADMINISTERED?	Yes	Yes	Yes	Yes	Yes
STUDENT ADMINISTERED?	No	No	Yes, once student is familiar with the program	Yes, once student is familiar with the program	No
CLINICIAN-SUPERVISED	No, but can be used in clinical settings	No	No	No	No
EDUCATOR QUALIFICATIONS	Any adult can administer	Any adult can administer	Any adult can administer	Any adult can administer	Classroom teacher
AMOUNT OF INITIAL TRAINING TIME	3-hour training on-site and 1-hour online follow-up	Online, self-directed 3-4-hour training must achieve 70% passing score on tests throughout the training to be certified as a Cogmed coach	6-hour in-person plus 12 hours online	No required training; teachers can choose to watch an orientation video	Web-based, on-demand, 8-hour training course followed by an online certification test. Can also participate in optional Q & A webinar

Mindfulness in Schools Project	MindUP	PATH to Reading	SMART	Tools of the Mind
2-8	Pre-K-8	K-12	6-12	Pre-K and K
Grades 2-6: six hours total: Can be taught as six 1-hour lessons or twelve 30-min. lessons. Grades 6-8: eight-nine hours total: nine lessons for 40-60 min. each	One 45 min. lesson per week plus Brain Breaks 3 times a day (25 min. each)	5 hours 20 minutes total: 64 5-min. sessions, either 1 session daily (5 min) or 2 sessions every other day at start of the school day	8.5 hours total: ten sessions implemented in two or three 45-50 min. sessions per week for four weeks	Curriculum is used every day throughout the day
For each classroom: computer with PowerPoint for Mac or Windows. Projector and speakers	None. Paper-based curriculum with a chime for start and end of Brain Breaks	Computer running Windows for each student using the program at the same time	None	Tech is not required. If using app with students, iPad required (ideally 4 iPads per classroom)
Yes	Initially	Initially	Yes	Yes
No	Teacher-facilitated. Students can seek out Brain Breaks	Yes, once student is familiar with the program	No	No
No	No	No	No	No
Any adult who has met the training requirements	All lead classroom teachers must be trained. Other school staff can be, too	Any adult can administer	Classroom teacher	All adults who interact with students are trained
8-week, 90-min. per week in-person secular mindfulness course, followed by in-person 3-day training taken 2-3 months following completion of the mindfulness course.	4-6 hour onsite Prof. Dev. training. 3-4 months later, classroom visits with 12-hour family work-shop held concurrently to teach how to use mindfulness at home.	8-min. training video for adults; 4-min. training video for students	30-hour initial in-person training plus 9-hour onsite training provided during implementation. Principals may attend a 1-day SMART leadership workshop	2 years of training with a combination of onsite and virtual sessions: four to five 1-day workshops plus online modules

ACTIVATE™

The ACTIVATE™ Program was developed by Professor Bruce Wexler, MD in research at Yale University and is distributed by C8 Sciences. It integrates computer-presented cognitive training exercises and specially designed physical exercises (that have built-in cognitive demands) to improve executive function—together developing attention, working memory, self-regulation, cognitive flexibility, pattern recognition, use of categories, and processing speed. Published peer-reviewed scientific papers show that ACTIVATE™ improves executive function and increases percentages of children meeting proficiency in math and reading. While useful with all types of students, high-need schools and students show the largest increases in math and reading proficiency. ACTIVATE™ is applicable to K-8 students, including typically developing as well as students with ADHD or learning disabilities because the six software-based training exercises disguised to look like computer games automatically monitor performance and adjust to provide individualized "lesson plans" for each student.

ACTIVATE™ physical exercises are specially designed to require EF skills. They train the same neurocognitive systems as do the computer exercises, but in the context of whole-body movement and social interaction. The physical exercises have the general value of getting up and moving around, and generating and releasing energy, but at the same time also improve EF skills. They are designed to be done in the classroom for 3-5 minutes at different times during the school day or at home with a parent.

Pre-, mid-, and post-assessments provide reports on each student's areas of relative cognitive strength and weakness to support individual design learning

AT A GLANCE
GRADES:
K–8
TYPE:
Cognitive Training
METHOD:
Autonomous-use, Teacher-assisted
STUDIES:
RCT, Review
PROGRAM FREQUENCY:
20 minutes of cognitive training/day, two days/week for 10 weeks for a minimum of 10 hours, plus 5 minutes exercise breaks two times/day
PLATFORM/TECHNOLOGY:
Online and teacher-directed physical exercise
TECHNOLOGY REQUIRED:
One computer or laptop for each educator with internet access, projector for computer-based slides and audio speakers
TRAINING REQUIRED:
Yes, 3-hour on-site teacher training and 1-hour online follow-up

and offer real-time cognitive improvement measures. Assessments compare scores to national, grade-specific cohorts of thousands of students. Assessments include the Flanker test of attention and the List-Sort Working Memory tests based on the NIH Toolbox, and self-control and risk-taking tests widely used in cognitive research and clinical evaluations. Additionally, self-report surveys inform educators about students' personal feelings about school, cognitive training, and their own abilities to learn.

The online portal allows teachers and administrators continuous monitoring of implementation fidelity and training progress, access to cognitive assessments, links to coaching tips, resources relevant to identified weaknesses in executive function, and FAQs. Teachers can only see their students' data, and principals can see summative data for the school as well as data for each class and student. District leadership sees summative reports of district use and results, as well as school, class, and individual student data.

C8 Sciences introduced its first product in 2010 and soon after received the National Institutes of Health Transformative Research Award for high innovation, high impact, paradigm-changing medical research. In the past five years alone, ACTIVATE™ has been implemented in more than 1,200 schools across the nation.

FIND OUT MORE

OVERVIEW
https://www.c8sciences.com/

RESEARCH
https://www.c8sciences.com/science/

KEY STUDIES SUMMARY

A randomized control trial of 583 2nd graders (211 in control group) who participated in the program's Cognitive Software three to four times a week, and in the physical exercise one to two times a week, showed improvements in both math and reading on standardized tests that outpaced 1:1 tutoring. Typical teacher-student ratios for implementation were 1:20. (Wexler, B., Iseli, M., Leon, S., Zaggle, W., Rush, C., & Goodman, A. et al. (2016). Cognitive priming and cognitive training: Immediate and far transfer to academic skills in children. *Scientific Reports, 6*(1). doi: 10.1038/srep32859.) https://www.nature.com/articles/srep32859)

Another report with varying sample sizes of at least 366 students across grades K-8 who participated in EF training in 20- to 30-minute sessions, 1-to-4 times per week for 2 to 6 months showed significant improvement in working memory, a measure of EF, compared to baseline. (Kavanaugh, B., Tuncer, O., & Wexler, B. (2018). Measuring and improving executive functioning in the classroom. *Journal of Cognitive Enhancement.* doi: 10.1007/s41465-018-0095-y.) https://www.researchgate.net/publication/327951039_Measuring_and_Improving_Executive_Functioning_in_the_Classroom

OTHER RESEARCH AVAILABLE

Wexler, B. E. (2013). Integrated brain and body exercises for ADHD and related problems with attention and executive function. *International Journal of Gaming and Computer-Mediated Simulations, 5(3)*, 10-26. doi:10.4018/jgcms.2013070102 (6 Case Studies within this paper) https://www.igi-global.com/article/integrated-brain-and-body-exercises-for-adhd-and-related-problems-with-attention-and-executive-function/93026

Case Studies: https://www.c8sciences.com/category/case-studies/

Imal, A. & Wexler, B. (2018) Increasing readiness to learn: Benefits of executive function training in kindergarten carry over to first grade. *Creative Education*, 9, 2662-2676. doi: 10.4236/ce.2018.916201. https://www.scirp.org/Journal/PaperInformation.aspx?PaperID=89014

Dr. Bruce Wexler, Founding Scientist and Chief Scientific Officer for C8 Sciences and ACTIVATE™, is a BrainFutures Advisory Board member.

Cogmed Working Memory Training®

Cogmed Working Memory Training® provides computer-based training for all school-aged children (grades 1-12), as well as separate programs for preschoolers and adults. Cogmed is offered by Pearson, an 80-year-old clinical assessment organization that provides programs and assessments for psychologists, speech language pathologists, occupational therapists, schools, and clinical settings. The software was developed in 2001 by Dr. Torkel Klingberg, a neuroscientist at the Karolinska Institute in Sweden. In 2006, Dr. Klingberg won the Philip's Nordic Prize for his research on working memory training for children with ADHD, and the 2009 MD Axel Hirsch prize in the field of neurobiology for advancements to the field of cognitive function development.

Key components of Cogmed include computer-based cognitive exercises designed by neuroscientists to challenge and improve a student's working memory capacity. Training is progressive—based on user performance, the program's difficulty level is adjusted in real time to continuously challenge the user at the right level to generate improvement. This adjustment feature makes the training applicable across varied user ages and levels. The computer-based training consists of 25 training sessions done online, each approximately 30-45 minutes. All sessions include tasks that target aspects of working memory. The standard 25-session program includes 5 sessions per week for 5 weeks (variable training products are available). The Cogmed Progress Indicator (CPI) uses 3 working memory tasks—following directions, mathematics, and visual/spatial

AT A GLANCE

GRADES:
1-12

TYPE:
Subject-Specific Comprehension with Cognitive Training

METHOD:
Autonomous-use, Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
150 minutes/week (recommended) in various slots (ex. 30 minutes, 5 days a week or 50 minutes, 3 days a week) until a product has been completed or desired achievement level reached

PLATFORM/TECHNOLOGY:
Online (via computer or tablet)

TRAINING REQUIRED:
Yes, 6-hours in-person training recommended with additional options of on-site consultation days or 1–2 hours of online training/consultation.

working memory—to assess pre-training working memory levels. The CPI assessments are repeated throughout the training to measure progress and lead to an index of improvement.

The program includes an administrative dashboard where teachers and principals can view participation, progress towards goals, fidelity of implementation, and measurable improvements. Additionally, the online Cogmed Coaching Centre offers teachers resources like report templates, rating scales, manuals, and online video training.

Cogmed also offers coach-assisted training. Coaches assist with program setup, user profile, and training levels. They also provide motivation, support, and feedback to ensure that as many users as possible accurately complete the training. Coaching takes a school through the stages of start-up, weekly support, wrap-up, and six-month follow-up.

According to Cogmed, when working memory capacity is improved, behavior also improves, because a deficit in working memory can manifest as general attention issues. In other words, training a tightly defined cognitive function creates a cascading effect of improvements, including the increased abilities to pay attention, resist distractions, self-manage, and learn. Studies have shown that students completing the training improved math and reading test scores. The program has been adopted in schools worldwide and is available in 9 languages. Cogmed is available for clinical or school use.

FIND OUT MORE

OVERVIEW
https://www.Cogmed.com/

WEBINAR/VIDEO/DEMO
https://www.Cogmed.com/calendar

CONTACT
https://www.Cogmed.com/consumer-contact

KEY STUDIES SUMMARY

Three studies of students, male and female, between the ages of 8 and 10, found that using the prescribed program improved performance and testing scores in math and reading. These studies were conducted in the UK and Sweden. Following are the references:

Holmes, J., Gathercole, S.E., & Dunning, D.L. (2009). Adaptive training leads to sustained enhancement of poor working memory in children. *Developmental Science*, 12(4), F9-F15. doi: 10.1111/j.1467-7687.2009.00848x https://www.cogmed.com/adaptive-training-leads-to-sustained-enhancement-of-poor-working-memory-in-children

Holmes, J. & Gathercole, S.E. (2013). Taking working memory training from the laboratory into schools. *Educational Psychology: An International Journal of Experimental Educational Psychology*, 34(4), 440-450. doi:10.1080/01443410.2013.797338 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4579053/

Söderqvist, S. & Bergman Nutley, S. (2015) Working memory training is associated with long term attainments in math and reading. *Frontiers in Psychology*, 6, 1711. doi: 10.3389/fpsyg.2015.01711

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4639603/

OTHER RESEARCH AVAILABLE

Cogmed summarizes the research literature and independent studies involving Cogmed Working Memory Training to produce a Claims & Evidence document. The current version of this document includes summaries of over 80 studies showing efficacy of the Cogmed method. This review leads to a list of specific claims that Cogmed references based on set of criteria outlined in the document:

https://www.Cogmed.com/wp-content/uploads/CogmedClaimsEvidence.pdf

Fast ForWord®

Fast ForWord® is offered by Scientific Learning, a company dedicated to developing products that improve cognitive, language, and reading skills. More than 3 million learners have used the company's software products. Scientific Learning was co-founded in 1996 by four renowned scientists: Drs. Michael Merzenich (professor emeritus, University of California, San Francisco), Paula Tallal (Salk Institute and University of California, San Diego), William Jenkins (formerly of Keck Center for Integrative Neurosciences at the University of California, San Francisco Medical Center), and Steven Miller (formerly of the Center for Molecular and Behavioral Neuroscience at Rutgers University). Their work spans the fields of education and neuroscience; brain plasticity; auditory, developmental language, and reading impairments; psychology; behavioral algorithms; and multimedia technology.

Fast ForWord® itself is an oral language and reading intervention program that addresses memory, attention, processing speed, and sequencing skills by using a 3-part model that includes foundational language and cognitive skill building, deliberate practice, and real-time corrective feedback. Fast ForWord® can be used as a Pre-K–12 intervention at-home or in a clinically supported environment. It is appropriate for students with reading deficits, dyslexia, auditory processing disorders, special education needs, as well as for English language learners and those on the autism spectrum.

The program uses specialized gamification strategies to encourage active participation in the computer-training exercises, such as points earned and animations. As with other programs, it recalibrates,

AT A GLANCE

GRADES:
Pre-K–12

TYPE:
Subject-Specific Comprehension with Cognitive Training

METHOD:
Autonomous-use, Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
150 minutes/week (recommended) in various slots (ex. 30 minutes, 5 days a week or 50 minutes, 3 days a week) until a product has been completed or desired achievement level reached

PLATFORM/TECHNOLOGY:
Online (via computer or tablet)

TRAINING REQUIRED:
Yes, 6-hours in-person training recommended with additional options of onsite consultation days or 1–2 hours of online training/consultation.

automatically adapting to individual skill levels and responses, adjusting the learner's training content. The online program also includes embedded coaching and instructions to help students progress more quickly and effectively without teacher intervention, and offers daily progress reports for teachers and educators.

Reports are delivered through MySciLEARN, an online data analysis and reporting tool that tracks individual learner, classroom, school, and district level performance. Progress reports, including diagnostic and prescriptive information, offer specific

intervention guidance as well as recommendations to maximize the impact of the intervention. MySciLEARN also offers future forecasting with insights into the potential effects Fast ForWord® can have on a school district's performance in future timeframes beginning at one year.

Because of the automatic recalibration to level, a reporting feature that allows teachers to monitor progress, and the ability for trained coaches to work in conjunction with instructional staff, the program can be used inside or outside of school hours—during classroom time, computer labs or resource periods, before/after school programs, and during summer school. For school-based settings, the initial training will get teachers started, while the company recommends further on-site consulting with a Fast ForWord® Professional Customer Success Manager who can work with teachers and students on classroom implementation. Remote consulting sessions are also available.

Fast ForWord® products, now adopted in more than 40 countries, use breakthroughs in brain plasticity as well as patented, computer enabled, digitally-enhanced sound (to slow sound down and amplify transitions from sound to sound), helping students discriminate sounds of speech. This trains the student's brain to develop increased processing speed and reading skills. Speech verification technology offers corrective feedback and guided reading support to students as they read aloud. Research-proven techniques are built into each Fast ForWord® exercise and include: frequency and intensity of trials; adaptivity of the levels to students' performance; simultaneous development of multiple skills; and timely motivation to develop the basic cognitive skills of memory, attention, processing, and sequencing. The Fast ForWord® products develop these cognitive abilities in the context of oral language and reading skills that students need to succeed academically, such as phonemic awareness, phonics, vocabulary, fluency, comprehension, syntax, grammar, and morphology.

Research studies of students using Fast ForWord® showed gains in executive function, language, and reading skills. Two recently updated products, Fast ForWord® Foundations I and II, include improved exercise introductions, built-in coaching and explicit instructions, and increased adaptivity.

Fast ForWord® won the 2014-15 eSchool News "Readers' Choice Awards" for top K-12 EdTech products. In 2014, 2015, and 2016, it was named a "Readers' Choice Top 100 Product" by *District Administration* magazine for K-12 products that help school districts nationwide excel in areas such as technology, instruction, and assessment. The program also won the 2016 Gold Readers' Choice Award from *THE Journal*, for "Best Intervention & Remediation Software." In 2018, the program was recognized with the Best Homeschooling Resources & Curriculum Award from HowToHomeschool.net.

FIND OUT MORE

OVERVIEW:
https://www.scilearn.com/products/fast-forword

WEBINAR/VIDEO/DEMO:
https://www.youtube.com/watch?v=WulFNyBnAAQ

CONTACT:
info@scilearn.com

KEY STUDIES SUMMARY

Two hundred eight students in a quasi-experimental study. The experimental group participated in training 90 minutes a day, 5 days a week, for 4-8 weeks, averaging 24 days on the product. Test subjects showed significant improvements on Executive Function assessments. (Scientific Learning Corporation (2004). Improved Language and Early Reading Skills by Students who used Fast ForWord Middle & High School. *Product Reports*, 8(2): 1-4.) http://www.scilearn.com/sites/default/files/imported/alldocs/rsrch/sbr/30054ffwmhprodrpt.pdf

OTHER RESEARCH AVAILABLE

Gaab, N., Gabrieli, J.D.E., Deutsch, G.K., Tallal, P., & Temple, E. (2007). Neural correlates of rapid auditory processing are disrupted in children with developmental dyslexia and ameliorated with training: an fMRI study. *Restorative Neurology and Neuroscience*, 25, 295-310. https://www.ncbi.nlm.nih.gov/pubmed/17943007

Rogowsky, B., Papamichalis, P., Villa, L., Heim, S., & Tallal, P. (2013). Neuroplasticity-Based Cognitive and Linguistic Skills Training Improves Reading and Writing Skills in College Students. *Frontiers In Psychology*, 4. doi: 10.3389/fpsyg.2013.00137 https://www.frontiersin.org/articles/10.3389/fpsyg.2013.00137/full

Stevens, C., Fanning, J., Coch, D., Sanders, L., & Neville, H. (2008). Neural mechanisms of selective auditory attention are enhanced by computerized training: Electrophysiological evidence from language-impaired and typically developing children. *Brain Research*, 1205, 55-69. doi: 10.1016/j.brainres.2007.10.108 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2426951/

Scientific Learning Corporation. (2005). Improved cognitive and language skills by students in the Niagara Falls City School District who used Fast ForWord products. *MAPS for Learning: Educator Reports*, 9(33): 1-7. http://www.scilearn.com/sites/default/files/imported/alldocs/rsrch/sbr/30182niagaraedurpt2.pdf

Inner Explorer™

I nner Explorer ™ program offers simple to implement, audio-guided mindfulness programming that helps PK-12 students, their teachers, and families experience less stress, greater focus, and improved self regulation. As a result, behavior issues are reduced and academic performance is increased. Inner Explorer ™ was co-founded and received 501c3 non-profit status in 2012 by long-time education and mindfulness researchers and practitioners Laura S. Bakosh, Ph.D. and Janice L. Houlihan, M.Ed. The program uses daily 5- to 10-minute audio-guided sessions to help students develop self-awareness, better manage negative emotions, and ready themselves for learning. Themes covered in the program follow MBSR and SEL formats and include breathing and relaxation practice, awareness of self, of senses and thoughts, regulating emotions and behavior, focusing attention, and cultivating compassion and connection.

Inner Explorer ™ is an easy and accessible way for teachers to bring mindfulness into the classroom and offer daily mindfulness practice. The program is designed to promote compassion, gratitude and self-regulation, and improve focus. It can be used in the context of any school subject or setting, such as classroom, after school, or youth detention center, and has specific trainings and tools to involve parents and families. The Tune-In feature allows parents and caregivers to access all the audio practices for home use and offers the opportunity for family members to receive an email when the class is pausing in the day to use the audio mindfulness practice. This allows families to practice too, listening to the same audio file. The program is intended to build a community of mindfulness practitioners among students,

AT A GLANCE

GRADES:
Pre-K–12

TYPE:
Mindfulness; SEL

METHOD:
Teacher-assisted, Autonomous-use

STUDIES:
RCT, Review, Meta-analysis

PROGRAM FREQUENCY:
5-10 minutes/day, 5 days a week throughout school year (recommended)

PLATFORM/TECHNOLOGY:
Integrated platform provides program access of audio files (via mobile app or computer with speakers), automatically linked to families at home

TRAINING REQUIRED:
5-minute orientation video and automated onboarding sequence

Program strongly recommends allocating 10-minutes/day in school schedule.

families, teachers, and administrators, positively impacting school and home culture and climate.

The format is a selection of 90 pre-recorded, on-demand guided audio mindfulness practices by age group, with narrators from diverse ethnic backgrounds. Teachers do not need to plan or prep, rather log-in and play the next sequenced practice. The program has been shown to address challenges many school districts face, including low academic performance and graduation rates, discipline

problems, negative school climate, and bullying. Because teachers participate with students, it also reduces their stress and improves well-being and efficacy.

An administrative dashboard gives teachers and administrators the ability to see usage analytics by classroom to assess impact compared to key academic measures. No formal training is required; teachers can learn how to use Inner Explorer™ through a brief orientation video. The audio collection is available with a 1-year or longer license.

The program is currently reaching 820,000 students in 3,200 schools. The Pre-K, Elementary, and Middle School programs are also available in Spanish (with High School in development). Inner Explorer™ is included in the CASEL Guide to Effective Social a nd Emotional Learning Programs as a designated "SEL-Related Approach."

FIND OUT MORE

OVERVIEW:
https://innerexplorer.org/

WEBINAR/VIDEO/DEMO:
Audio samples in English and Spanish
https://innerexplorer.org/compass/ourProgram

CONTACT:
https://innerexplorer.org/compass/contactUs

FOR PROFESSIONAL DEVELOPMENT:
info@innerexplorer.org

KEY STUDIES SUMMARY

An 8-week study of 191 3rd graders used a pre-recorded, 10-minute-per-day, audio-guided program. Teachers were instructed to play one audio track, in sequence 1–35, each school day. They were guided to select a normal transition time to run the program,

for instance, after recess or lunch. During the last 2 minutes of each 10-minute recording, students were instructed, while still quiet, to take out their journals and write or draw about their experience with the practice that day in order to integrate any insights. Results found significant improvement in reading and science academic performance, as well as a 50% reduction in disruptive behavior. (Bakosh, L., Snow, R., Tobias, J., Houlihan, J., & Barbosa-Leiker, C. (2015). Maximizing Mindful Learning: An Innovative Mindful Awareness Intervention Improves Elementary School Students' Quarterly Grades. *Mindfulness*, doi: 10.1007/s12671-015-0387-6) http://meditationfreedom.com/wp-content/uploads/2015/10/Bakosh-Houlihan-2015-Maximizing-Mindful-Learning.pdf

OTHER RESEARCH AVAILABLE

Bakosh, L. S., Tobias Mortlock, J. M., Querstret, D., & Morison, L. (2018). Audio-guided mindfulness training in schools and its effect on academic attainment: Contributing to theory and practice. *Learning and Instruction, 58*, 34-41. http://dx.doi.org/10.1016/j.learninstruc.2018.04.012

Maynard, B., Solis, M., Miller, V., & Brenden, K. (2017). Mindfulness-Based Interventions for Improving Cognition, Academic Achievement, Behavior, and Socioemotional Functioning of Primary and Secondary School Students. Campbell Collaboration. doi: 10.4073/csr.2017.5.

Semple, R., Droutman, V., & Reid, B. (2016). Mindfulness goes to school: Things learned (so far) from research and real-world experiences. *Psychology in the Schools, 54*(1), 29-52. doi: 10.1002/pits.21981 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5405439/

Master Mind

Master Mind is a mindfulness education prevention program designed to enhance the coping strategies and decision-making skills of elementary school students to prevent substance abuse. It is a product of innovation Research & Training (iRT), founded in 1999 by Dr. Janis Kupersmidt, who is a clinical child psychologist. Dr. Kupersmidt, President and Senior Research Scientist at iRT, sought to bridge research, intervention, and prevention to address real-world challenges, and developed Master Mind with Dr. Alison Parker (PI) with the support of grants from the National Institute of Drug Abuse (NIDA) and the National Institute of Alcohol Abuse and Alcoholism (NIAAA).

The program is practiced 15 minutes daily for 5 weeks. It is implemented by a trained instructor who can be the classroom teacher, guidance counselor, social worker, prevention specialist, or a similar trusted educational professional. At the end of the program, students discuss plans to continue their mindfulness practice on their own and as a class, as the program is intended to develop a sustainable mindfulness practice among individual students and the school community. Research has shown that students using the program showed improved EF scores and fewer teacher-reported social problems and less aggressive behavior as compared to the control group. Master Mind aligns with the Common Core and Healthy Living Essential Standards.

Program lessons are led by the trained instructor and Master Mind provides educators with a curriculum and teaching resources to support classroom or school adoption. Teachers are given access to the Master Mind Program website which includes the instructor's kit: downloadable PDFs

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AT A GLANCE

GRADES:
4th and 5th

TYPE:
Mindfulness; SEL

METHOD:
Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
15-minute daily lessons for 5 weeks

PLATFORM/TECHNOLOGY:
Online Teacher's Manual, online multimedia classroom presentations, and online downloadable Student Workbook

TRAINING REQUIRED:
Yes, 8-hour online teacher training

of the Teacher's Manual and Student Workbooks, multimedia classroom presentations, and additional instruction resources. Teachers complete a web-based, on-demand, 8-hour training course followed by an online certification test, and have the option of participating in a free webinar with the program developer for additional training and to ask any follow-up questions.

While the program was designed to be taught in a classroom setting and the findings from the evaluation study noted below are based on this delivery method, the content and materials are flexible and can be taught in other settings and across multiple school subject areas.

An evaluation study investigating the efficacy of the Master Mind program for improving health outcomes of late elementary school-aged students has just been completed.

FIND OUT MORE

OVERVIEW:
http://mastermindprogramsonline.com/

WEBINAR/VIDEO/DEMO:
N/A

CONTACT:
aparker@irtinc.us

KEY STUDIES SUMMARY

A total of 111 students (71 – intervention, 40 – control) participated in the study. Students in the intervention group exhibited higher EF scores over control, as well as fewer teacher-rated social problems and less aggressive behavior. (Parker, A., Kupersmidt, J., Mathis, E., Scull, T., & Sims, C. (2014). The impact of mindfulness education on elementary school students: evaluation of the Master Mind program. *Advances in School Mental Health Promotion, 7*(3), 184-204. doi: 10.1080/1754730x.2014.916497) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4821437/

OTHER RESEARCH AVAILABLE

Parker, A. & Kupersmidt, J. (2016). Two universal mindfulness education programs for elementary and middle school students: Master Mind and Moment. In K. Schonert-Reichl & R. Roeser (Eds). *The Handbook of Mindfulness in Education: Emerging Theory, Research, and Programs (1)*, 335-354. New York: Springer Press. Available at https://link.springer.com/chapter/10.1007/978-1-4939-3506-2_21

Semple, R., Droutman, V., & Reid, B. (2016). Mindfulness goes to school: Things learned (so far) from research and real-world experiences. *Psychology in the Schools, 54*(1), 29-52. doi: 10.1002/pits.21981 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5405439/

Mindfulness in Schools Project

Founded in the UK in 2009 by schoolteachers and mindfulness practitioners Richard Burnett and Chris Cullen as a solution to the lack of classroom-based curricula to teach mindfulness, Mindfulness in Schools Project (MiSP) is a nonprofit committed to a) training educators how to implement mindfulness in schools, and b) providing teachers with effective classroom-based mindfulness curriculum and resources. MiSP offers curricula for teachers, parents, and educators based on research in clinical psychology and neuroscience.

More than 450,000 primary and secondary students have used the MiSP programs, which are intended to help students manage anxieties and stressors associated with classroom learning, develop a greater emotional intelligence, promote prosocial habits while reducing conflictual and oppositional behaviors, and increase attention and self-regulation toward improved concentration. Studies have shown that students involved in an MiSP curriculum demonstrated increase in well-being, reduced stress, and lower rates of depression. Teachers reported improved EF skills in their students.

There are two school-based curriculums. Their acronymic program names point to key elements of mindfulness practice: ".b" means "stop and be" while "paws b" means "pause, breathe and be," MiSP offers Paws b for 7- to 11-year-olds, and .b for 11- to 18-year-olds. The curriculums are taught to students by trained teachers in their schools. Paws b covers 12 themes and is delivered in six 1-hour lessons or twelve 30-minute lessons. Topics include the brain,

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AT A GLANCE

GRADES:
2-8

TYPE:
Mindfulness; Brain Literacy

METHOD:
Teacher-administered

STUDIES:
RCT

PROGRAM FREQUENCY:
Teach Paws b: six 1-hour lessons or twelve 30-minute lessons; Teach .b: nine 40-60 minute lessons

PLATFORM/TECHNOLOGY:
Workbook, projector for computer-based slides and audio speakers

TRAINING REQUIRED:
Yes, prerequisite eight-week, 90-minute per week in-person secular mindfulness course plus an in-person 3-to 4-day course held 23 months after completion of mindfulness course

INFO:
www.mindfulnessinschools.org

choices, attention, presence, mood awareness, steading attention, reactivity, deliberate responses, recognition of thought patterns, observation of thoughts, happiness, and appreciation. The .b curriculum is offered through 9 lessons that can vary in length for 40-60 minutes. Topics include mindfulness fundamentals, attention exploration, mind "taming" and kindness/curiosity cultivation, stress management, responsiveness vs. reactivity, mindful movement, perspective-gaining on thoughts, emotion management, gratitude development, and strategies for future practice. Teachers are encouraged to find natural connections between the MiSP curricular themes and school subject content.

A core tenet of the program requires educators to develop their own mindfulness practice by taking the MiSP ".begin" live online, 8-week introduction to mindfulness course or another recognized 8-week course (such as MBSR, MBCT, Breathworks, etc.), and maintaining a 2-3 month mindfulness practice prior to being eligible for the 3- or 4-day training that certifies the participant to teach MiSP curriculum in the classroom. An advanced training is also available for educators to become a School Mindfulness Lead. A worldwide network of trained MiSP teachers can join and access resources at "The Hub," a portal with teacher resources, materials, teacher maps, logos, e-groups for mindfulness practice, online support, and an impact assessment tool.

The MiSP curriculum is flexible and can be used across school subjects or in a variety of educational or youth-related settings (such as sports clubs and young offender programs). The key effort is to promote building a daily mindfulness practice in order to make a positive difference in the mental health and well-being of young people and educators.

FIND OUT MORE

OVERVIEW:
https://mindfulnessinschools.org

WEBINAR/VIDEO/DEMO:
https://mindfulnessinschools.org/about/

CONTACT:
https://mindfulnessinschools.org/contact/

KEY STUDIES SUMMARY

In one study of 71 students aged 7- to 9-years-old, teacher assessment of EF increased. (Vickery, C. & Dorjee, D. (2016). Mindfulness Training in Primary Schools Decreases Negative Affect and Increases Meta-Cognition in Children. *Frontiers in Psychology, 6.* doi:10.3389/fpsyg.2015.02025.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4709470/.

In another study, *522* 12- to 16-year-olds who participated in MiSP showed an increase in well-being, reduced stress and lower rates of depression at a 3-month follow-up. (Kuyken, W., Weare, K. et al. (2013), Effectiveness of the Mindfulness in Schools Programme: non-randomised controlled feasibility study. *The British Journal of Psychiatry, 203*, 126–131. doi: 10.1192/bjp.bp.113.126649.) https://www.ncbi.nlm.nih.gov/pubmed/23787061.

The .b programme is currently the basis for the large-scale MYRIAD study, a collaborative study funded by the Wellcome Trust, which involves an RCT involving 250 teachers and 8,000 students: http://oxfordmindfulness.org/news/mindfulness-resilience-adolescence-myriad-project/

MindUP

Founded in 2003 by actress Goldie Hawn's educational foundation and a team of neuroscientists, educators, and psychologists, MindUP is a classroom program that provides a curriculum at the intersection of neuroscience, positive psychology, mindful awareness, and SEL. The aim of MindUP is to help students focus their attention, improve self-regulation skills, build resilience to stress, and develop a positive mindset in school and in life. MindUP creates a positive classroom environment and builds focus, resilience, and compassion in students, enabling them to better regulate emotions in the face of social and academic challenges.

The MindUP curriculum is published by Scholastic Inc., and is offered in three age-related levels, Pre-K–2, Grades 3-5, and Grades 6-8. Each level consists of 15 lessons in four units—Getting Focused, Sharpening Your Senses, It's All About Attitude, and Taking Mindful Action—taught throughout a semester or year. MindUP begins by teaching students about their brains and introducing them to mindful breathing, two themes that extend throughout the program. Daily, students and teachers engage in mindful breathing as a class—at the start of the day, before or after lunch, and before school lets out—to promote a culture of mindfulness that acts as an underpinning to the MindUP curriculum. This core practice of MindUP is the Brain Break—a focused breathing exercise with the purpose of taking a moment to calm anxiety and stress, regain focus, and live in a quiet self-empowering moment. All MindUP lessons are designed to fit into core school subjects with minimal preparation required, and to encourage mindful teaching across a school's curriculum.

AT A GLANCE

GRADES:
Pre-K–8

TYPE:
Mindfulness; SEL; Brain Literacy

METHOD:
Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
15 lessons in 4 units; one time/week for 30-45 mins and "Brain Breaks" three times/day for 2-5 minutes each

PLATFORM/TECHNOLOGY:
Textbook curriculum delivered by teacher

TRAINING REQUIRED:
Strongly encouraged day-long training for school-wide implementation; MindUP Curriculum available through Scholastic, Inc.

MindUP offers comprehensive training for schools interested in implementing the program. Training includes an initial on-site workshop by a Certified MindUP Consultant who prepares teachers to integrate the MindUP lessons into their classrooms. This is followed by videoconference mentoring sessions at the 1-month and 2-month mark post-launch. After a school is 3 to 5 months into its implementation, a MindUP Consultant is available for another onsite workshop to observe classroom adoption and offer grade-level coaching. A family session is also available during this second visit to help familiarize the extended school community with the MindUP approach. A final call with a MindUP

Consultant and school leadership takes place 7 months into implementation to review assessment plans and discuss next steps.

A core component of the 12-month training and support program is to engage parents and families by providing tools and techniques to use MindUP in the home environment as well as in the classroom. The on-site family workshop is facilitated by a certified MindUP Consultant and is available in English and Spanish. All Certified MindUP Consultants have an extensive background in education, SEL, and mindfulness training.

Teachers who wish to individually implement the program prior to a full school adoption can purchase the curriculum through Scholastic, Inc. and review videos of sample lessons on the MindUP website. MindUP provides partner schools with an official MindUP pre- and post-evaluation toolkit to assess student outcomes, student/teacher satisfaction, and measure student/teacher social competencies.

MindUP is a CASEL SELect program, meeting high design quality and evidence-based criteria. The program has more than 10 years of independent research, including four randomized control trials. Findings have shown that students participating in the MindUP curriculum have demonstrated reduced aggression and increased prosocial behaviors and have shown gains in EF skills, math, and language arts.

FIND OUT MORE

OVERVIEW:
www.mindup.org

WEBINAR/VIDEO/DEMO:
Lesson examples https://mindup.org/category/videos/
Program overview https://www.youtube.com/
watch?v=tAo_ZSmjLJ4

CONTACT:
https://mindup.org/contact/

KEY STUDIES SUMMARY

A study of 99 Canadian 4th and 5th graders, 9- to 11-years-old, approximately half male and female, participated in the curriculum once a week for 40 to 50 minutes, and practiced core mindfulness exercises (breathing and attentive listening) three times a day for approximately 3 minutes, for 4 months. Results found significant improvements in EF, positive behavioral change, improved performance in math, and increases in prosocial behavior towards self and others compared to the regular school program. (Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: a randomized controlled trial. *Developmental Psychology, 51*(1), 52-66. doi:10.1037/a0038454.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4323355/)

OTHER RESEARCH AVAILABLE

Schonert-Reichl, K., & Lawlor, M. (2010). The effects of a mindfulness-based education program on pre- and early adolescents' well-being and social and emotional competence. *Mindfulness, 1*(3), 137-151. doi: 10.1007/s12671-010-0011-8

Thierry, K., Bryant, H., Nobles, S., & Norris, K. (2016). Two-Year Impact of a Mindfulness-Based Program on Preschoolers' Self-Regulation and Academic Performance. *Early Education and Development, 27*(6), 805-821. doi: 10.1080/10409289.2016.1141616. http://dx.doi.org/10.1080/10409289.2016.1141616

de Carvalho, J., Pinto, A., & Marôco, J. (2016). Results of a mindfulness-based social-emotional learning program on Portuguese elementary students and teachers: a quasi-experimental study. *Mindfulness, 8*(2), 337-350. doi: 10.1007/s12671-016-0603-z

PATH to Reading

PATH to Reading is a patented computer game designed to improve reading, attention, and memory by training specific parts of the brain that support these functions. PATH stands for Perception Attention Therapy and was created by neurobiologist Dr. Teri Lawton, who experienced its effects firsthand while developing her PhD. thesis. Following a severe concussion at age 25, Dr. Lawton used PATH's visual exercises to help re-learn how to walk and talk within months—and 13 years faster than doctors predicted for her recovery. According to the PATH to Reading website, "Studies show PATH therapy to be a rapid and effective means for treating children with a wide spectrum of reading and attention difficulties, from ordinary poor reading to Dyslexia, Attention Deficit Disorder (ADD and ADHD) and Autism" and the following are typically expected user outcomes: after 5 sessions, 100% average increase in reading speed; after 10 sessions, 200% average increase in reading speed; after 30 sessions, 400-1000% average increase in reading speed ("PATH to Reading," 2019). Because of its focus on improving visual and cognitive skills, the program is intended for users looking to achieve gains in grade-level reading skills, fluency, comprehension, spelling, pronunciation, attention, and both visual and auditory working memory.

Dr. Lawton has studied visual perception for more than 45 years. Based on her research, underdevelopment in visual pathways—the reduced ability to detect motion, specifically in the retina and in the brain—is causal in dyslexia and creates difficulty in identifying the correct sequence of letters in a word from the sea of visual features on a page. This creates challenge in learning how to read, and in developing language and reasoning.

AT A GLANCE

GRADES:
K–12

TYPE:
Subject-Specific Comprehension with Cognitive

TRAINING METHOD:
Autonomous-use, Teacher-assisted, or Clinician-dependent

STUDIES:
RCT

PROGRAM FREQUENCY:
One time/day for 5 minutes or two 10-15-minute sessions 2-3 times/week, for 12-16 weeks

PLATFORM/TECHNOLOGY:
Computer per student

TRAINING REQUIRED:
Therapists and teachers must be trained online by a PATH specialist for 2 hours; online video training and written instructions available to those who have been trained.

PATH's visual training, which includes practicing left-right eye movements and identifying patterns on backgrounds, strengthens and improves the eye-brain connection and the function of the visual pathways, enabling readers to correctly identify letter and sequences and improve reading and comprehension.

Students engage in the sessions once a day for five minutes or for 10-15-minutes two to three times per week for 12-16 weeks. Literacy-specific tasks should follow PATH activities. Research on the PATH patented program has shown improvements in reading, attention, and working memory skills in

children. PATH improves reading skills by training the brain to discriminate left-right movement of faint, striped, grayscale patterns that move on varied backgrounds. The patterns are designed to activate motion sensitive cells at both early (retinal) and later (cortical) processing levels. PATH uses automatic feedback and recalibration to adjust the challenges to each student's ability through a game-like platform. The program gives students animated encouragement when doing a task correctly and when a more complex level has been completed. It also provides visual feedback on how students are progressing. A dashboard for teachers generates individual data and summary files on each student throughout the intervention.

A licensed therapist will train licensee educators (or clinicians) on how to administer the cognitive training program, and students can complete the sessions independently. Home use is also available. Individuals administering PATH need to complete PATH training with staff at Perception Dynamics Institute, which is included in the license fee. The package also comes with program and measuring/diagnostic tools.

FIND OUT MORE

OVERVIEW:
https://pathtoreading.com/

WEBINAR/VIDEO/DEMO:
https://pathtoreading.com/research-demos/

CONTACT:
https://pathtoreading.com/contact/

KEY STUDIES SUMMARY

A study including 42 2nd and 3rd graders who used PATH for 30 minutes, twice a week for 12 weeks, found significant improvement in typically developing and dyslexic students in the following measures: Dyslexia Determination Test, the Comprehensive Test of Phonological Processing (CTOPP), Cognitive Assessment Systems test of Expressive Attention (Stroop: color-word interference), Test of Information Processing Skills (TIPS- working memory), Computer-based Reading Speed Assessment, and Contrast Sensitivity (Timing Diagnosis). (Lawton, T. & Shelley-Tremblay, J. (2017). Training on movement figure-ground discrimination remediates low-level visual timing deficits in the dorsal stream, improving high-level cognitive functioning, including attention, reading fluency, and working memory. *Frontiers in Human Neuroscience, 11, 236.*) https://www.ncbi.nlm.nih.gov/pubmed/28555097

A study of 58 2nd graders with dyslexia who used PATH for 30 minutes, three days a week for 20 weeks found significantly improved attention, reading fluency, both speed and comprehension, phonological processing, and both auditory and visual working memory relative to controls, whereas auditory training to improve phonological processing did not improve these academic skills significantly more than found for controls. (Lawton, T. (2016) Improving dorsal stream function in dyslexics by training figure/ground motion discrimination improves attention, reading fluency, and working memory. *Frontiers in Human Neuroscience, 10, 397.* doi: 10.3389/fnhum.2016.00397) https://www.frontiersin.org/articles/10.3389/fnhum.2016.00397/full#h1

OTHER RESEARCH AVAILABLE

Lawton, T. (2019). Increasing visual timing by movement discrimination exercises improves reading fluency, attention span, and memory retention in dyslexics. *Neuro Neurosurg, 2*, 1-8. doi: 10.15761/NNS.1000118

Lawton, T. and Huang, M. (2019). Dynamic cognitive remediation for a Traumatic Brain Injury (TBI) significantly improves attention, working memory, processing speed, and reading fluency. *Restorative Neurology and Neuroscience, 37*, 71-86. doi: 10.3233/RNN-180856

Lawton, T. (2011) Improving magnocellular function in the dorsal stream remediates reading deficits. *Optometry Vision Development 42*(3), 142-154. https://www.researchgate.net/publication/265812611_Improving_Magnocellular_Function_in_the_Dorsal_Stream_Remediates_Reading_Deficits

Lawton, T. (2007). Training direction discrimination sensitivity remediates a wide spectrum of reading skills. *Optometry and Vision Development, 38*(1), 37-51. https://psycnet.apa.org/record/2007-07097-004

SMART

SMART (Strategic Memory Advanced Reasoning Training) is a program developed by researchers from the Adolescent Reasoning Initiative, a division of the Center for Brain Health, University of Texas at Dallas. The program is based on the premise that by improving complex reasoning and innovative thinking, students will expand their cognitive capacity during middle school years and on into college. This adolescent stage of development represents a period associated with rapid growth and reorganization of the brain's frontal networks, which support advanced EF development. The program trains teachers to implement a set of content-focused cognitive strategies that empower students to take control of their higher-order learning performance. The higher-order EF strategies taught by SMART elevate student confidence, increase their learning ability, and improve academic and life outcomes.

Teachers are provided tactical strategies to engage students in active classroom learning by integrating specific EF bottom-up processes into top-down approaches that improve depth of processing. For example, SMART teaches students how to utilize:

1. Inhibitory control by omitting less important information and controlling against distractions during deeper level thinking;

2. More efficient working memory to rapidly synthesize and encode abstracted meanings to avert overload of low-level facts; and

3. Mental flexibility to shift from concrete informational input to bigger ideas that consider real life applications

AT A GLANCE

GRADES:
6–12

TYPE:
Cognitive Training

METHOD:
Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
Ten 45-50 minute classroom sessions over one month

PLATFORM/TECHNOLOGY:
Textbook curriculum delivered by teacher

TRAINING REQUIRED:
Yes, 5-day intensive teacher training during summer plus 9 hours on site during implementation; after year 1, teachers participate in a 12-hour review course

Through pen and paper assignments and group activities, SMART trains students in how to use EF skills to attend to the most important and relevant information, and to identify connections between critical content before the processing of details. This 7-step process includes: deliberate inhibition of extraneous information; chunking and organizing relevant information; inference; paraphrasing; synthesis of important details; interpretation of take-home messages; abstraction of deeper meaning; and synthesis of all the processes to apply top-down thinking ("Improve gist reasoning to help 8th-graders close achievement gap," 2019). This protocol develops gist reasoning, which is the ability to make

connections between pieces of information and generalize meaning from what one is learning to other situations.

SMART's pre- and post-assessments measure gist reasoning and changes in cognition using the Scale of Advanced Reasoning© (SOAR). SMART has been shown to increase speed and durability of learning, generalize concepts to new content areas, aid the creation of new ideas, build frontal networks function, and improve psychological well-being. The EF integrative cognitive strategies of SMART teach students how to think and reason on deeper levels versus just memorizing facts for short-term retention. The program provides evidence that deploying such strategies elevates learning capacity and can improve standardized test passing rates and scores in all content areas by up to 50 percent.

Educators interested in implementing the SMART program are required to complete intensive training. SMART training includes a summertime, 5-day teacher training as well as a 1-day Leadership Workshop for principals. An additional 9-hour training is required during implementation, and a 12-hour training follows the first year of implementation.

Schools can start a SMART Club, an optional after-school enrichment program. The Adolescent Reasoning Initiative team provides resources for teachers to tailor SMART Club activities to their students.

FIND OUT MORE

OVERVIEW:
https://brainhealth.utdallas.edu/programs/adolescent-reasoning-initiative/

WEBINAR/VIDEO/DEMO:
N/A

CONTACT:
bhSmartEd@utdallas.edu, (972) 883-3247

Dr. Sandra Bond Chapman, Founder and Chief Director at the Center for BrainHealth, is a BrainFutures Advisory Board member.

KEY STUDIES SUMMARY

Fifty-four students (30 girls and 24 boys) in three sections of an eighth grade Advancement via Individual Determination (AVID) class in an inner-city urban Texas public middle school participated in the program. Students demonstrated improvements in gist reasoning—the ability to abstract meaning from complex information. (Gamino, J., Chapman, S., Hull, E., & Lyon, G. (2010). Effects of higher-order cognitive strategy training on gist-reasoning and fact-learning in adolescents. *Frontiers in Psychology, 1.* doi: 10.3389/fpsyg.2010.00188)   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3153797/

Another study of 913 7th and 8th graders showed similar improvements in gist reasoning. (Gamino, J., Motes, M., Riddle, R., Lyon, G., Spence, J., & Chapman, S. (2014). Enhancing inferential abilities in adolescence: new hope for students in poverty. *Frontiers in Human Neuroscience, 8.* doi: 10.3389/fnhum.2014.00924) https://www.frontiersin.org/articles/10.3389/fnhum.2014.00924/full

OTHER RESEARCH AVAILABLE

Motes, M., Gamino, J., Chapman, S., Rao, N., Maguire, M., Brier, M., Kraut, M., & Hart, J., Jr. (2014). Inhibitory control gains from higher-order cognitive strategy training. *Brain and Cognition, 84,* 44-62. doi: 10.1016/j.bandc.2013.10.007 https://www.ncbi.nlm.nih.gov/pubmed/24286804

Tools of the Mind

Tools of the Mind (Tools) offers a comprehensive curriculum and teacher training program for Pre-K and K classrooms that targets the development of students' fundamental learning skills, or mental "tools," both cognitive and affective. The Tools curriculum dates back to 1993, when Dr. Elena Bodrova and Dr. Deborah Leong began working with early childhood classrooms to improve children's learning and support teachers with new techniques for teaching young children.

Today, the program is being taught to more than 300,000 students in urban, rural, public, and private schools. It can be implemented in multiple settings serving children ages 3-6, including public and private schools, Head Start programs, public and private preschools, and early childhood education centers. It can be used in half-day and full-day programs and in multi-age classrooms. While typically used during school year, its use can be extended to a summer program.

Tools is a holistic science-informed, research-based developmental approach that includes the development of play and social-emotional skills, as well as underlying cognitive and academic skills. In Tools Pre-K and K classrooms, children daily engage in a variety of literacy, math, and science activities, such as Scaffolded Writing and Buddy Reading, that are specifically designed to support self-regulation and EF while at the same time building academic skills. Tools teachers are trained to provide children with individualized scaffolding geared to their level of development. Research has shown that students participating in the Tools program outperformed their peers on the measures of executive functions,

AT A GLANCE

GRADES:
Pre-K and K

TYPE:
EF Curriculum

METHOD:
Teacher-assisted

STUDIES:
RCT

PROGRAM FREQUENCY:
Ongoing (part of classroom curriculum design)

PLATFORM/TECHNOLOGY:
Textbook curriculum delivered by teacher

TRAINING REQUIRED:
Yes, 4 to 5 one-day workshops plus online modules taught over Years 1-2

reasoning ability, and attention, and demonstrated larger gains in reading, vocabulary, and mathematics.

In Pre-K classrooms, Tools teachers support children's engagement in mature make-believe play in theme-based play centers that change over the course of a year. Specific instructional strategies, such as Play Planning, are utilized to support skill development in executive function, literacy, and SEL. During Play Planning, Pre-K students plan the first few minutes of their play by saying, drawing, or writing what they are going to do, which helps children self-regulate and act with intention. In K classrooms, children dramatize stories and their Play Plans evolve into Learning Plans that help students set goals for what they wish to accomplish each day and week. From these goals, children take part in

"playful, purposeful learning" that often involves playing increasingly more challenging learning games with a partner or with a small group of peers. Children learn to monitor and evaluate their work by working in pairs and checking each other's work products against the set of learning goals each of the "Study Buddies" had set for themselves.

Tools PreK and Kindergarten curricula are aligned with the Head Start Early Learning Outcomes Framework, Common Core State Standards, and New Generation Science Standards. The curricula are also aligned with the major assessment instruments used in preschool and Kindergarten classrooms including ECERS, CLASS, and TS GOLD. When a school district or a program has unique local requirements, Tools staff work with the district to make sure that Tools meets these requirements.

Tools has a strong professional development focus in training teachers in its approach to self-regulation and foundational literacy and numeracy skills development through four 1- to 2-day workshops and online modules that take place over two years. Training includes on-site and virtual technical assistance from a Tools trainer, curriculum manuals with classroom activities, and a subscription to iScaffold—a virtual coach app for teachers. Kindergarten training uses the same model and offers the same features as for Pre-K, with an additional subscription to the program's PowerTools Literacy Solution reading platform.

A unique feature of Tools is its computer-based tool iScaffold that helps teachers implement the program with high fidelity. Another technology component currently used in Tools Kindergarten classrooms— the PowerTools iPad app—combines teaching of reading and science concepts with promoting the development of executive functions. When children interact with the app, they engage in self-monitoring, self-reflection, and strategy use. The app also promotes co-regulation as children are encouraged to use it with a partner.

In 2001, the program was given the distinction of an "exemplary educational intervention" by UNESCO's International Bureau of Education. Tools of the Mind is also a CASEL SELect program, meeting high design-quality and evidence-based criteria.

FIND OUT MORE

OVERVIEW:
https://toolsofthemind.org/

WEBINAR/VIDEO/DEMO:
https://toolsofthemind.org/

CONTACT:
https://toolsofthemind.org/contact/

KEY STUDIES SUMMARY

A study of 723 kindergarteners across 12 districts and 29 schools showed a significant increase in working memory and academic performance in math. The program was implemented for one year following training of teachers and teaching assistants. A one-year follow-up study found SEL improvements including significantly lower levels of aggression, conduct and general behavior problems with better performance than the control group in working memory, reading and mathematics. (Blair, C., & Raver, C. (2014). Closing the achievement gap through modification of neurocognitive and neuroendocrine function: Results from a cluster randomized controlled trial of an innovative approach to the education of children in kindergarten. *Plos ONE, 9*(11), e112393. doi: 10.1371/journal.pone.0112393.) https://doi.org/10.1371/journal.pone.0112393

An RCT study of 715 kindergarteners found that children who used Tools of the Mind showed a reduction in behavioral issues and increases in self-regulations, social-emotional competence and positive teacher-child relationship, accord to teacher-reported data. (Blair, C., McKinnon, R., & Daneri, M. (2018). Effect of the tools of the mind kindergarten program on children's social and emotional development. Early Childhood Research

Quarterly, 43, 52-61. doi: 10.1016/j.ecresq.2018.01.002.) http://insight.bostonbeyond.org/wp-content/ uploads/2018/03/SEL-article-Blair.pdf

OTHER RESEARCH AVAILABLE

Bodrova, E., & Leong, D. J. (2001). Tools of the Mind: A case study of implementing the Vygotskian Approach in American early childhood and primary classrooms. *Innodata Monographs 7.* Geneva, Switzerland: UNESCO International Bureau of Education. http://www.ibe.unesco.org/fileadmin/ user_upload/archive/Publications/innodata/inno07. pdf

Diamond, A., Barnett, W., Thomas, J., & Munro, S. (2007). The Early Years: Preschool program improves cognitive control. *Science, 318*(5855), 1387-1388. doi: 10.1126/science.1151148. https://www.ncbi.nlm.nih.gov/ pmc/articles/PMC2174918/

Barnett, W., Jung, K., Yarosz, D., Thomas, J., Hornbeck, A., Stechuk, R., & Burns, S. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly, 23*(3), 299-313. doi: 10.1016/j.ecresq.2008.03.001 https://pdfs.semanticscholar.org/8732/ c14f80545ae0be8d858bc3a03edbbe2c7250.pdf

Imholz, S., & Petrosino, A. (2012). Teacher Observations on the Implementation of the Tools of the Mind curriculum in the classroom: Analysis of interviews conducted over a one-year period. *Creative Education, 3*(2), 185-192. doi: 10.4236/ce.2012.32029. https://file.scirp.org/pdf/ CE20120200002_11368128.pdf

Millaway, S. A. (2015). Impact of Tools of the Mind on Middle School Achievement, Saint Peter's University. http://librarydb.saintpeters.edu:8080/ handle/123456789/193

Related publications on the Tools of the Mind website. Go to https://toolsofthemind.org/learn/ resources/ and click on "Research on Tools"

Program Costs Summary

	Start Up Costs Per School[1]	Start Up Costs Per Teacher[2]	Annual Cost Per Teacher[2]	Annual Cost Per Student[3]	Notes
ACTIVATE				$$	Includes 3-hour on-site teacher training and software licenses
CogMed			$$		Annual license includes online training for up to three teachers
Fast ForWord	$$-$$$*			$$-$$$*	*Annual subscription or perpetual: for each option, schools can purchase per student licenses or a schoolwide license
Inner Explorer				$	Spanish language materials available for PreK-8
Master Mind		$	$		2-year license includes training and online access to all materials
Mindfulness in Schools		$$			Different training costs for grades 2-5 and 6-8
MindUP	$$$				4-6 hour on-site training for all school staff. Second visit 3-4 months later for classroom visits plus schoolwide meeting
PATH to Reading	$			$$$	Start up cost: online training for entire school
SMART		$$$	$$$		Start up cost: 30 hour in-person teacher training plus 9 hours on-site
Tools of the Mind		$$$	$$$		PreK and K classrooms only. Two years of training with 4 to 5 one-day on-site workshops plus online modules.

[1] **$** less than $2,000
$$ $2,000-4,999
$$$ $5,000+

[2] **$** less than $500
$$ $500-1,499
$$$ $1,500+

[3] **$** less than $25
$$ $25-149
$$$ $150+

Note: Some programs provide multiple options, including technican assistance and site visits. Many programs offer flexible pricing for larger volumes.

Appendices

School Implementation Strategies

In our interviews with educators and administrators, they shared many best practices that contributed to the successful implementations of brain fitness interventions in their schools. The top five recommendations were included in the main report. However, for those looking to glean additional insights, a complete list from the interviews is compiled below. This should not be seen as a required checklist to ensure success, but rather as ideas that may be useful in informing schools' approaches.

LEADERSHIP AND ACCOUNTABILITY

- Top-down and bottom-up buy-in and participation from administrative decision-makers to boots-on-the-ground faculty

- A commitment to the implementation as a mission-driven priority that won't be compromised when competing priorities arise

- A context-specific approach that considers a school's specific setting, demographics, and culture, as well as defined goals that articulate what implementation success looks like

- Clear expectations of faculty and administrators as it relates to implementation compliance and accountability

ADVANCE PLANNING

- Preliminary planning to consider items such as timelines, potential calendar adjustments, and favorable timing that support faculty teaching considerations; educational information sessions to build buy-in across all stakeholders; and working groups to ideate an ideal roll-out and sustained adoption relative to a school's specific considerations

- Understanding of the necessary skills and equipment needed to successfully implement an intervention, including an appraisal of and strategy for the human capital and infrastructure gaps that need to be met prior to implementation

HIGH-QUALITY IMPLEMENTATION

- Fidelity to a program's protocol so that outcomes have the best chance at showing improvements

- Pre-, mid-, and post-assessment metrics that demonstrate to all constituents the gains achieved comparable to intended targets, while providing teachers with invaluable data about students' current cognitive strengths and deficits

- Strategies for mid-implementation course corrections that might be needed based on changing school considerations or ongoing assessment data

INVESTMENT IN CHAMPIONS

- Development of onsite local experts and community-builders who can lead the implementation and become trusted advocates and advisors for their colleagues, students, and students' families

- Ongoing capacity building for faculty and administrators so that educators at all levels understand the power and process behind EF's impact on improving the learning profiles of every student and are empowered to continually be best-in-class professionals

FUNDING

- Funding options that are aligned with the capacity of the school. For those schools with limited funds, ESSA monies are now more readily available for evidence-based interventions. Additionally, partnering with researchers to test an intervention can also significantly mitigate adoption and implementation costs.

SUPPLEMENTARY ADOPTION STRATEGIES

- Reviewing program-related research and academic outcomes with colleagues, and showcasing videos of the proposed intervention at work in the classroom, can be powerful when building school-wide support.

- Breaking program costs down to per pupil and/or per year investments can help demonstrate fiscally prudent discernment.

- Contact a program provider to find schools with similar demographics and/or settings that have implemented the intervention, and speak directly with those leaders and educators who can lend testimonials and credibility to the program, and who can provide invaluable advice on a school's adoption plans.

- Clarify the length of initial training and the frequency of any follow-up trainings to reassure teachers that their time is being wisely considered.

Selection Criteria

APPROACH	INTERVENTION	ONE RCT OR QUASI-EXPERIMENTAL STUDY IN A PEER-REVIEWED JOURNAL W/10+ SAMPLE SIZE	CLASSROOM-BASED IMPLEMENTATION IN AT LEAST ONE STUDY	EXECUTIVE FUNCTION OUTCOMES IN AT LEAST ONE STUDY	"TYPICALLY DEVELOPING" STUDENTS IN AT LEAST ONE STUDY
CT	ACTIVATE	X	X	X	X
CT	Arrowsmith Program		X	X	X
CT	BrainWare Safari		X	X	X
CT	Captain's Log MindPower Builder	X	X	X	
CT	CogMed	X	X	X	X
CT	SMART	X	X	X	X
SSCCT	Edublox online tutor		X	X	X
SSCCT	Fast ForWord	X	X	X	X
SSCCT	Path to Reading	X	X	X	X
SSCCT	TNT Reading	X		X	
EFC	Tools of the Mind	X	X	X	X
EFC	Rush NeuroBehavioral Center EF Curriculum		X	X	X
M	Calmer Choice		X	X	X
M	Holistic Life Foundation's Stress Reduction and Mindfulness Curriculum	X	X		X
M	Inner Explorer	X	X	X	X
M	Integra Mindfulness Martial Arts Program	X		X	
M	Learning to Breathe	X		X	X
M	Master Mind	X	X	X	X
M	Mindfulness in Schools Project	X	X	X	X
M	MindUP	X	X	X	X
M	Mindful Life Project		X	X	X
M	Mindful Schools	X	X		X
M	Peace in Schools		X	X	X
M	Quiet Time	X	X		X
NF/CT	ATENTIVmynd	X		X	X
NF/CT	Focus EDU		X	X	X
NF/CT	Neurotracker	X	X	X	
NF/CT	Play Attention	X		X	
NF/CT/M	Muse		X	X	X

CT = Cognitive Training | EFC = EF Curriculum | M = Mindfulness | NF = Neurofeedback | SSCCT = Subject-Specific Comprehension with Cognitive Training

Promising Programs

In addition to the 10 programs that met our full rubric criteria, these 19 programs also show promising outcomes for students.

The Arrowsmith Program

The Arrowsmith Program for elementary or secondary students is a full-day, multi-year, cognitive training program designed to strengthen cognitive skills in students with learning challenges, including dyslexia, dyscalculia, dysgraphia, auditory, visual and non-verbal processing, and attention. It is also useful for individuals who do not have identified learning difficulties, but who are challenged by issues of organization, processing, problem solving, communication, memory, and/or independence. It was founded by Barbara Arrowsmith-Young through her process of figuring out how to remediate her own learning disabilities. Ms. Arrowsmith-Young holds both a B.A.Sc. in Child Studies from the University of Guelph and a Master's degree in School Psychology from the University of Toronto's Ontario Institute for Studies in Education.

The program includes exercises to strengthen 19 areas of cognitive function. The exercises are divided into three categories:

1. Computer exercises for reasoning, comprehension, math, reading, and visual memory

2. Computer exercises for speaking, writing, and vocabulary, as well as for auditory, phonemic, and working memory

3. Pen and paper exercises for motor skills

Students must spend a minimum of four 40-minute periods per day, 5 days a week for at least 3 years engaged in the exercises, eventually returning to normal school curriculum. In-depth assessments provide an initial profile of cognitive strengths and weaknesses to individualize the intervention and end-of-year reports to track progress and modify future program protocols.

The program has been implemented in over 100 educational organizations in Canada, the U.S., Australia, New Zealand, Spain, Switzerland, the Cayman Islands, and Asia. It can only be accessed through an accredited school in operation for at least 5 years with a minimum of 100 students. It is unavailable for home use. The program is administered by a teacher certified in a three-week intensive summer training at the Arrowsmith School in Toronto.

AVAILABLE RESEARCH

- https://cdn.arrowsmithschool.org/wp-content/uploads/2018/04/ARROWSMITH-PROGRAM-RESEARCH-SUMMARY-v4-Mar-6-2018.pdf.

- https://arrowsmithschool.org/research/

FOR MORE INFORMATION

www.arrowsmithschool.org

ATENTIVmynd

ATENTIVmynd™ games use FOCUSforward™ cognitive training technology to develop attention and impulse control. Tiered products are available for age groups 4-7, 8-12, 13-18, and 19+. The company was founded by its current CEO, Eric B. Gordon, a veteran entrepreneur in the medical and healthcare technologies fields.

Designed primarily for home use, the computer games teach cognitive skills by immersing students in a virtual adventure story. A neurofeedback headset connected to monitoring software is worn by the participant to measure brainwave attention states that affect the pace of the game. The headset and monitor give the user instant feedback on their attention control via messages on the screen, allowing them to adjust attention accordingly. As a player's attention level rises, new cognitive skill challenges emerge within the story.

Students learn to control their attention and impulsivity by overcoming multiple challenges, which develops 13 attention and impulse control skills. Among the skills targeted are: focused, sustained, divided, selective and alternating attention; behavioral inhibition; self-regulation; delayed gratification; and novelty inhibition.

Each adventure lasts about 8 hours, divided into 24 training sessions of 20-25 minutes each, over 4-8 weeks. Mission Performance Reports (MPRs) allow parents to monitor their child's progress.

AVAILABLE RESEARCH

- https://journals.sagepub.com/ doi/10.1177/1087054715623044
- http://www.atentiv.com/files/Atentiv_Release_ TP_FINAL.pdf

FOR MORE INFORMATION

www.atentiv.com

BrainWare SAFARI

BrainWare SAFARI, offered through BrainWare Learning Company, is a software program used to develop cognitive skills in a videogame format. Like many computerized cognitive training programs, it does not teach academic subjects but rather the underlying cognitive skills that improve the ability to learn. The online exercises (or games) are divided into six mental processing categories: attention, memory, visual processing, auditory processing, sensory integration, and reasoning/logic. It is suitable for ages six to adult, but is used primarily in elementary and middle schools.

The website describes the games as "exercises derived from multidisciplinary clinical therapy, drawing from speech pathology, vision development, psychology, and other disciplines" ("Education and Skills development, MyBrainWare," 2017). It targets a wide range of students, including typically developing, those with identified cognitive deficits, and high performers.

The program includes 20 exercises with 168 levels of progressive difficulty, developing 41 cognitive skills. The recommended timing is 30-40 minute sessions, three to five times a week for 12 to 14 weeks. The games can be accessed anywhere there is a computer and internet connection and do not require teacher supervision.

BrainWare SAFARI has received numerous awards including the Academics' Choice Mind Spring Award; the Top 100 Products of 2011 in the November issue of *District Administration Magazine*; the Parent Tested Parent Approved Winner's Seal of Approval; the Mom's Choice Awards for family-friendly media, products and services; the 2009 CODIE Award for Best Education Game or Simulation from the Software and Information Industry Association; the Teachers' Choice Family Award from *Learning Magazine*; the Parents' Choice Foundation Silver Honor; and the EdNET Rookie of the Year Award for 2006.

AVAILABLE RESEARCH

- https://mybrainware.com/research-studies/
- https://mybrainware.com/white-papers-and-reports/
- https://mybrainware.com/wp-content/uploads/2017/03/Millville0BWS-CloseGapSY2013-APril2015V3.pdf

FOR MORE INFORMATION

https://mybrainware.com/brainware-safari/educator/

Calmer Choice

Calmer Choice was founded in 2010 as a grassroots effort by a group of Cape Cod parents and community members concerned about the well-being of local youth and the rise in opioid addiction in the area. It is a mindfulness-based prevention program that integrates with SEL education and is currently available to Cape Cod public schools and communities. Its aim is to teach stress management, self-control, and conflict resolution to elementary, middle, and high school students, while increasing compassion and resilience.

Lessons focus on brain science, stress physiology, the five senses, body awareness, mind-body connection, emotional awareness, perspective, optimism, and understanding. The goal is to direct attention toward experience, i.e., breath, listening, kindness, gratitude, and happiness, and to rewire pathways of attention by increasing concentration and emotional regulation.

The program is designed as an 8-week course. It is implemented 20 minutes per day, twice a week for elementary school, and 45 minutes a day, once a week for middle and high school. Educators at participating schools are instructed in a 40-hour classroom training, which includes experiential exercises and engaged activities plus 28-hours of observation/student teaching in the classroom with mentoring and coaching.

According to its website, "[through a research] partnership with MIT and the Harvard School of Education, Calmer Choice students were involved in the first study ever conducted using brain scans with youth that provides scientific evidence that a school-delivered mindfulness-based program can enhance attention and reduce stress. MIT researchers found Calmer Choice effectively enhances sustained attention in middle-school students and positively changes brain connectivity, as well as reduces amygdala reactivity to fear and stress" (Calmer Choice, 2018).

Massachusetts Governor Charlie Baker approved $50,000 in state funding for Calmer Choice, recognizing its leadership in substance abuse prevention.

Calmer Choice has been implemented in 28 schools and 12 community-based organizations, reaching more than 20,000 students and 1,000 teachers. Researchers from Tufts, Yale, MIT, and Harvard universities have studied the impact of the program on over 2,000 students.

AVAILABLE RESEARCH

- https://calmerchoice.org/news-resources/assessing-the-changes-in-brain-structure-and-function-of-school-based-mindfulness

FOR MORE INFORMATION

http://www.calmerchoice.org

Captain's Log MindPower Builder—School Edition

Captain's Log MindPower Builder—School Edition, a BrainTrain, Inc. program, is an adaptive computerized cognitive training program used in various settings to remediate a variety of cognitive skills, including working memory and encoding, and supports students at all grade levels. BrainTrain, Inc. was founded in 1989 by

Joseph A. Sandford, PhD, a clinical neuro-psychologist, and offers a series of educational programs for cognitive training, neurofeedback, and reading, as well as clinical diagnosis tools for therapists.

MindPower Builder for students is a "neuro gym" that consists of more than 2,000 computer-based exercises targeting 20 different cognitive skills, including visual and auditory processing speed, conceptual reasoning, working memory, response inhibition, visuospatial skills, fine motor control, and more. The program begins with skill tests that generate individualized training plans. Training modules are presented as games in which the student's performance is recorded and "points" are earned based upon the accuracy of performance. Different games specifically address individual cognitive abilities at different grade levels. The adaptive approach used within the program tracks a participant's progress. Assessment tests can be administered throughout the program's use to determine gains in cognitive areas, including a series of benchmark exercises which can be used both for creation of the initial training plan and for modification after training. The software has an Advanced Interface for building of the training plans, launch of benchmarking apps, viewing/printing of grades and reports, and a Player Interface that allows the trainee to run the Training Plan.

MindPower Builder—School Edition was specifically designed for use in schools and is installed directly on the educator's computer (not web-based). Students can use the product independently while in class. It provides detailed documentation of progress, which can be set up in the program settings to be automatically emailed to parents, teachers, and other supporters of student progress.

MindPower Builder is evidence-based, with studies showing significant improvements in working memory, reading, behavior and attention for students with attention difficulties. The platform can be customized to train specific cognitive skills for individual students and the video game-like platform encourages students' motivation to complete training tasks, increasing the potential development of cognitive skills. Its customizable training options target individuals with cognitive deficits, but the program is also effective for normal-developing students. Different behavioral tracks also let the educator target areas like patience, listening, and self-control. MindPower Builder also includes the NeuroSky MindWave neurofeedback device, which offers a variety of sensory feedback and "brain-controlled" exercises that can be used as part of the training to help students develop attention and a calm state of mind conducive for learning.

AVAILABLE RESEARCH

- https://www.researchgate.net/publication/299441567_Utilizing_computerized_cognitive_training_to_improve_working_memory_and_encoding_Piloting_a_school-based_intervention

- https://d1it4cyzkbb6df.cloudfront.net/wp-content/uploads/2016/05/EuropeanCongress_2015.pdf

Edublox Online Tutor

Edublox Online Tutor is a computerized program of cognitive training exercises designed to build strong learning skills for all students. The Edublox company was created in 1979 to address weak foundational skills in concentration, memory, and processing speed, which are at the core of many learning difficulties across subjects. It is for use at home or in school and is most suitable for ages 7-13. Some exercises require adult input, so limited supervision is required.

There are currently two packages available: Development Tutor and Reading Tutor (a Writing Tutor and Math Tutor package is scheduled to be released soon.) Development Tutor is the basic

package, recommended use is 20-25 minutes, 3-7 times a week, and it specifically addresses: focused and sustained attention; visual and auditory processing and processing speed; visual, auditory, sequential, iconic, short-term, long-term and working memory; and logical thinking and reasoning skills. Reading Tutor contains all of the exercises of Development Tutor with additional reading and spelling exercises that also improve: decoding, word attack and word recognition; reading speed; comprehension; spelling; and vocabulary. Recommended use is 40-45 minutes per day, 3-7 times a week.

The program purports to correct a range of learning disabilities, including dyslexia, dysgraphia, dyscalculia, and ADD/ADHD. The company offers a free initial assessment of a student's skills in reading, visual sequential memory, auditory memory, eye span, and logical thinking to help identify areas of cognitive difficulty as well as reading age to help determine which package is most beneficial.

Over the past thirty years, Edublox has reached over 150,000 people in approximately 40 countries.

AVAILABLE RESEARCH

- https://www.edubloxtutor.com/category/edublox-research/

FOR MORE INFORMATION

http://edubloxtutor.com

Executive Function Curriculum Series, Rush NeuroBehavioral Center

The Educational Services Department at Rush NeuroBehavioral Center (RNBC) of Rush University Medical Center in Chicago, Illinois, provides EF tutoring to individual students, workshops for Pre-K–12 educators, and school-based training programs to integrate EF skill development into K–12 classrooms.

Student tutoring is fee-based with 50-minute sessions conducted at RNBC. According to its website, RNBC staff professionals will: "assess a student's strengths, weaknesses, and interests; review any prior diagnostic testing; evaluate the student's work samples; develop executive function goals; [and] implement the tutoring plan over the appropriate period of time to achieve the goals" (Rush NeuroBehavioral Center, n.d.). Additional individual services could include consultations with families and school professionals, off-site student observations, Individualized Educational Planning (IEP) support, and record reviews.

RNBC's day-long workshops invite individual educators across subject areas, as well as administrators and school psychologists, to learn the fundamentals of how to integrate EF skill development into a classroom or an afterschool program. (Continuing Professional Development Units may be available.)

For entire schools interested in implementing EF research-based curriculums through a school-wide adoption, RNBC offers on-site consultation sessions. Each school receives three to four on-site consultations throughout the year during implementation. Teacher trainings are tailored to the needs of a particular school, and each participant is given an RNBC Executive Functions Curriculum Notebook and lessons with an implementation

plan specific to their school. Through classroom visits, lesson demonstrations, teacher meetings, and implementation plan reviews, schools can benefit from RNBC experts throughout the implementation process. RNBC administers two student assessments (pre and post) and provides related reports. RNBC also offers seminars for parents.

Both the educator workshop and school training focus on seven primary areas: materials management, planning and time management, study strategies, understanding learning strengths, goal setting, decision making, and learning environment.

AVAILABLE RESEARCH

- http://rnbc.org/research/professional-articles/
- https://m.store.schoolspecialty.com/OA_HTML/ xxssi_ibeGetWCCImage.jsp?docName=G3800350

FOR MORE INFORMATION

http://rnbc.org/education/for-schools-and-teachers/ programs-for-schools/

Focus EDU

Focus EDU uses brainwave-tracking headbands and a software platform to help educators monitor student engagement and attention states throughout a lesson while in the classroom. The product is offered by BrainCo, a high-tech company started in 2015 that offers Brain Machine Interface (BMI) wearables. According to its website, "BrainCo's FocusEDU provides the world's first technology that can quantify real-time student engagement in the classroom" (BrainCo, 2018).

Focus EDU software reports on classroom and individual learner attention states through electroencephalography (EEG) data collected from the student headbands and displayed on the teacher's monitor. This information can be used to inform and adjust teaching practices to help maximize student engagement. Students can also use the headband

with computer-based neurofeedback games to prepare for learning before lessons begin, and to access visualization exercises to get into calm states of mind that promote self-regulation and attention.

In addition to real-time tracking, the platform provides reports on individual student and classroom attention states that can be reviewed to determine improvements over time and to assess the impact of changes in teaching approaches.

Founder and CEO Bicheng Han, PhD candidate at Harvard Center for Brain Science, was included in the 2017 *Forbes* China's "30 under 30 China" list of leading innovators in the healthcare and science category, and in the 2017 MIT Technology Review "Innovators Under 35" list. BrainCo was the winner of the 2015 pitch competition at the Harvard China Forum for its Focus EDU products; and also won the 2017 annual Pitch Fest at the International Society for Technology in Education (ISTE) Conference in the "Most Innovative" category.

AVAILABLE RESEARCH

None available

FOR MORE INFORMATION

https://www.brainco.tech/focus-edu-system

Holistic Life Foundation's Stress Reduction and Mindfulness Curriculum (SRMC)

The Stress Reduction and Mindfulness Curriculum (SRMC) was created by the Holistic Life Foundation (HLF) for school-based use, adapted from the organization's popular after-school program. It is geared toward elementary and middle school students and introduces them to mindfulness practices and conflict resolution skills with the goal of improving concentration, self-regulation, and self-awareness.

HLF was founded in 2001 by brothers Ali and Atman Smith, along with college friend Andres Gonzalez. The brothers had each practiced meditation since childhood, and all three developed a yoga practice in college. After graduation, they wanted to bring the benefits of these practices back to the Baltimore community, where Ali and Atman had grown up.

SRMC is offered as a 24-week course of two, 45-minute sessions per week during resource periods aimed at academic/learning assistance. It emphasizes yoga, meditation, breathing, and Tai Chi, along with other mind- and body-based exercises. The sessions include discussions on mindfulness related topics, and students are given homework to complete between sessions for greater impact.

According to the HLF, SRMC was the subject of the first randomized controlled trial of a school-based mindfulness and yoga intervention for urban youth (Holistic Life Foundation, 2016). Researchers at the Johns Hopkins Bloomberg School of Public Health and The Edna Bennett Pierce Prevention Research Center at Pennsylvania State University studied the impact of the curriculum on students in four Baltimore City Public Schools. Findings showed that students engaged in the program showed gains in emotional regulation and a reduction in involuntary stress reactions (Mendelson et al., 2010). The same researchers are further studying the program as a part of a 3-year, federally funded trial in six public elementary and middle schools in Baltimore City.

The curriculum currently serves 7,500 students per week in more than 40 Baltimore area schools.

AVAILABLE RESEARCH

- https://hlfinc.org/research/
- https://www.ncbi.nlm.nih.gov/pubmed/20440550
- https://doi.org/10.1007/s12671-015-0463-y
- https://doi.org/10.1016/j.explore.2016.08.002
- https://doi.org/10.1002/yd.20097
- https://doi.org/10.1108/JCS-07-2013-0024
- https://www.tandfonline.com/doi/abs/10.1080/1754730X.2014.920135

FOR MORE INFORMATION

https://hlfinc.org

Integra Mindfulness Martial Arts Program

Integra Mindfulness Martial Arts™ is a group treatment program for adolescents with mental health issues and/or learning disabilities (LD). It is offered by the Integra Program at the Child Development Institute at Ryerson University in Toronto, Ontario, and was developed in 2002 by Paul Badali, a Registered Social Worker at Integra.

Adolescents with a variety of conditions, including but not limited to ADHD, anxiety, depression, and oppositional defiant disorder are treated together in the same martial arts class. Each class has eight students and is led by a trained child and family therapist, who is also qualified in meditation and martial arts.

The goal is to improve problem-solving skills and social, emotional well-being by allowing students to experience and then integrate distress in a structured, social environment. The approach weaves mindfulness, cognitive therapy, and behavioral therapy into mixed martial arts training. The martial arts framework promotes engagement in therapy for those who would not normally be interested in conventional talk therapy. It also builds self-confidence in body and mind by teaching students how to behave in a challenging environment. This strengthens awareness and control of the fight, flight or freeze response (an instinctive, midbrain reaction that happens under stress or trauma).

According to its website, studies on the program have shown results in "reduced externalizing behaviour (e.g., aggression) in youth with ADHD+LD compared to a waitlist control (Haydicky, Weiner, Badali, Ducharme, & Milligan, 2012); decreased self-reported anxiety in youth with LD + anxiety compared to a waitlist control (Haydicky, Weiner, Badali, Ducharme, & Milligan, 2012); significant gains on EEG indices of attention compared to a waitlist control (Sibalis et al., in press; Milligan et al., submitted); significant gains in secondary control and realistic thinking compared to a waitlist control (Milligan et al., 2017)" (Ryerson University Child Self-Regulation Laboratory, 2019).

The course consists of 90-minute sessions, once a week for 20 weeks. To date, more than 450 youth have gone through the program.

AVAILABLE RESEARCH

- https://www.researchgate.net/publication/257794604_Evaluation_of_a_Mindfulness-based_Intervention_for_Adolescents_with_Learning_Disabilities_and_Co-occurring_ADHD_and_Anxiety

- https://www.researchgate.net/publication/271767797_Using_Integra_Mindfulness_Martial_Arts_to_Address_Self-regulation_Challenges_in_Youth_with_Learning_Disabilities_A_Qualitative_Exploration

- https://psychlabs.ryerson.ca/childselfregulation/research/integra-mindfulness-martial-arts/

- http://www.excellenceforchildandyouth.ca/sites/default/files/gai_attach/EIG-1155_Final_Outcomes_Report.pdf

FOR MORE INFORMATION

https://psychlabs.ryerson.ca/childselfregulation/research/integra-mindfulness-martial-arts/

Learning to BREATHE

Learning to BREATHE (L2B) is a developmentally-appropriate, mindfulness-based curriculum designed to be integrated into classroom instruction. It was created by Dr. Patricia C. Broderick, who is a licensed clinical psychologist as well as a certified school psychologist and counselor for grades K–12. The course is designed for adolescents and college-age students.

L2B seeks to build focused attention and emotion regulation, develop prosocial emotions like gratitude and compassion, increase stress management skills, and promote the integration of mindfulness into daily living. The program covers six themes that can be adapted to a 6-, 12-, or 18-session program. Each lesson starts and ends with a mindfulness practice, including an overview of the session and an interactive group activity and discussion.

Teachers participate in a two-three day training that emphasizes demonstration and practice, preparing participants to teach L2B in their classrooms. Teacher resources include outcome assessments, audio practice files, and a workbook that can be personalized.

The 2015 CASEL Guide highlighted L2B in its "Conclusions and Future Directions" section as one of four programs designed to promote mindful awareness that met CASEL's research criteria and that could supplement SEL programs and may itself have the potential to facilitate SEL (CASEL, 2015).

According to its website, "L2B is designed to coordinate with curriculum standards for health, developmental guidance or other academic areas in secondary schools...Currently, ten published, peer-reviewed studies have demonstrated its effectiveness, and several more studies are currently underway" (Learning to BREATHE, 2019).

AVAILABLE RESEARCH

- https://learning2breathe.org/research-2/
- https://learning2breathe.org/list-of-published-studies-and-reviews/
- https://learning2breathe.org/category/studies/
- https://learning2breathe.org/wp-content/uploads/2018/05/Broderick__Metz_2009.pdf
- https://learning2breathe.org/wp-content/uploads/2018/05/Metz-et-al-2013.pdf

FOR MORE INFORMATION

https://learning2breathe.org/introduction/

Mindful Life Project

Mindful Life Project (MLP) delivers school-based mindfulness and SEL programs to underserved elementary and middle schools in the Bay Area. The program is adopted from the Mindful Schools curriculum (www.mindfulschools.org) with adjustments incorporated to address self-awareness, self-regulation, resilience, empathy, and social awareness.

MLP was founded in 2012 by JG Larochette, the organization's Executive Director. As an elementary school teacher in Richmond, California, Larochette became concerned about the social and emotional needs of his students. He experimented with various ways to address these needs and began to see positive behavioral and academic results when incorporating mindfulness, yoga, expressive arts, and performing arts into the classroom. Today, MLP integrates these techniques into its three main offerings, Rise Up, Mindful Community, and Mindful Educator Training.

Rise Up is a school intervention program that delivers mindfulness training through the arts, yoga,

and hip hop to small groups of high-risk students referred by teachers and administrators. These participants are partnered with high-performing students to help build a supportive community. It teaches two 50-minute sessions per week throughout the school year, organized in three 8-week, themed rotations. In 2019, Rise Up reached 240 students at six Title I schools.

Mindful Community offers weekly 25-minute mindfulness and SEL instruction to each classroom in a school, to teachers, parents, and other interested community members. In 2019, this program served more than 10,000 students at 22 Title 1 elementary and middle schools in the Bay Area.

Mindful Educator Training is a 2-day program designed for educators and other youth-serving professionals. The program offers curriculums for TK-2nd grade and grades 3-8. The training covers the fundamentals of bringing mindfulness and SEL practices into the classroom through "culturally relevant pedagogy." In 2019, MLP trained 500 educators and 150 parents. For those adults wishing to go deeper, MLP's Mindful Educator Fellowship hosts a six-week intensive to help teachers build a personal mindfulness practice, and to learn to teach mindfulness and SEL practices to their students. More than 250 teachers, 50 school psychologists, 60 occupational therapists, and 75 speech therapists have participated in the fellowship.

To date, MLP curricula have served more than 25,000 students.

AVAILABLE RESEARCH

- http://www.mindfullifeproject.org/results.html

FOR MORE INFORMATION

http://www.mindfullifeproject.org/

Mindful Schools

Started in 2007 in Oakland, California by a small group of educators, social justice professionals, and mindfulness experts, Mindful Schools curriculum was specifically designed for underperforming, under-resourced public schools to manage the effects of toxic stress on students and faculty. The program teaches educators and students mindful breathing and body exercises, sensory awareness, and appreciation of thoughts and emotions. Grade-specific curricula are available for Pre-K–2, K-5, and 6–12 and are focused on stress management, emotion regulation, and interpersonal communication.

Each level has approximately 25-30 modules. Lessons are taught in 15-minute increments, 2-3 times per week. Each lesson includes discussions about incorporating mindfulness into daily life, and an optional 5-minute journaling period. Teacher manuals, student workbooks, program evaluations, and a professional online community and resource center come with each level.

Mindful Schools offers three separate trainings for teachers: Mindfulness Fundamentals, Mindful Educator Essentials, and Mindful Teacher Certification Program. (Trainings offer educator credits and mental health provider continuing education units.)

Mindfulness Fundamentals is a self-directed, online course that runs for six weeks. It covers mindfulness basics, mindfulness research, and brain science. It is a prerequisite for the more advanced educator trainings.

Mindful Educator Essentials trains educators in a K–12 mindfulness curriculum through a six-week, self-paced, online course. Once trained, teachers can use the curriculum in the classroom or in other youth-serving settings. Educators learn to use developmentally appropriate language to introduce mindfulness concepts and activities to different

grade levels. Training also covers: mindfulness and neuroscience research related to youth, attention, and emotion; group facilitation and classroom management strategies; and advocacy resources.

Mindful Teacher Certification Program is a 300-hour, year-long, blended-learning certification program that starts and finishes with a residential retreat. It is for educators who want more intensive training in their personal mindfulness practice, and who want to learn more ways to teach experiential mindfulness curricula to various audiences in their schools and communities.

More than 50,000 educators, parents, and mental health professional have been trained by Mindful Schools, reaching over 3 million children in over 100 countries.

Mindful Schools has been featured in two documentaries, Room to Breathe (2012) and Healthy Habits of Mind (2014).

AVAILABLE RESEARCH

- https://www.mindfulschools.org/about-mindfulness/research/
- https://www.mindfulschools.org/pdf/Mindful%20Schools%20Pilot%20Study%20Whitepaper.pdf

FOR MORE INFORMATION

https://www.mindfulschools.org/

Muse

Muse is a neurofeedback-based app and wireless headset that offers "technology enhanced meditation" for the user through immediate audio feedback about their brain state. It is intended to develop sustained undistracted attention and promote calmness and relaxation. Muse is a product of InteraXon Inc., a brain-sensing technology company launched in 2014

by co-founders Ariel Garten (psychotherapist), Chris Aimone (product developer), and Trevor Coleman (product designer). It can be used by children and adults.

Seven electroencephalogram (EEG) headset sensors detect and measure the brain's electrical activity during meditation and the app deciphers the data. If the sensors detect calmness, a user will hear calm nature sounds; if the sensors detect restlessness, a user will hear stormy weather as encouragement to return to a calmer, more focused frame of mind.

The Muse Meditation app works with the headset via Bluetooth, transmitting brainwave information to the user's smartphone or tablet. The app generates graphs and charts that allow users to review results and track progress. Muse 2, the most recent model, has additional features that track heart rate, breath rate, and posture.

The original Muse headband works with the EEG 101 app—a free and open-source software currently available for Android devices—that helps students experientially understand the neuroscientific basis for how EEG technology works and the types of related data that can be visually represented. The Muse Research Tools available directly through InteraXon provide similar educational opportunities to work with raw EEG data.

MUSE reports reaching hundreds of thousands of users and being in over 200 research institutes worldwide, including MIT, Harvard, The Mayo Clinic, and Walter Reed Hospital.

Research projects utilizing Muse include understanding how decisions are made, measuring brain responses to cognitive task and different types of emotional or educational content, managing pain, detecting lapses in sustained attention, and determining how brain activity is impacted by age (Garten, A., n.d.; Muse, 2018).

Muse was nominated in 2019 in the 23rd Annual Webby Awards presented by the International Academy of Digital Arts and Sciences (IADAS) for Best in Apps, Mobile, and Voice: Connected Products & Wearables. In 2014, it won the User Experience Award Silver Prize for Best Next-Generation Experience.

AVAILABLE RESEARCH

- https://choosemuse.com/muse-research/
- https://medium.com/@choosemuse/denver-public-schools-incorporates-muse-into-curriculum-89c8608e51c8

FOR MORE INFORMATION

https://choosemuse.com/

NeuroTracker

NeuroTracker is an online, three-dimensional multiple object tracking (3D-MOT) training program that offers a series of visual exercises aimed at improving attention, awareness, working memory, and processing abilities. The product addresses attention deficits and other compromised EF skills and is designed to promote mental clarity and focus. This perceptual-cognitive training system was developed over 20 years by optometry professor and neuroscientist Dr. Jocelyn Faubert in his lab at the School of Optometry at the University of Montreal. It can benefit a wide range of users, including students with learning difficulties and those looking to improve already strong academic performance.

Users view a series of balls on a screen that are moving randomly. The movement stops, and two or more balls are highlighted momentarily. The user is then instructed to track these targets when motion continues (and the balls are no longer marked), and successfully select them when motion stops again. The program is being used to improve

situational awareness and response times in many academic and elite-performance settings (including the NFL and the Canadian military). Research has shown that NeuroTracker training results in significant improvements in EF skills (including working memory and inhibition control), attention, and processing speed, and it has demonstrated effectiveness in assisting children with learning difficulties. Additional studies have shown that NeuroTracker training heightened neocortical brain activity.

NeuroTracker is available for school and home use. Supervision is not needed, and teachers have access to an online portal to review student results. The sessions are 6 minutes long and recommended for use 2-3 times per week. The product is programmable for speed and challenge levels and can be managed and monitored remotely.

NeuroTracker's scope of research populations include children, university students, elite athletes, military personnel, medical school students, and the elderly. Research partners include universities in Canada, the U.S., Brazil, and Spain.

Neurotracker reports reaching more than 400,000 users.

AVAILABLE RESEARCH

- https://neurotracker.net/organizations/scientific-studies/

FOR MORE INFORMATION

https://neurotracker.net/learning/

Peace In Schools

Peace in Schools was established in Portland, Oregon in 2014. It is the first for-credit high school mindfulness course in the nation. Its goal and vision is to make mindfulness a "valued discipline" in high schools. The program was founded by Caverly

Morgan, a mindfulness practitioner for more than 20 years, with 8 years of training in a silent Zen monastery. Morgan currently heads up the Peace in Schools teaching team.

The in-school course focuses on four elements of mindfulness: meditation, movement, communication, and compassion. The program also offers Teen Mindfulness Nights for practice outside of class and Teen Mindfulness Retreats for practice in nature.

According to its website, students in the program's Mindful Studies class across high schools had the following outcomes: 97% report positive changes in their emotional and mental state after participating in the full-credit Mindful Studies course; 99% report multiple physical benefits such as increased flexibility and balance; 92% report less stress, tension, and anxiety; 94% also use the mindfulness tools outside of school; 98% would recommend the courses to their peers (Peace in Schools, n.d.).

Educators at participating schools are introduced to the curriculum at a weekend training, followed by an 8-week intensive course that digs into the neuroscience behind mindfulness. Teacher training also includes a 4-day Mindful Educator retreat, and a Mindfulness and the Brain course offered online that examines the fundamentals of interpersonal neurobiology.

In addition to being in 10 public high schools in Portland, Peace in Schools also partners with social services and alternative schools, providing trainings to professionals in those organizations.

AVAILABLE RESEARCH

- https://www.peaceinschools.org/mindfulness-research/

FOR MORE INFORMATION

https://www.peaceinschools.org/

Play Attention

Play Attention is a comprehensive, attention-training neurofeedback system that develops core cognitive EF skills. Students take part in computer game-like exercises by wearing an armband that tracks bioindicators of attention states and cognitive processes. To meet the challenges of each exercise and advance the game, the "player" must achieve and maintain desired brain states. Visual and auditory signals notify the user about their focus level. Play Attention calls this "Edufeedback," as it helps shape behavior and educational focus.

Play Attention is recommended for users ages 6–adult who have focus and attention challenges and have an IQ above 65. It specifically targets those with ADHD through full-service packages that extend beyond the computer-based games to include exercise, nutrition, mindfulness, coaching, behavior shaping, and parent training. Play Attention is offered by Unique Logic & Technology, Inc., founded in 1994 by teacher Peter Freer and developed in partnership with multiple academic institutions and psychologists.

The program begins with games for working memory, spatial memory, short-term memory, planning, finishing tasks, and overall focus and attention. It then addresses basic math, social cues, motor skills, auditory processing, homework skills, and tasks specific to the individual.

Play Attention offers packages for professional or home use. According to its website, schools interested in adopting the technology are given the software, the BodyWave® armband, interface box, Bluetooth dongle, user manual, behavior shaping charts, all behavioral management materials, free and unlimited technical and educational support, a full introductory tutorial over the phone, an interactive manual with audio and video clips, and an unlimited user-license. Training is available for educators to become Play Attention coaches and

takes approximately 2 hours to work through the free tutorial with a company representative.

Additional features of the Play Attention system include FOCUS Assessment and Sheer Genius™. FOCUS Assessment measures different aspects of attentional control, which can be reviewed with a Play Attention specialist to understand results and build customizable Play Attention programs for each user. Sheer Genius™ is a virtual coach that helps set developmentally appropriate performance goals, identifies problem behaviors to encourage adjustments toward accurately completing tasks, automatically calibrates challenge levels based on performance, and motivates through positive reward systems.

Effects of Play Attention have been studied by Tufts University School of Medicine in three randomized controlled trials conducted in Boston public schools. These studies showed that students who participated in Play Attention training had greater improvements in attention, hyperactivity, and executive functioning than students participating in other kinds of brain games (Rodden, 2019).

AVAILABLE RESEARCH

http://www.playattention.com/index.php/our-program/clinical-studies

FOR MORE INFORMATION

http://playattention.com/

Quiet Time

Quiet Time is offered by the David Lynch Foundation, which was founded in 2005 to bring the evidence-based techniques of Transcendental Meditation® (TM) to at-risk populations to improve health, emotional well-being, behavior, and cognitive function. To date, Quiet Time has served hundreds of thousands of students (and teachers) in inner-city

schools within high-poverty neighborhoods both in the U.S. and internationally.

Quiet Time is available for grades 5–12 and requires commitment to a full-school adoption. This is intended to ensure the program has the most effective positive impact on school and classroom culture and on the academic and behavioral outcomes of all participating students. The program offers TM to students twice a day for 15-20 minutes each as a way to relax the central nervous system and decompress from tensions while developing EF skills and physiologically readying the brain for learning. Practice requires students to sit comfortably with closed eyes using a specific technique that settles thoughts and allows students to experience a calm, relaxed sense of awareness. TM is a type of secular meditation that reinforces a brainwave pattern associated with EF development and increased alertness (Hebert et al., 2005).

Quiet Time school-based implementations follow distinct steps. First, school leadership receives TM training followed by faculty training. Then the school principal signs a letter of intent, gains approval from the school's governing body, garners parent and faculty buy-in, and adjusts the school-day schedule to accommodate the Quiet Time sessions. Finally, students who wish to participate (and who have parental permission) receive daily instruction from certified full-time Quiet Time TM instructors. Students who do not wish to participate in TM are required to quietly engage in an educational activity like reading. Quiet Time staff remain available for faculty coaching and capacity building as well as for student support. Each school is assigned a Quiet Time Site Leader and a team of full-time program instructors who are responsible for delivering the daily program sessions and offering workshops, events, assemblies, and school coaching to promote TM practices across curricular and co-curricular structures.

According to its website, research on schools that have adopted Quiet Time have shown: gains in test scores; better student creativity happiness, focus and self-confidence; reduced student psychological distress; reduced ADHD symptoms and other learning disorder symptoms; fewer suspensions and violent conflicts; and improved teacher retention (David Lynch Foundation, 2019).

Quiet Time is currently partnering with SRI International (formerly Stanford Research Institute) to document program outcomes and optimal implementation protocols.

AVAILABLE RESEARCH

- https://eric.ed.gov/?id=EJ1081698
- https://eric.ed.gov/?id=EJ996375
- https://eric.ed.gov/?id=EJ952157
- https://eric.ed.gov/?id=EJ1032007
- https://cdn.theatlantic.com/assets/media/files/quiet-time-white-paper.pdf
- http://cwae.org/research_intro.php

FOR MORE INFORMATION

https://www.davidlynchfoundation.org/schools.html

TNT Reading

Test 'n' Train Reading (TNT) is available through BrainTrain, the company that also offers Captain's Log Mindpower Builder. BrainTrain was founded in 1989 by Joseph A. Sandford, PhD, a clinical neuropsychologist. The company offers TNT as a comprehensive reading system for ages K-3. TNT tests and trains children to read by first using a variety of diagnostics that identify difficulty areas, and then adapts computerized cognitive lessons with over 1,000 exercises to help children progress in proficiency in their deficit areas, continuing to test periodically for skill development.

This early intervention program works on developing the cognitive skills necessary for reading comprehension, including attention, working memory, mental processing speed, auditory discrimination, letter recognition, and phonics. To help keep students motivated, non-violent video game-like features in the program allow students to take breaks from the main computer-instructed exercises while still developing processing speed.

TNT can be configured to run automatically, customize criteria for level advancement, choose a standard or accelerated mode, determine if testing should precede or follow training, alternate exercises between reading mastery and reading comprehension, and acknowledge effort even if success isn't reached within a level. Additionally, the new BrainPower™ neurofeedback option enhances the regular training by giving students feedback on their mental state while they read, encouraging a calm, alert, and positive approach to reading.

Included in the digital downloadable (or DVD) package are unlimited reading assessment tests for regular monitoring of progress. The TNT exercises follow the national Common Core Standards.

The founders of TNT have more than 25 years of reading research. In 2012, TNT won the Silver Award from TopTenREVIEWS for its design and The Mom's Choice Awards® that recognizes programs that offer high-quality family media, products and services.

AVAILABLE RESEARCH

- https://www.braintrain.com/tnt-reading-research/
- https://academic.oup.com/acn/article/31/6/601/2240061

FOR MORE INFORMATION

https://www.braintrain.com/tntreading-edu/

Understanding Evidence-Based Interventions and the Every Student Succeeds Act (ESSA)

In December 2015, ESSA passed into law. It replaced the No Child Left Behind Act (NCLB) and is a reauthorization of the Elementary and Secondary Education Act (ESEA) of 1965. This reauthorization raised the bar for school interventions, from research-based in NCLB to evidence-based through ESSA's "Evidence of Effectiveness" criteria.

According to Results for America's May 2017 policy report, ESSA "gives state education agencies (SEAs), local education agencies (LEAs), and schools more opportunities to design their own educational systems. At the same time, ESSA also requires in some parts (and encourages in others) the use of evidence-based approaches and continuous improvement to help leverage greater student success with federal funds. Indeed, ESSA represents a shift from the compliance-based frame of the No Child Left Behind Act to one premised on state and local authority to take evidence-based actions and continuously improve education systems and student outcomes over time" (Results for America & Council of Chief State School Officers, 2017).

DEFINING EVIDENCE-BASED

Evidence-based is broadly defined in section 8101(21)(A) of the ESEA as follows:

> *"… the term 'evidence-based,' when used with respect to a State, local educational agency, or school activity, means an activity, strategy, or intervention that—(i) demonstrates a statistically significant effect on improving student outcomes or other relevant outcomes based on—(I) strong evidence from at least one well-designed and well-implemented experimental study; (II) moderate evidence from at least one well-designed and well-implemented quasi-experimental study; or (III) promising evidence from at least one well-designed and well-implemented correlational study with statistical controls for selection bias; or (ii) (I) demonstrates a rationale based on high-quality research findings or positive evaluation that such activity, strategy, or intervention is likely to improve student outcomes or other relevant outcomes; and (II) includes ongoing efforts to examine the effects of such activity, strategy, or intervention."*

However, the type of grant an applicant is seeking determines the definition of evidence used. This is largely because federal education awards fall into two major types of grants—*formula grants* and *discretionary grants,* and each uses a slightly different approach to defining evidence.

TYPES OF GRANTS

Entities eligible for ESEA grants can include schools, local educational agencies (LEAs), state educational agencies (SEAs), other educational agencies, nonprofit organization, and institutions of higher education. Jonathan Jacobson, PhD at the National Center for Education Evaluation and Regional Assistance, a division of the U.S. Department of Education's (ED) Institute of Education Sciences, summarizes the two major types of grants and their applicable tiers-of-evidence definitions as follows:

- **Discretionary grants** (which include competitive grants), are subject to a uniform set of evidence standards. In July 2017, the ED updated the evidence definitions that apply to its discretionary grants. These Education Department General Administration Regulations (EDGAR, 34 CFR 77.1) use the ED's What Works Clearinghouse (Institute of Education Sciences, 2019) tiers-of-evidence ratings of reviewed studies to determine a consistent scientific base of evidence across interventions relative to improved student outcomes. This threshold for tiers 1 and 2 is more rigorous than the broader

definition in section 8101(21)(A) of the ESEA. A comprehensive overview of the considerations that make up these discretionary grant tiers of evidence can be found in Appendix 5.) When the ED issues a Notice Inviting Applications (NIA) that includes EDGAR evidence definitions, it will specify which of these tiers of evidence applies to the funding opportunity.

- **Formula grants** (or block grants) are determined based on a preset formula, so that states and schools can annually plan on federal monies. With regards to evidence-base considerations, awardees determine how to use these funds, within the looser parameters set out in section 8101(21)(A) of the ESEA. They are not obligated to follow the non-regulatory guidance published by the Department of Education in September 2016, and awardees can rely on other sources of information including Technical Assistance (TA) partners to make a case for evidence and outcomes. Where formula grants are concerned, What Works Clearinghouse reviews are optional, relative to definitions of evidence.

Tiers of Evidence for the U.S. Department of Education's Discretionary Grants

T ier 1 and Tier 2 evidence requirements for U.S. Department of Education's discretionary (a.k.a competitive) grant programs can be determined by the What Works Clearinghouse Individual Study Reviews, Intervention Reports, or Practice Guides. The following charts offer a comprehensive overview of the considerations related to discretionary grants tiers-of-evidence definitions. A Notice Inviting Applications (NIA) from the Department will specify which tier of evidence is required to apply for the related funding opportunity.

WHAT WORKS CLEARINGHOUSE (WWC) INDIVIDUAL STUDY REVIEW

Individual studies that have been reviewed by the WWC and categorized into ESSA evidence tiers

		Description	WWC Rating Required (based on WWC Handbook Version 2.1 or 3.0)	WWC'S Findings for Relevant Outcome
Tiers of Evidence for U.S Dept. of Ed. Discretionary (a.k.a Competitive) Grants	Tier 1: Strong Evidence	Based on at least one well-designed, well-implemented experimental study— including a randomized control trial, a regression discontinuity design, or a single-case design.	Without Reservation	Demonstrates statistically significant and positive of a project component on at least one relevant outcome, with no overriding statistically signfiicant and negative effects on relevant outcomes reported in the study or in a corresponding WWC intervention report (under version 2.1 or 3.0 of the WWC Handbook. Note: version 4.0 schedule for effect soon)
	Tier 2: Moderate Evidence	Based on at least one well-designed, well-implemented quasi-experimental study, or based on an experimental study considered as good as or better than a quasi-experimental study.	Without Reservation or With Reservation	Demonstrates statistically significant and positive for at least one relevant outcome, with no overriding statistically signfiicant and negative effects on relevant outcomes reported in the study or in a corresponding WWC intervention report (under version 2.1 or 3.0 of the WWC Handbook. Note: version 4.0 schedule for effect soon)
	Tier 3: Promising Evidence	Based on at least one well-designed, well-implemented correlational study with statistical controls for selection bias, or based on an quasi-experimental study or experimental study.	WWC rating not required; but a study (as opposed to an experiment) was conducted to show that a relationship exists between an intervention and a given outcome, typically through data collection and analysis.	Demonstrates statistically significant and positive for at least one relevant outcome, with no overriding statistically signfiicant and negative effects on relevant outcomes reported.
	Tier 4: Evidence that Demonstrates a Rational	A key project component included in the project's logic model (a.k.a. the framework that identifies key project components hypothesized to be critical to achieving the relevant outcomes and that describes the theoretical and operational relationship among the key project components and relevant outcomes) is informed by research or evaluation findings that suggest the project component is likely to improve relevant outcomes. Finding can come from an experimental study, quasi-experimentals study, correlational study with statistical controls for selection bias, or some other high-quality research study or evaluation.	WWC rating not required; but should have a clear and effective logic model/theory of action which explains how the intervention is likely to improve relevant outcomes; be supported by research in the field; and have an effort underway to study the effects of the intervention by the state educational agency, local educational agency, or outside research organization to determine effectiveness and impact.	No formal evidence may currently exist.

Notes: To see if a study has been reviewed, go to individual studies database and search by author, year, title, or by topic area; check for the Handbook version, study rating, and at least one statistically significant and positive finding; also see if there is a corresponding WWC Intervention Report, and if so, check it to be sure there is no negative effectives that are statistically significant; check an individual study's "Details" tab to see sample size and sites; and check the "Sample Characteristics" tab to see sample demographics (e.g. grade level, socioeconomic status, race/ethnicity, English-learners, students with disabiliities, migrant populations, gender, etc.) and setting (e.g. rural/ urban/suburban, public/private/charter) to compare overlaps with proposed project.

Study Sample (alone or in a combination of studies if show same level of evidence, with similar population and setting)

Sample Size	Multi-Site	Overlaps with proposed student population	Overlaps with proposed setting
350 or more individuals	> 1 state, county, city, district or post-secondary campus	Required	Required
350 or more individuals	> 1 state, county, city, district or post-secondary campus	Overlap is required for either proposed population or proposed setting	Overlap is required for either proposed population or proposed setting
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Sources: Institute for Education Sciences, 2018a; Institute for Education Sciences, 2018b; California Department of Education, 2018

WWC INTERVENTION REPORT

Based on a systematic review of all studies associated with an intervention.

		WWC's "Effectiveness Rating" for Relevant Outcomes	WWC's "Extend of Evidence" Rating	Populations and Setting	
				Overlaps with proposed student population	Overlaps with proposed setting
Tiers of Evidence for U.S Dept. of Ed. Discretionary (a.k.a Competitive) Grants	Tier 1: Strong Evidence	"Positive effect," with no reporting of a "negative effect" or "potentially negative" effect under WWC Handbook version 2.1 or 3.0	"Medium to large"	Required	Required
	Tier 2: Moderate Evidence	"Positive effect" or "potentially positive effect" with no reporting of a "negative effect" or "potentially negative effect"under WWC Handbook version 2.1 or 3.0	"Medium to large"	Overlap is required for either proposed population or proposed setting	Overlap is required for either proposed population or proposed setting
	Tier 3: Promising Evidence	"Positive effect" or "potentially positive effect," with no reporting of a "negative effect" or "potentially negative effect" under any version of the WWC Handbook	Either "small" or "medium to "large"	Overlap with neither required	Overlap with neither required
	Tier 4: Evidence that Demonstrates a Rational	N/A	N/A	N/A	N/A

Notes: Appendix A of Intervention Reports provides info on sample populations and settings

Sources: Institute for Education Sciences, 2018a; Institute for Education Sciences, 2018b; California Department of Education, 2018

WWC PRACTICE GUIDE

Characterizes the evidence supporting a set of recommendations made by a panel of researchers and practitioners focused on instruction in a certain topic area.

		Evidence under WWC Handbook for practice recommendation cited for a proposed project component.[1]	*Populations and Setting*	
			Overlaps with proposed student population	Overlaps with proposed setting
Tiers of Evidence for U.S Dept. of Ed. Discretionary (a.k.a Competitive) Grants	Tier 1: Strong Evidence	"Strong evidence" base from WWC Handbook version 2.1 or 3.0	Required	Required
	Tier 2: Moderate Evidence	"Strong evidence" base or "moderate evidence" base from WWC Handbook version 2.1 or 3.0	Overlap is required for either proposed population or proposed setting	Overlap is required for either proposed population or proposed setting
	Tier 3: Promising Evidence	"Strong evidence" base or "moderate evidence" base from any version of the WWC Handbook	Overlap with neither required	Overlap with neither required
	Tier 4: Evidence that Demonstrates a Rational	N/A	N/A	N/A

[1] Recommendations based on "minimum evidence" do not qualify as strong, moderate, or promising under the Department of Education's evidence definitions.

Notes: When using a Practice Guide to demonstrate evidence, the applicant should site a specific practice recommendation in the guide relevant to the proposed project and that meets the evidence requirements defined by the notice inviting applications. Additionally, Practice Guide recommendations based on "minimum evidence" do not qualify as strong, moderate, or promising under the Department of Education's evidence definitions.

Sources: Institute for Education Sciences, 2018a; Institute for Education Sciences, 2018b; California Department of Education, 2018

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