KEYNOTE

Building the Cognitive Foundation for Reading Success

What the Research Reveals About Working Memory,
Processing Speed, and Lasting Gains

Dr. Carol T. Brown, Ed.D. - Rise to the Challenge - equippingminds.com

Why This Matters to Me

Before I developed Equipping Minds, I was a parent searching for hope.

Our son Clayton was diagnosed with a language processing disorder and symptoms of dyslexia, dyscalculia, and dysgraphia. He did not speak his first sentence until he was four. At five, a school turned him away because he scored lower than any other applicant. Thankfully, an educator saw his potential. He scored 99% on phonemic awareness but was not reading.

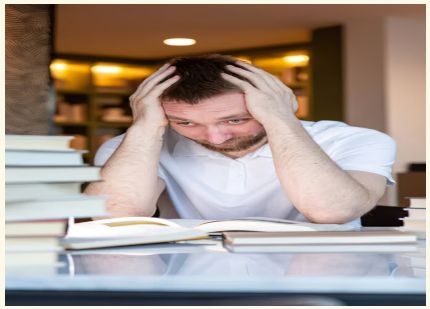
Underneath the reading struggle were slow processing speed and weak working memory. At a dyslexia conference, I finally heard his struggles described, and heard the word hope. When he was 8, he would do an intensive intervention for 4 hours a day, 5 days a week for 8 weeks. While he was reading and comprehending, he would eventually hit a wall at 16. He said he couldn't process the information or hold on to it as fast as it came at him. The hope we had previously felt turned to despair. It seemed like an unending battle. In reviewing his testing, his processing and working memory scores were the greatest challenge. This was the obstacle that needed to be overcome.

"There is so much in there that wants to get out."

The educator who first saw Clayton's potential

Clayton Brown, B.S., Boyce College (2014)

The Session Overview



The Problem

Why strong reading instruction does not always stick.



The Demonstration

What cognitive training feels like.



The Research

Peer-reviewed studies, independent replications, and school implementation data.



The Unanswered Question

How does building executive functioning and cognitive skills change reading outcomes?

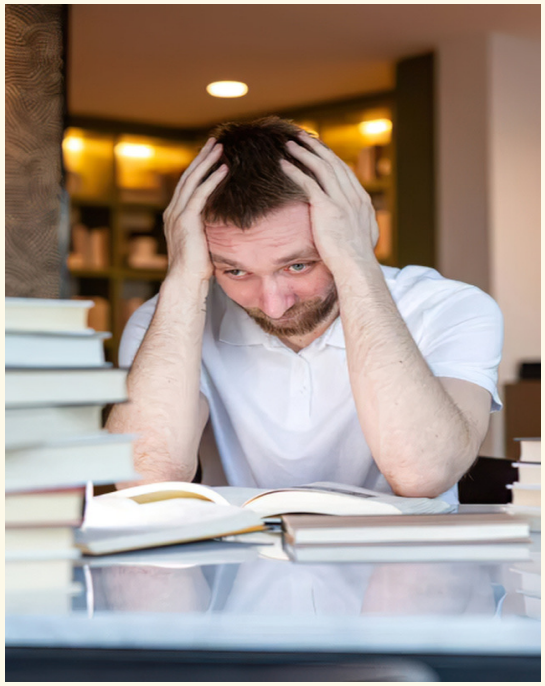
The Problem

Why do capable, motivated students who receive excellent reading instruction still struggle to retain it?

Dyslexia: Beyond Phonological Processing

The International Dyslexia Association's 2025 revised definition and accompanying explanation recognize that dyslexia is associated with a broader range of cognitive challenges, including working memory, processing speed, and visual processing.

These cognitive processes support learning and may influence how students acquire, process, retain, and apply reading-related information. The good news: that cognitive architecture is buildable in thirty minutes a day with Equipping Minds.



→

What we need: Executive Skills Behind Reading

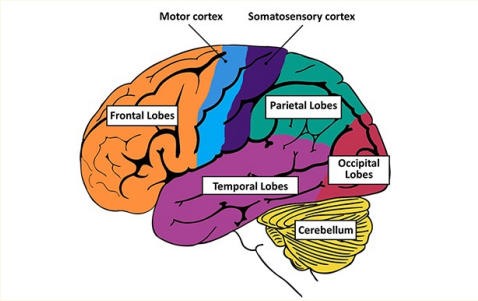
Executive skill	What it does in reading	How EMCDC builds it	Selected evidence
Working memory	Holds sounds long enough to blend them; holds the start of a sentence and the text's meaning while decoding.	Brown N-Back: 1 to 11 simultaneous attributes under timed load.	*Zhou et al. (2026); Brown et al. (2026)*
Inhibitory control (the Stroop mechanism)	Suppresses the first guess ("bring" for "bridge"), irrelevant details, and the wrong meaning of a word.	Stroop Animals and Stroop exercises: the controlled response over the automatic one.	*Zhou et al. (2026); Cartwright (2023)*
Processing speed	Turns accurate decoding into fluent reading before meaning is lost.	Timed N-Back, Colored Arrows, Number and Symbol Hunt.	*IDA (2025) definition*
Cognitive flexibility	Shifts between sounds and meanings, and between decoding and understanding; weaker in readers with specific comprehension difficulties.	Ten Categories and multi-attribute card games: rapid shifting between categories.	*Cartwright et al. (2019); Cartwright (2023)*
Planning and organization	Sets a purpose; uses word, sentence, and text structure to remember.	Ten Categories sorting; picture-sequence story retell.	*Cartwright (2023); Duke & Cartwright (2021)*
Social understanding	Infers characters' thoughts, feelings, and intentions.	Stare Cards: Socratic questioning with an image.	*Duke & Cartwright (2021); Cartwright (2023)*

Without the architecture: instruction arrives → working memory cannot hold it → it is lost → the student tries harder → conclusion: "low ability."
With EMCDC: instruction arrives → working memory holds it → inhibition blocks the guess → processing speed keeps pace → learning sticks.

Cartwright (2023), Executive Skills and Reading Comprehension (2nd ed.), Guilford; Duke & Cartwright (2021), Reading Research Quarterly, 56(S1); Cartwright et al. (2019); Zhou et al. (2026), Educational Psychology Review, 38, 67; Brown et al. (2026), Mind, Brain, and Education, 20(2); International Dyslexia Association (2025) definition.

Working memory and dyslexia: what the latest research shows

Recent meta-analyses (2024–2026) confirm that verbal working memory is among the most consistently documented cognitive weaknesses in dyslexia, and among the least directly addressed in intervention.



In plain words: the brain's "holding space" for sounds is the weakest link for many children with dyslexia, and it can be trained.

Verbal working memory showed the largest executive-function deficit in dyslexia (effect size 0.88); 1.00 with co-occurring ADHD.

Brown, Cornelius & Mecklin (2026), Mind, Brain, and Education, 20(2), meta-regression

Across 60 studies (275 effect sizes), executive functions were significantly associated with reading; updating (working memory) showed the largest association.

Zhou et al. (2026), Educational Psychology Review, 38, Article 67, meta-analysis

Children with specific learning disorders show moderate executive-function delays compared with typically developing peers.

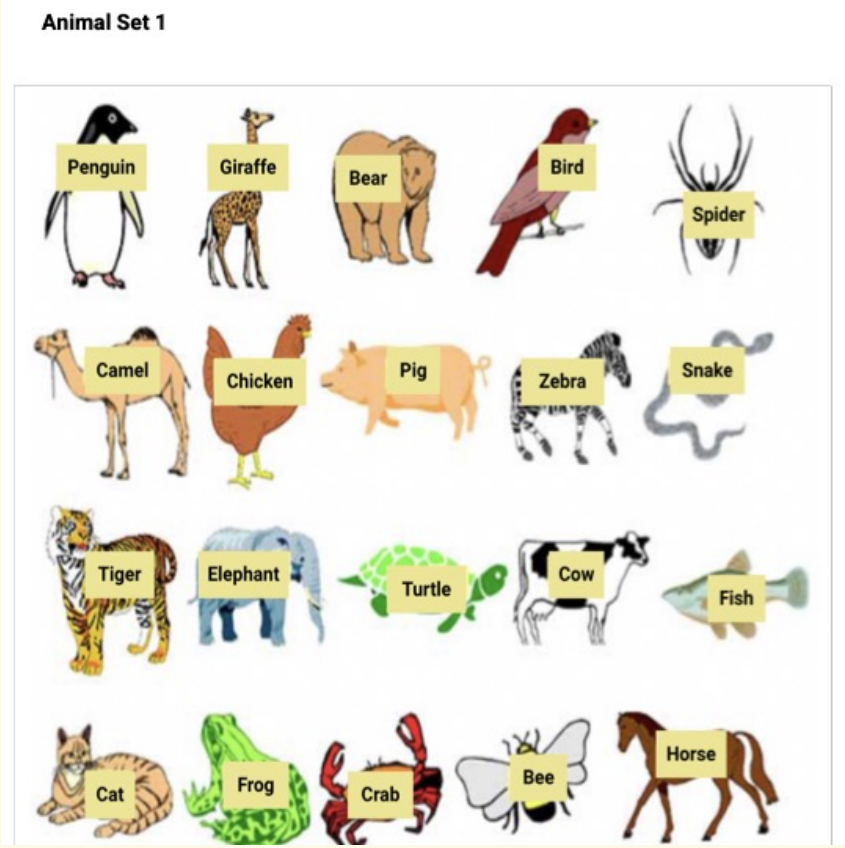
Sadozai et al. (2024), Nature Human Behaviour, 8(12), 2357–2366, meta-analysis

EXPERIENCE IT · ROUND 1

Stroop Animals

Name each picture aloud, left to right, as fast as you can.

Animal Set 1: word and picture agree. Notice how easy this feels.

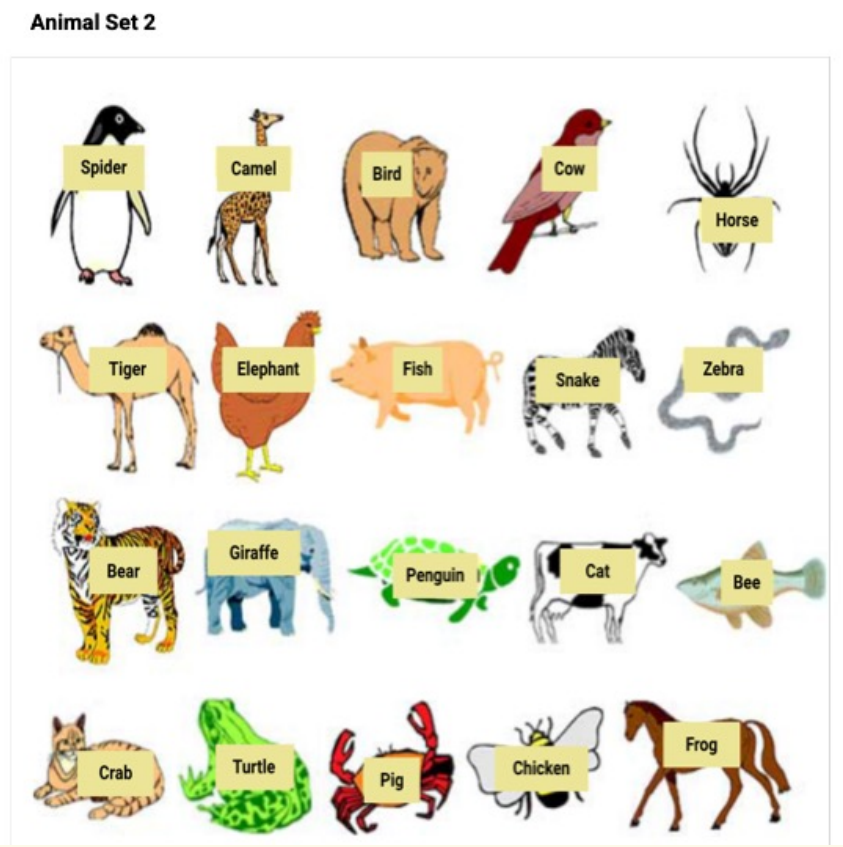


EXPERIENCE IT · ROUND 2

Now Try This

Name the picture. Ignore the word.

Animal Set 2: reading is automatic, so the word competes with the picture. Resolving that conflict takes inhibitory control and processing speed.



What You Just Felt

In the Stroop task	Executive function	In a struggling reader
Stopping the word from coming out	**Inhibitory control**	Stopping the guess, the wrong vowel, the look-alike word
How quickly you recovered	**Processing speed**	Fluency: how fast accurate decoding becomes automatic
Keeping the rule “picture, not word”	**Working memory**	Holding the rule, the sounds, and the sentence at once
Switching between Round 1 and Round 2	**Cognitive flexibility**	Switching between sound options, and between decoding and meaning

Every one of these capacities can be trained through graduated, mediated practice.



The Brown Six-Eleven N-Back

Standard N-Back: one attribute at a time (a letter or a position), usually on a screen.

EM Colored House Cards: graduated from sorting by one attribute to chaining eleven simultaneous attributes: color, shape, number, number word, letter, animal, and more. Human-mediated, with language built in.

Beyond shortcuts

Deliberate, human-mediated, graduated work: 30 minutes a day building the architecture reading instruction assumes students already have.

Every learner

Dyslexia and other learning disabilities, ADHD, auditory processing difficulties, Down syndrome, slow processing speed.

Any setting

Classrooms, resource rooms, clinics, homes, and tutoring, with Unifix cubes, EM Cards, and the EMCDC workbooks.

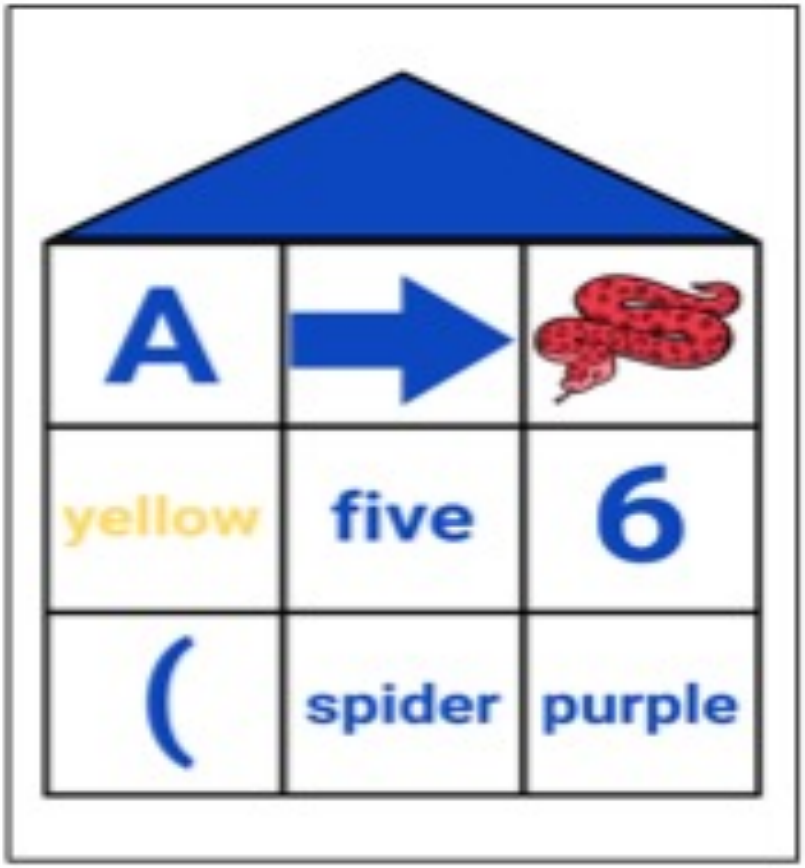
Colored Houses Beginner Cards



Always model first: “I see bear on bear.” Use only the elements the learner knows, and gradually add. All ages, Pre-K through adult.

Xtreme Level Cards

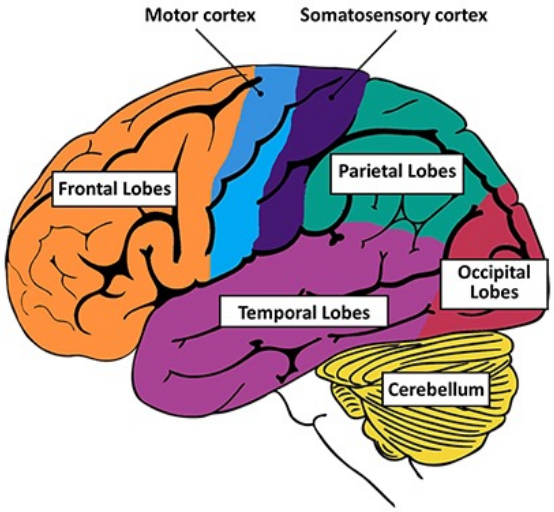




Where the N-Back Lives in the Brain

FRONTAL · Prefrontal cortex
The conductor: working memory holds every attribute together; inhibition (Stroop).

TEMPORAL LOBE
Sounds · letters · animals · presidents · months: naming, language, sequence.



PARIETAL LOBE
Numbers · directions: quantity and space.

OCCIPITAL LOBE
Colors · shapes · symbols · images: seeing.

CEREBELLUM
Timing, rhythm, and movement.

The demo: say one item aloud: “three, red, snake, box, i, C, kuh, Jefferson, March, right.” Each word is handled by a different part of the brain, so one item engages the whole brain at once.

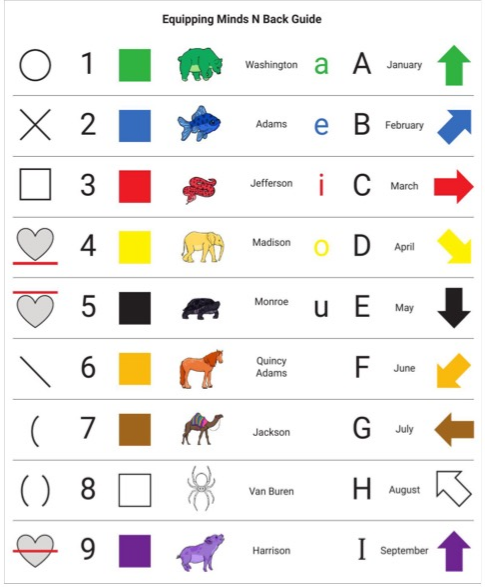
EMCDC 2026, pp. 18–19. Regions are educational approximations.

Reading Is Binding Many Codes to One Symbol

b

Shape: ball and stick, facing right
Name: “bee”
Sound: /b/
Pattern: b, bb, -be
Meaning: in bat, bed, bubble

A sight word forms only when spelling, sound, and meaning are bonded in memory. A child with dyslexia often cannot hold all the layers at once, so the letter does not stick.



The N-Back Code

One anchor, many layers, held together. Each number 1–9 carries a symbol, color, animal, president, vowel and letter sound, month, and direction.

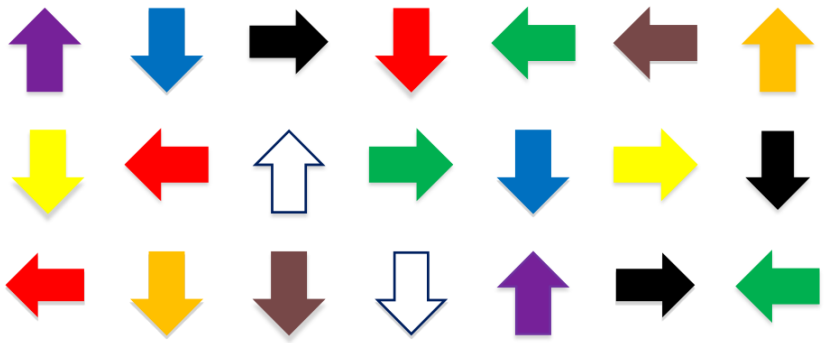
Like a letter, every code must be bound and held at once. That is the mental act reading requires.

Ancient Hebrew — **Aristotle** — **Comenius** — **Stroop, 1935** — **Feuerstein** — **Brown, 2009**

Foundational: Ehri (2014), Scientific Studies of Reading, 18(1); Perfetti (2007), Scientific Studies of Reading, 11(4).

EXPERIENCE IT · ROUND 3

Directionality Meets Reading



Colored Arrows: say the color, then the direction, then alternate: color, direction, color… Then, say b for a right arrow and d for a left arrow.

b b d b d d b

b d b d b b d

b d d d b b b

b and d: touch b with the right finger and d with the left. Say the direction, then "right b, left d," then "right /b/, left /d/."

Directionality comes first: secure left, right, up, and down on the Arrows before b and d. Then extend to p, q, m, and w.

Auditory Processing: Sounds in Order

To read and spell, a child must know how many sounds there are, their order, whether they are the same or different, and hold all of that in place. Short-vowel discrimination is essential.

Vowel Hunt: read the vowels and say the sounds, then alternate sound and color.
Phonics phone: the teacher models the letter name and sound; the child hears their own voice and repeats.
Letter by letter: say the name, say the sound, write it. Add a new letter only after mastery.
Sound therapy: part of the holistic approach for students who struggle here.



Works with any phonics program (Workbook 10.2).

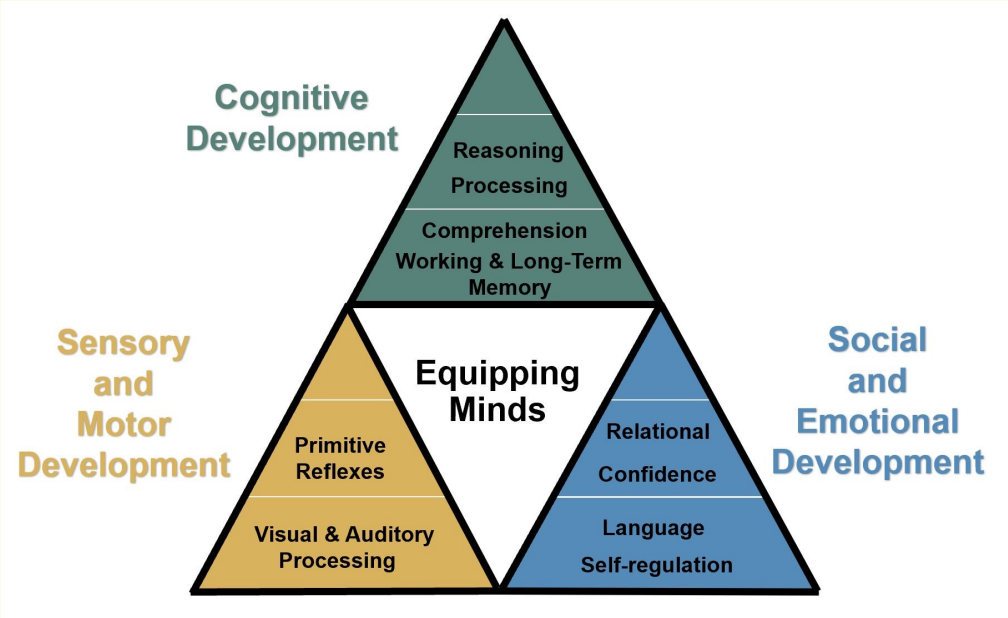


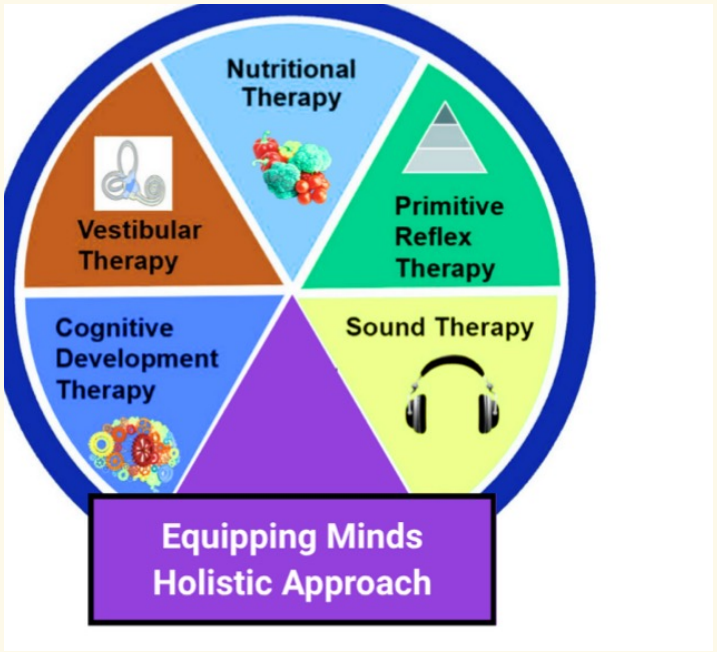
EMCDC

Equipping Minds Cognitive Development Curriculum addresses the cognitive access architecture that is foundational to learning.

It is designed to improve a learner's working memory, visual and auditory processing, attention, processing speed, logic, comprehension, language, social skills, executive functioning, behavior, and self-regulation.

Educating the Whole Learner





Cognitive training sits within the whole learner: sensory and motor, cognitive, and social-emotional development, supported by nutrition, sleep, exercise, vision, vestibular, primitive reflex, and sound therapy.

The Research

SIX STUDIES · PART 1 · PEER-REVIEWED

Study	Finding
Brown (2018), controlled study. 32 students with SLD, grades 4–8, randomly assigned to training or active control.	Training group gained on the KBIT-2 IQ Composite (+16.8, $p < .0001$) and on TerraNova Reading, Science, and Spelling. Active control group: no significant gains.
Brown (2018), case studies. Seven learners with Down syndrome, FAS, autism, and post-concussion, ages 9–23.	Cognitive and academic gains in all seven, including "Marie," a learner with Down syndrome followed for four years (next slide).

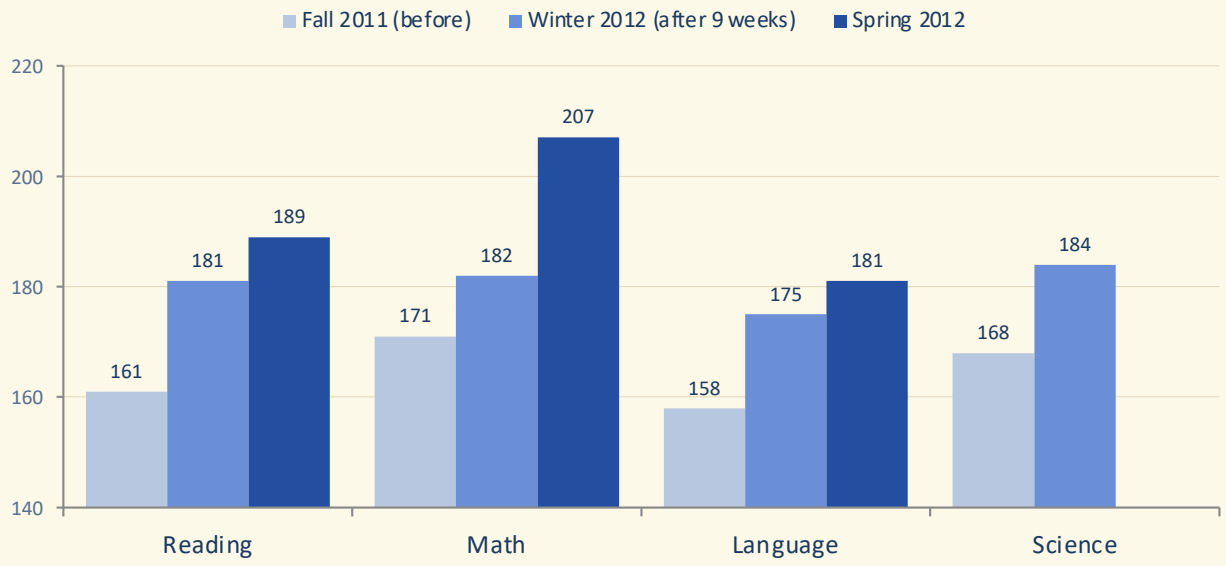
Published in the Journal of Alternative Medicine Research, 10(2), 2018. Also published in Brown (2016), Christian Education Journal, 13(1), and Brown (2023), School Violence and Primary Prevention (2nd ed.), Springer.

In plain words: in a randomized study, students who did Equipping Minds improved in thinking skills and reading; similar students who did other activities did not.

The Research

SIX STUDIES · PART 1 · PEER-REVIEWED

"Marie," a learner with Down syndrome · MAP RIT scores, 2011–12 school year



+11 to +20

RIT points in 9 weeks across all four subjects; typical growth is 3–5

171 → 207

math, fall to spring, after a full year of flat scores

Brown, C. T. (2018). Journal of Alternative Medicine Research, 10(2); also Brown (2016), Christian Education Journal, 13(1), and Brown (2023), School Violence and Primary Prevention (2nd ed.), Springer. Single-case design; no spring 2012 science score reported.

The Research

SIX STUDIES · PART 2 · INDEPENDENT

Study	Population	Key outcomes
Spangler (2025), University of North Alabama, master's thesis	Grades 5–6, SLD and OHI/ADHD	i-Ready Reading +48 points; i-Ready Math +34 points
Horner (2024), GFCS school pilot	Ages 10–14, Christian school	Quantitative Reasoning +43.3 points and Verbal Reasoning +10 percentile points relative to peers
Smith (2025), Boyce College / SBTS, dissertation	College students (ages 18–24), no learning disabilities	KBIT-2 gains; reading comprehension gains
Williams (2023), Dallas Theological Seminary, dissertation	Older adults, ages 57–68	KBIT-2 cognitive improvements; working memory rating gains

Two peer-reviewed studies plus four independent studies (a thesis, two dissertations, and a school pilot): six studies, ages 9–68. Independent studies are not peer-reviewed and have no comparison groups.

The Research

SIX STUDIES · PART 2 · INDEPENDENT

Spangler (2025) · Univ. of North Alabama · Grades 5–6, SLD and OHI/ADHD · Public school special education

+48
points, i-Ready Reading

+34
points, i-Ready Math

+1.6
Working Memory Rating Scale (WMRS)

Weekly
faster processing speed across the intervention

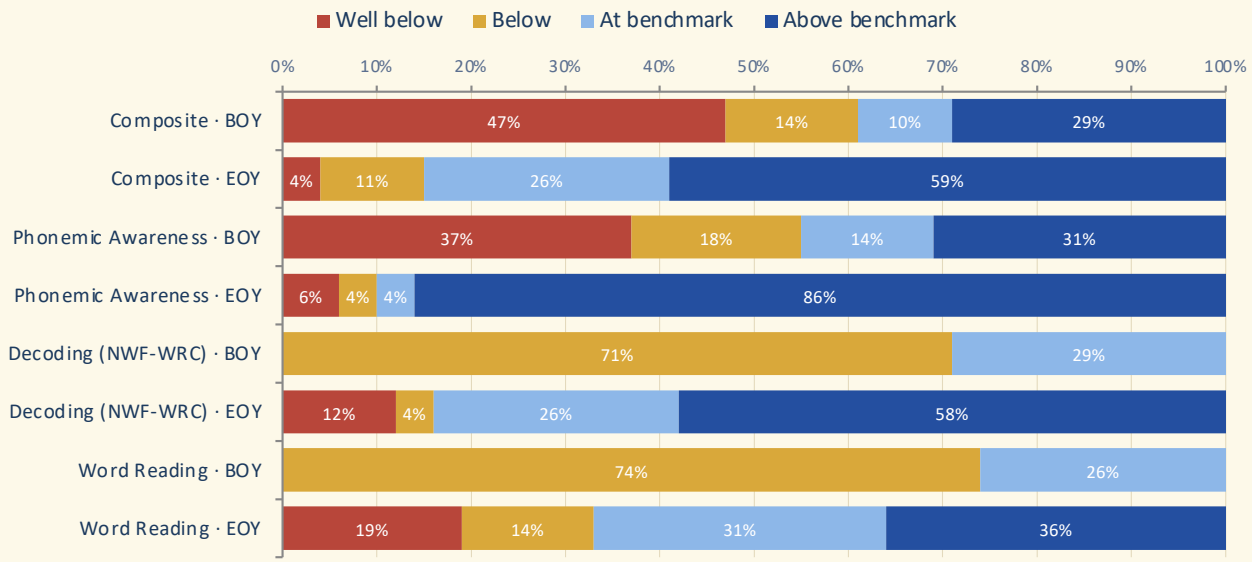
Why it matters for this audience: the closest match to a dyslexia classroom in the research base: upper-elementary special education students, a public-school setting, and standard academic measures (i-Ready) alongside a working memory measure.

Spangler, K. (2025). Master's thesis (action research), University of North Alabama. Not peer-reviewed; no comparison group. Source: EMCDC Teacher Workbook (2026), 1.4.

The Research

PART 3 · SCHOOL IMPLEMENTATION DATA

Kindergarten · DIBELS 8th Edition · Benchmark levels, beginning (BOY) and end of year (EOY) 2025–26



39% → 85%

at or above benchmark on the composite score

47% → 4%

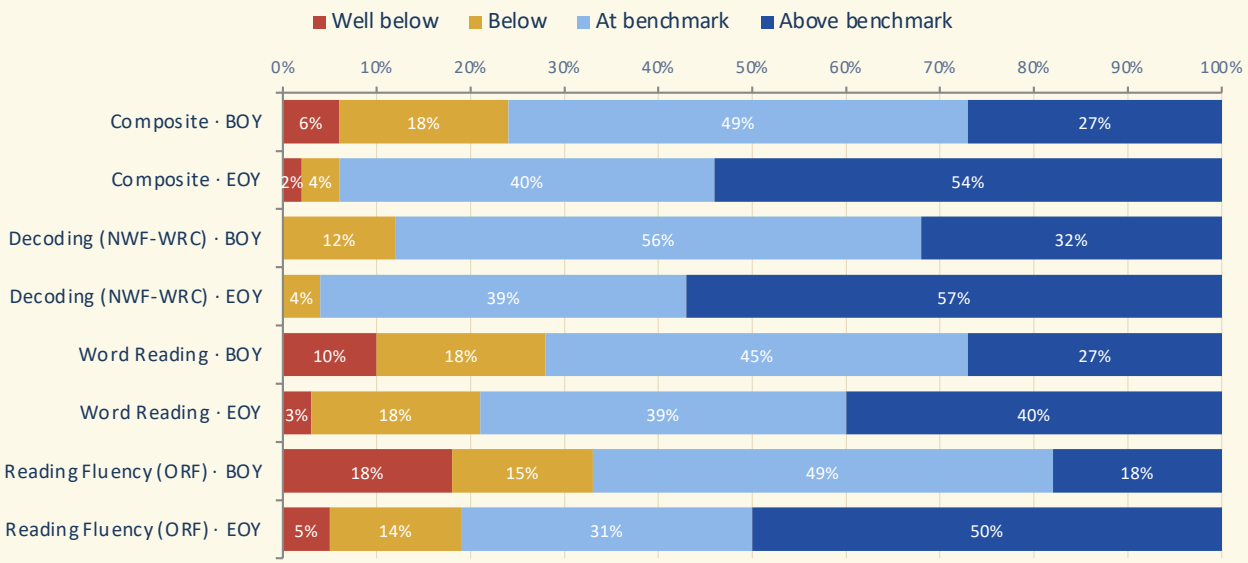
well below benchmark on the composite (34 students at beginning of year)

Source: Amplify DIBELS 8th Edition benchmark report, Hartselle City Schools, Barkley Bridge Elementary, Kindergarten (n = 72–73). Discontinued students are counted in their level; one school, one year, no comparison group.

The Research

PART 3 · SCHOOL IMPLEMENTATION DATA

Grade 1 · DIBELS 8th Edition · Benchmark levels, beginning (BOY) and end of year (EOY) 2025–26



76% → 94%

at or above benchmark on the composite score

18% → 50%

above benchmark in oral reading fluency

Source: Amplify DIBELS 8th Edition benchmark report, Hartselle City Schools, Barkley Bridge Elementary, Grade 1 (n = 72–73). Discontinued students are counted in their level; one school, one year, no comparison group.

The Research

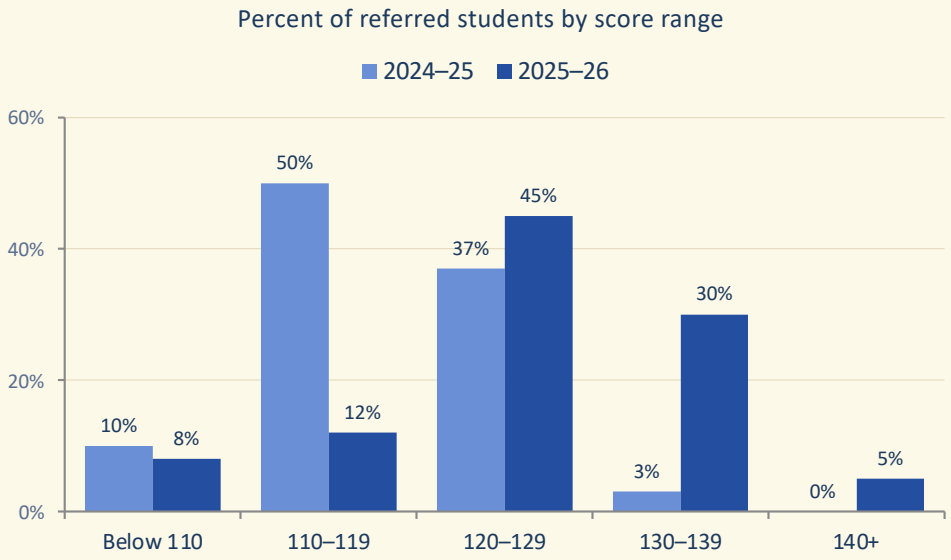
PART 3 · SCHOOL IMPLEMENTATION DATA

Aptitude testing: IQ scores of referred students, before and after implementation

118.3
mean IQ, 2024–25 (n = 30)

126.6
mean IQ, 2025–26 (n = 40)

1 → 14
referred students scoring 130 or above (3% → 35%)

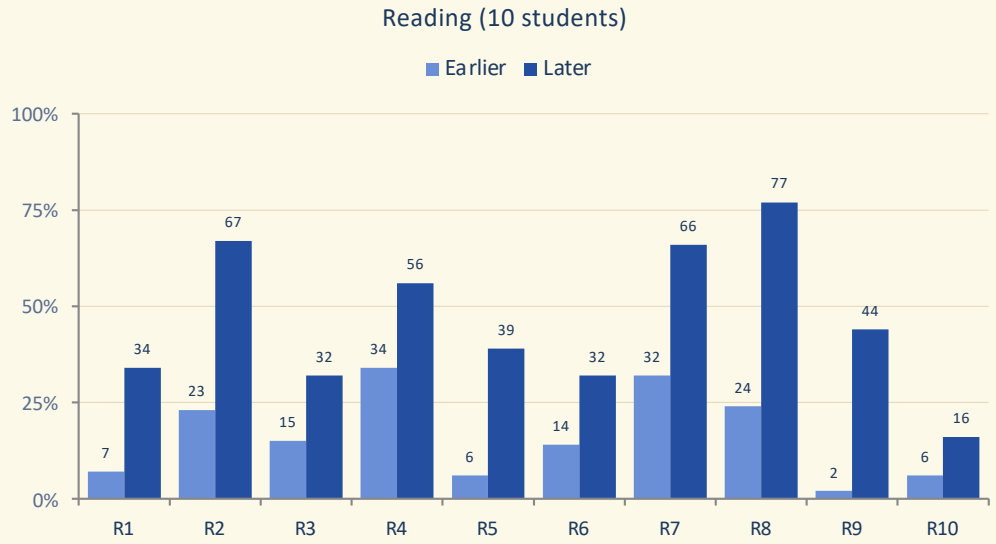


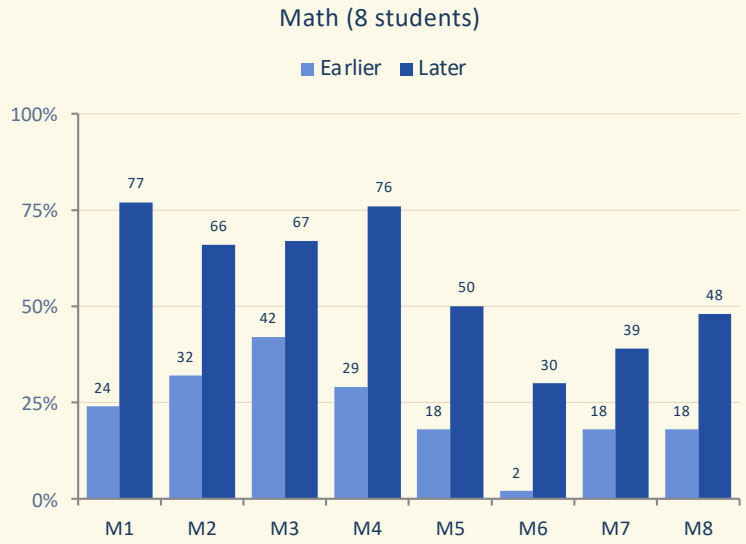
Different students were referred each year, so this compares two cohorts, not the same students over time. Welch's t-test: $t \approx 4.1$, $p < .001$.

The Research

PART 3 · SCHOOL IMPLEMENTATION DATA

Owensboro Public Schools (KY) · i-Ready sampling, 2023–24 · Each pair is one student's score, earlier → later



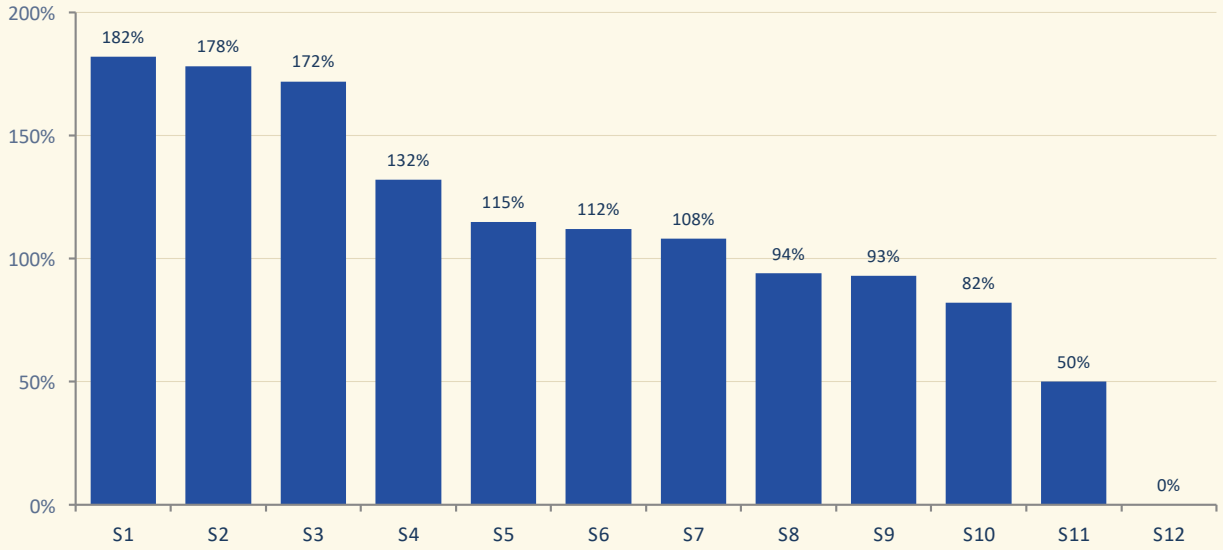


Source: Owensboro Public Schools, "What is happening in OUR classrooms: 2023/24 i-Ready sampling," presented at the Kentucky CEC conference after two years using Equipping Minds. A sample of students, not a full class; no comparison group.

The Research

PART 3 · SCHOOL IMPLEMENTATION DATA

i-Ready Reading Diagnostic Growth · 12 students · Percent of a year's typical growth reached by March 14, 2025



110%

median progress toward a full year's typical growth, with months left in the year

7 of 12

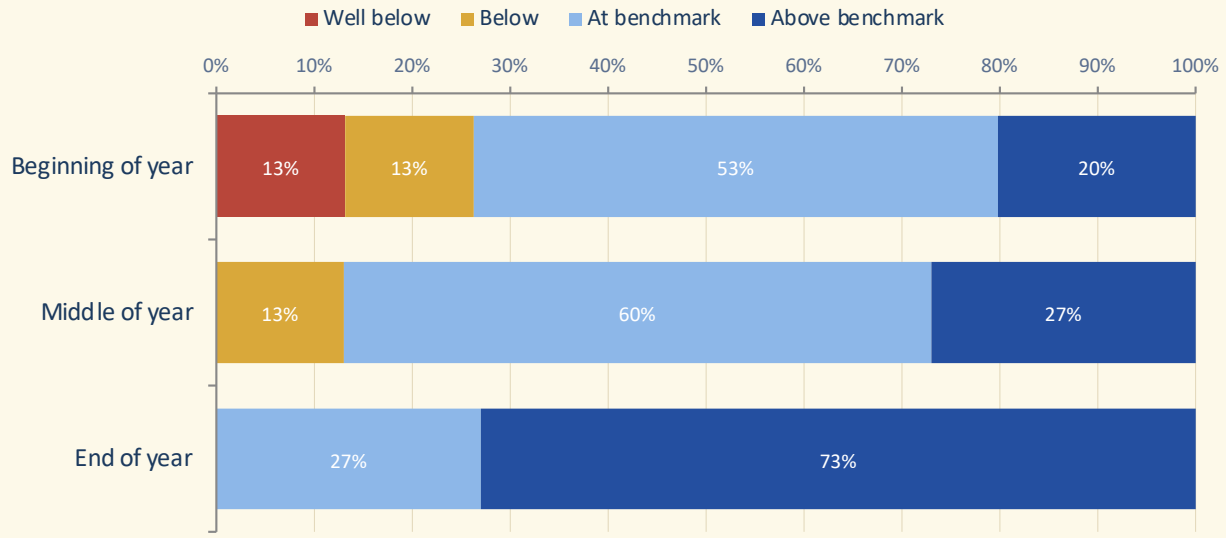
students had already met a year's typical growth; most began two or more grade levels below

Source: Curriculum Associates i-Ready Diagnostic Growth report, Reading, all reading students (12), report dated 03/14/25. 100% = a full year of typical growth for the student's grade and starting level. No comparison group.

The Research

PART 3 · SCHOOL IMPLEMENTATION DATA

Class benchmark summary · 15 students · Beginning, middle, and end of year



73% → 100%

at or above benchmark

3 → 11

students above benchmark (20% → 73%)

Source: class benchmark summary shared in the Equipping Minds newsletter. One class, one year, no comparison group.

Reading the Evidence Carefully

THE FAIR QUESTION

Generic working memory training transfers to similar tasks but shows essentially no far transfer to academics against active controls (g ≈ 0). EF training in **non-reading** tasks barely moved reading (g = 0.09, n.s.), while EF training embedded in reading did (g = 0.45).

Sala & Gobet (2020), Psychonomic Bulletin & Review, 27(3), 423–434; Gobet & Sala (2023), Perspectives on Psychological Science; Cartwright & Palian (2024), Educational Psychologist, 59(4), 263–290

WHAT EMCDC DOES DIFFERENTLY

Human-mediated, not screen-based · multi-attribute, not single-attribute · language built into every exercise: letters, vowel sounds, words, and the Ten Categories · practiced alongside reading instruction. The design target is the reading-specific side of the evidence.

Supporting signal: EF activities embedded in text tasks improved text memory and verbal updating in a cluster-randomized trial (Ruffini et al., 2025, RRQ; small–medium effects, no follow-up). EMCDC needs further controlled trials; the independent studies to date are thesis, dissertation, and school-pilot level.

The Unanswered Question

What happens to reading outcomes when the cognitive architecture is built first, or alongside structured literacy?

We know what predicts reading success beyond decoding: working memory, inhibitory control, processing speed, and cognitive flexibility (Cartwright, 2023; Duke & Cartwright, 2021). EMCDC builds them. The study we are designing tests whether building them adds to the gains of structured literacy instruction alone.

STRONGLY SUPPORTED, NOT YET PROVEN

Building executive function through EMCDC alongside structured literacy may produce larger reading gains than structured literacy alone. The mechanism is well supported, and school data are encouraging. No controlled study has yet tested this specific comparison.

What Lasting Gains Require

1

Daily, 30 minutes

5–10 min processing, 10 min working memory / N-Back, 5–10 min comprehension, 5–10 min logic. Five days a week, alongside reading instruction.

2

Think out loud

Use “I see you…” and “I see me…” throughout the day. Narrate the logic to build a visual image in the brain.

3

“Hard is good”

Say “That’s a tricky one,” then process it together. Never “You’re wrong” or “Think harder.” “We will do this together. I will help you.”

4

Measure it

Cognitive (KBIT-2, WISC-V, BRIEF) and academic (DIBELS, i-Ready, MAP) data, before and after.

Longest follow-up to date: Marie, a four-year case study with Down syndrome (Brown, 2018). Recommended dose: 5 days a week for 12–24 weeks (Workbook 7.1).

What You Can Do at Home

Say it

"I see you…" then "What do you see yourself doing?" Say "Check" instead of "wrong." "Hard is good: I will help you."

Play it

EM Colored House Cards: sort by color, number, animal, letter. Then alternate two attributes, then three. Tic Tac Toe on one board, then two.

Picture it

After reading, ask the Ten Categories questions: Who? How many? What color? What is happening? Where? When? Build a movie in the mind.

Keep it

30 minutes a day, 5 days a week. Have fun, model first, and start where your child is. Track it on the Home Exercise Checklist.

From Card Games for Home Practice and the Home Exercise Checklist (Workbook 7.5, 13.3).

Next Steps

Parents: Equipping Minds Cards and the cards course; the Equipping Minds in the Classroom course or ROSES program on your own or with a certified provider.

Therapists & teachers: EMCDC Certification, Level 1 and Level 2, in person or online. Use it alongside your structured literacy work.

Schools & districts: On-site training and implementation support; become a host site.

equippingminds.com

Continue With Me Today

Time	Session	Room
10:00 – 11:30	**Aristotle, Grammar & Reading Comprehension:** Teaching Students to Think in Categories	Wynfrey ABC
1:00 – 2:00	**From Diagnosis to Action:** Using the Cognitive Profile to Guide Dyslexia Intervention	Wynfrey ABC
2:00 – 3:30	**Working Memory & Dyslexia:** Hands-On Training with the Brown Six-Eleven N-Back	Wynfrey ABC

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Thank You

"So take my hand during this race, we will run a steady pace, confident with hope and success, until we unlock your gifts."

Clayton Brown, "Take My Hand and Run with Me" (2014)