BrainScience Works Logic Model

Study Type: ESSA Evidence Level IV

Prepared for:
BrainScience Works

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EXECUTIVE SUMMARY

BrainScience Works engaged LearnPlatform by Instructure, a third-party edtech research company, to develop a logic model for their product. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).[1]

Logic Model

A logic model provides a program roadmap, detailing program inputs, participants reached, program activities, outputs, and outcomes. LearnPlatform collaborated with BrainScience Works to develop and revise the logic model.

Study Design for BrainScience Works Evaluation

Informed by the logic model, the next phase will focus on planning for a series of ESSA-sligned studies (Levels I - III) to examine the extent to which BrainScience Works impacts student learning outcomes in reading.

Conclusions

This study satisfies ESSA evidence requirements for Level IV (*Demonstrates a Rationale*). Specifically, this study met the following criteria for Level IV:

- ✅ Detailed logic model informed by previous, high-quality research
- ✅ Study planning and design is currently underway for a series of ESSA-aligned studies

[1] Level IV indicates that an intervention should include a "well-specified logic model that is informed by research or an evaluation that suggests how the intervention is likely to improve relevant outcomes; and an effort to study the effects of the intervention, that will happen as part of the intervention or is underway elsewhere…" (p. 9, U.S. Department of Education, 2016).

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Introduction

BrainScience Works engaged LearnPlatform by Instructure, a third-party edtech research company, to develop a logic model for their program. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).

Effective interventions for dyslexic students should not only provide phonics instruction but should also target visual-spatial skills. However, the primary focus of many interventions for dyslexic students is on phonemic awareness. To address this gap in education for dyslexic individuals, BrainScience Works provides a structured program that systematically builds literacy skills by implementing visual-spatial instruction to support reading fluency and comprehension, through explicit instruction and tailored assessments to ensure mastery and success in reading and writing.

The study had the following objectives:

1. Define the BrainScience Works logic model and foundational research base.
2. Draft study design for a series of ESSA-aligned studies.

Previous Research. Dyslexia is the most common learning disability, affecting up to 17.5% of children, and is characterized by unexpected difficulties in developing reading proficiency (Shaywitz et al., 1998). While dyslexia causes challenges with reading skill development, it is not associated with differences in IQ (Tanaka et al., 2011). However, the incorrect assumption that dyslexia and IQ are connected has resulted in underdiagnosis, thus there are likely even higher rates of dyslexia than are currently accounted for and being addressed in educational settings (Odegard et al., 2020). Given the prevalence of dyslexia, there is a critical need for effective interventions to help students with this learning disability.

Some researchers have proposed that children with dyslexia have greater difficulty learning to read because they struggle to understand that words, both written and spoken, can be broken into small segments of sounds (i.e., phonemes) tied to specific letters that make up written words. This theory, the phonological deficit hypothesis, resulted in systematic phonics instruction being a commonly used remediation approach for students with dyslexia (Shankweiler & Liberman, 1989; Snowling, 1998). Widespread adoption of the phonological deficit hypothesis resulted in the recommendation and use of systematic phonics instruction as a key dyslexia intervention (e.g., Ehri et al., 2001; National Reading Panel, 2000). However, neuroscience research suggests that other mechanisms (e.g., visual-spatial attention) also contribute to dyslexia and therefore should be addressed in addition to phonics instruction (Bosse et al., 2007; Share, 2021; Vidyasagar & Pammer, 2010). Furthermore, there is evidence that suggests a focus on supporting the development of visual-spatial areas of the brain may be superior to phonics instruction for dyslexic students: Hoeft and colleagues (2011) found that use of the right brain visual-spatial areas predicted which children with dyslexia would have improved right skills two and a half years later with 92% accuracy.

Students with dyslexia often misorder or reverse letters due to visual-spatial attention deficits, which leads to reading difficulties not explained by phonological deficits alone (Franceschini et al., 2022; Vidyasagar & Pammer, 2010). Moreover, students may have no difficulty with the phonological processing of single-letter units, but cannot decipher larger orthographic units (i.e., multi-letter graphemes or syllables), which suggests that visual-spatial attention deficits function independently from phonological deficits (Peyrin et al., 2012). This assertion is supported by brain imaging studies that demonstrated differences in brain activation for students with dyslexia who had differences in their visual-spatial attentional and phonological deficits. Students with dyslexia are also shown to have difficulty ignoring irrelevant visual information (White et al., 2019), therefore providing support for developing selective attention should be included as part of reading interventions. Visual-spatial attention deficits are associated with phonological processing difficulties as incorrect letter ordering inhibits students' ability to identify orthographic units (i.e., letter groupings) connected to phonemes (i.e., sound units), therefore reading interventions must address both components to help students with dyslexia (Franceschini et al., 2022).

Neuroimaging studies have further contributed to the understanding of dyslexia. For example, research demonstrated that right prefrontal brain mechanisms activated during phonological processing are associated with greater reading improvement among students with dyslexia (Hoeft et al., 2011). Neuroimaging research has also investigated whether there are differences in brain activation in areas not specifically involved in phonological processing between students with dyslexia who become better readers compared to those who do not and found that the areas implicated in executive control (i.e., frontal-parietal network) also contribute to reading improvement (Nugiel et al., 2018). Taken together, neuroimaging studies show that multiple neural circuits contribute to reading developmental differences among students with dyslexia (D'Mello & Gabrieli, 2018). This research highlights that it is possible to identify specific areas of the brain associated with reading outcomes, and by doing so, neuroimaging may be helpful in the diagnosis and remediation of dyslexia.

BrainScience Works used these insights from neuroimaging research to develop their program for students with dyslexia. Specifically, BrainScience Works uses a progression of distinct activities (i.e., "say, build, see, and write" for *Show me Symbols* as well as "say, build, see, write and meaning" for *Building Words*) that prompts increased brain activation and helps students learn letters, how to spell words, and the meaning of words. By focusing on visual-spatial activation, BrainScience Works provides students with support for an essential component of reading that is not always emphasized in other phonemic awareness interventions but is essential for reading development (Franceschini et al., 2022).

Logic Model

A logic model is a program or product roadmap. It identifies how a program aims to impact learners, translating inputs into measurable activities that lead to expected results. A logic model has five core components: inputs, participants, activities, outputs, and outcomes (see Table 1).

Table 1. Logic model core components

Component	Description	More information
Inputs	What the provider invests	What resources are invested and/or required for the learning solution to function effectively in real schools?
Participants	Who the provider reaches	Who receives the learning solution or intervention? Who are the key users?
Activities	What participants do	What do participants do with the resources identified in Inputs? What are the core/essential components of the learning solution? What is being delivered to help students/teachers achieve the program outcomes identified?
Outputs	Products of activities	What are numeric indicators of activities? (e.g., key performance indicators; allows for examining program implementation)
Outcomes	Short-term, intermediate, long-term	Short-term outcomes are changes in awareness, knowledge, skills, attitudes, and aspirations. Intermediate outcomes are changes in behaviors or actions. Long-term outcomes are ultimate impacts or changes in social, economic, civil or environmental conditions.

LearnPlatform reviewed BrainScience Works resources, artifacts, and program materials to develop a draft logic model. BrainScience Works reviewed the draft and provided revisions during virtual meetings. The final logic model depicted below (Figure 1) reflects these conversations and revisions.

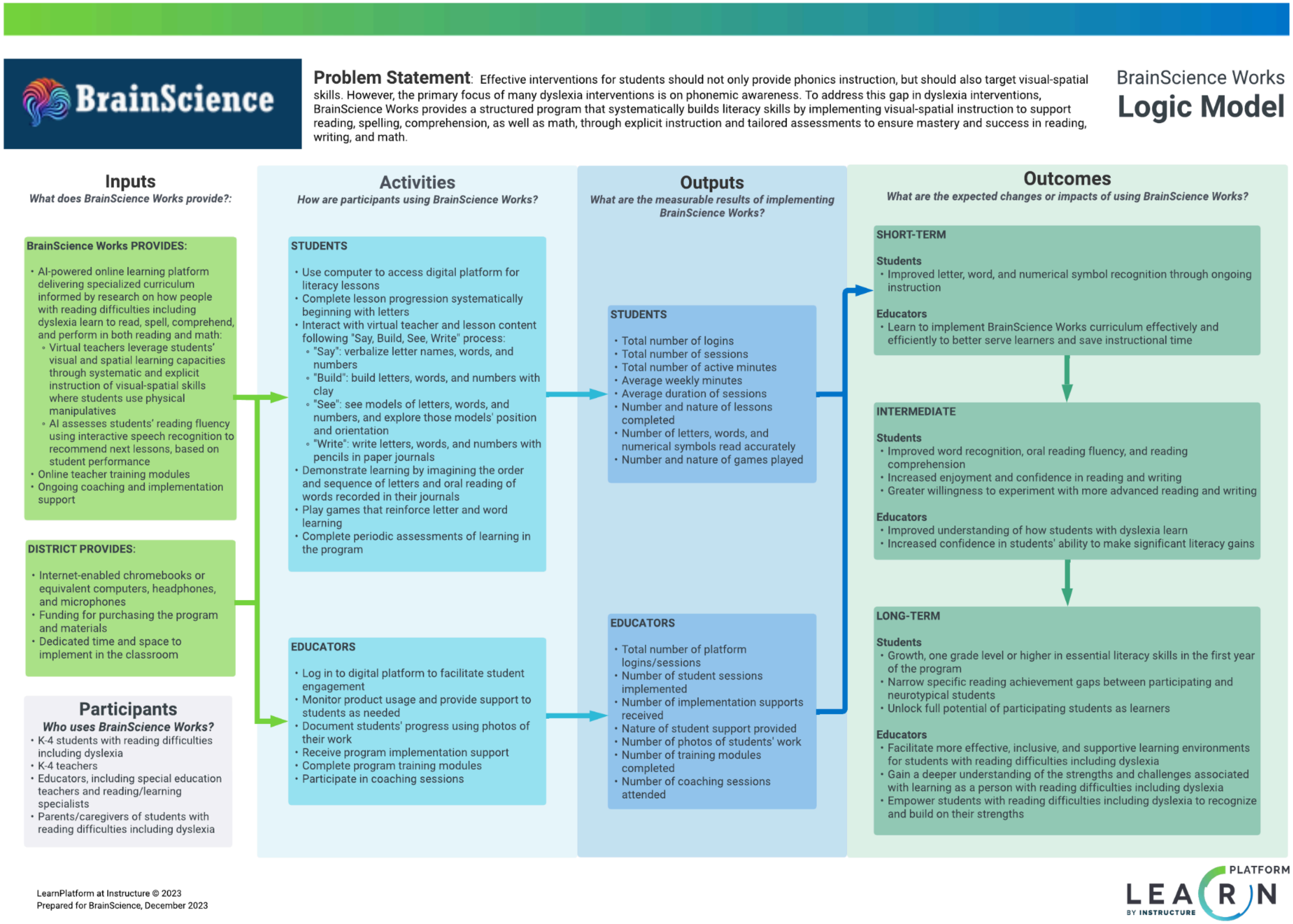

Figure 1. BrainScience Works logic model

BrainScience Works Logic Model Components. BrainScience Works invests several resources into their program. This includes their AI-powered online learning platform, delivering a specialized curriculum informed by research on how people with reading difficulties including dyslexia learn to read, spell, comprehend, and perform in both reading. The platform's virtual teachers leverage students' visual-spatial learning capacities through systematic and explicit instruction of visual-spatial skills where students use physical manipulatives. The platform uses AI to assess students' reading fluency using interactive speech recognition to recommend next lessons based on student performance. BrainScience Works also provides online teacher training modules along with ongoing coaching and implementation support. Ultimately, the BrainScience Works program aims to reach teachers as well as students with reading difficulties including dyslexia in Kindergarten through 4th grade, including special education teachers and reading/learning specialists, and parents.

Using these program resources, students and educators can engage with the BrainScience Works platform in the following activities:

- Students:
    - use computers to access digital platform for literacy lessons
    - complete lesson progression systematically beginning with letters
    - interact with virtual teacher and lesson content following "Say, Build, See, Write" process:
        - "Say": verbalize letter names, words, and numbers
        - "Build": build letters, words, and numbers with clay
        - "See": see models of letters, words, and numbers, and explore those models' position and orientation
        - "Write": write letters with pencil in paper journals
        - "Meaning": show meaning for words built with manipulatives
    - demonstrate learning by imagining the order and sequence of the letters and oral reading of words recorded in their journals
    - play games that reinforce letter and word learning
    - complete periodic assessments of learning in the program

- Educators:
    - log in to digital platform to facilitate student engagement
    - monitor product usage and provide support to students as needed
    - document students' progress using photos of their work
    - receive program implementation support
    - complete program training modules
    - participate in coaching sessions

BrainScience Works can examine the extent to which core activities were delivered and participants were reached by examining the following quantifiable outputs:

- Students':
    - total number of:

- logins
- sessions
- active minutes

- average:
  - weekly minutes
  - duration of sessions
- number and nature of lessons completed
- number of letters, words, and numerical symbols read accurately
- number and nature of games played

- Educators'
  - total number of platform logins/sessions
  - number of:
    - student sessions implemented
    - implementation supports received
    - photos of students' work
    - training modules completed
    - coaching sessions attended
- nature of student support provided

If implementation is successful, based on a review of program outputs, BrainScience Works can expect the following short-term outcomes. First, students will experience improved letter, word, and numerical symbol recognition through ongoing instruction. Meanwhile, educators will learn to implement BrainScience Works curriculum effectively and efficiently to better serve learners, and save instructional time.

As implementation continues, BrainScience Works can expect the following intermediate: students have improved word recognition, oral reading fluency, and reading comprehension. They also have increased enjoyment and confidence in reading and writing, leading to a greater willingness to experiment with more advanced reading and writing. For educators, intermediate outcomes will consist of an improved understanding of how students with dyslexia learn and increased confidence in their students' ability to make significant literacy gains.

Eventually, with successful long-term implementation, the following long-term outcomes will arise. Students will grow one grade level or higher in essential literacy skills after the first year of the program, narrowing specific reading achievement gaps between participating and neurotypical students, and unlocking participating students' full potential as learners. As educators continue to facilitate more effective, inclusive, and supportive learning environments for students with reading difficulties including dyslexia, they will gain an even deeper understanding of the strengths and challenges associated with learning as a person with reading difficulties including dyslexia. This will allow educators to further empower these students and to recognize and build on their strengths.

Study Design for BrainScience Works Evaluation

To continue building evidence of effectiveness and to examine the proposed relationships in the logic model, BrainScience Works has plans to conduct a series of evaluations to determine the extent to which its program produces the desired outcomes. Specifically, BrainScience Works has plans to begin a series of ESSA-aligned studies (i.e., Levels I-III) study to answer the following research questions:

Implementation Research Questions

1. Overall, what percent of students, randomly assigned to the BrainScience Works treatment, used it during the 2023-24 school year?
    a. On average, how many BrainScience Works sessions were completed by students randomly assigned to the BrainScience Works treatment during the 2023-24 school year?
    b. On average, how much time was spent on BrainScience Works by students randomly assigned to the BrainScience Works treatment during the 2023-24 school year?

Intent-to-treat Research Question

2. What is the impact of BrainScience Works on students' reading outcomes among students randomly assigned to receive BrainScience Works?

Treatment-on-treated Research Questions

3. Are there differential impacts of BrainScience Works use on students' reading outcomes among students who used BrainScience Works?
    a. How do these effects vary by student demographic factors (i.e., race, ethnicity, gender, English language learner and special education status, and free/reduced lunch eligibility)?
4. Does the impact of BrainScience Works depend on the instructional focus of tutoring received?

BrainScience Works plans to begin this study in the summer of 2024.

Conclusions

This study satisfies ESSA evidence requirements for Level IV (*Demonstrates a Rationale*). Specifically, this study met the following criteria for Level IV:

✅ Detailed logic model informed by previous, high-quality research
✅ Study planning and design is currently underway for an ESSA Level I study

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