Best Practices in Math Interventions

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In the following report, Hanover Research examines best practices in math interventions across all grade levels. This report provides an overview of common practices, summarizes rigorous academic evaluations of math interventions, and concludes with profiles and evaluations of seven math intervention programs.

HANOVER RESEARCH

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EXECUTIVE SUMMARY AND KEY FINDINGS

INTRODUCTION

School districts are faced with a multitude of academic intervention decisions, and the choice of a mathematics intervention is one of great importance. This curricular review and assessment, conducted by Hanover Research, is intended to provide additional insight on this topic. Information contained in the following report is predominantly drawn from national educational councils, organizations, or centers, as well as scholarly publications. Predominant sources include the What Works Clearinghouse, The Best Evidence Encyclopedia, and The National Council for Intensive Interventions, as well as the National Center for Learning Disabilities and the National Council of Teachers of Mathematics. The report is organized into two sections:

- **Section I: Literature Review** begins with a brief introductory overview of standard components of intervention programs, before providing insight into general best practices of math intervention programs as identified by national councils, associations, and research centers. The section then examines research specifically dedicated to interventions for elementary age students published in academic journals and conducted by research centers.
- **Section II: Program Profiles** identifies seven math instruction and intervention programs whose effectiveness has been identified by a credible authority. This section provides an overview of each program and describes the supporting research.

KEY FINDINGS

- **Hanover Research identified seven mathematics intervention programs with broad support from the research community.** Credible authorities suggest the following programs are likely to significantly improve students' mathematics abilities:
  - Fraction Face-Off!
  - Hot Math Tutoring
  - Number Worlds
  - I CAN Learn Pre-Algebra and Algebra
  - DreamBox Learning
  - enVisionMATH
  - Do The Math
- **Three crucial practices should be applied to all mathematics interventions: universal screening, explicit and systematic instructional methods, and data-based decision making.** The American Institutes for Research and the What Works Clearinghouse recommend that educators should screen all students in order to identify those in need of supplementary assistance. Additionally, the National Council of Teachers of Mathematics and the What Works Clearinghouse found that explicit and systematic instructional methods are highly effective strategies. Lastly, the use of data to drive decision making is a common theme that unites recommendations from the American

Institutes for Research, the Institute of Educational Sciences, and the National Center on Intensive Interventions.

- **Several research studies indicate additional practices that may effectively improve students' mathematics performance**, including: the dedication of at least 10 minutes to "fluent retrieval of basic arithmetic facts," the development of students' systemized approach to all problem types, and the nurturing of students' confidence. Recommendations specific to principals and other school leaders include providing implementation support at all levels of multi-tiered systems and allowing individual schools to select intervention programming that suits their specific core curricula.
- **General consensus among researchers indicates that elementary school math interventions are essential to avoiding later difficulties.** Research is united in the belief that early detection and remedy of math difficulties eliminates future struggles with increasingly complex and abstract mathematical concepts studied throughout secondary grades. Researchers have identified "fluency and proficiency with basic arithmetic combinations and the increasingly accurate and efficient use of counting strategies" as indicators of early math proficiency.
- **Research-based mathematics interventions typically use decidedly engaging tactics, such as role-playing or technology-assisted learning.** While engaging students is viewed as a top priority, interventions typically emphasize distinctive qualities. For instance, *Hot Math* emphasizes students' mastery of word problems, while *Fraction Face-Off* aims to improve students' proficiency with fractions.

SECTION I: LITERATURE REVIEW

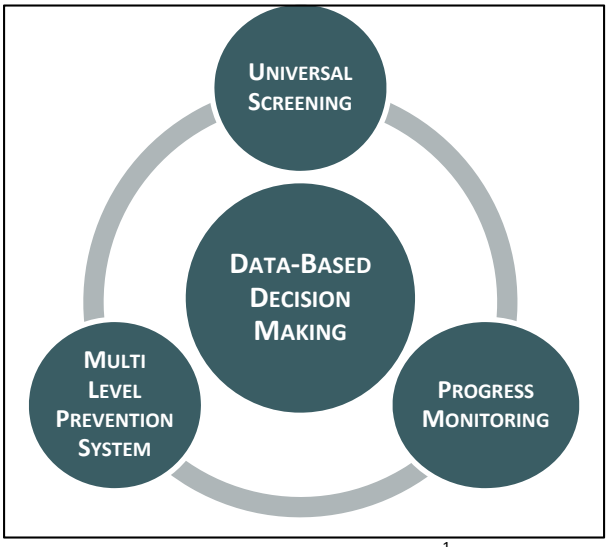
After a brief introductory overview of standard components of intervention programs, this section provides insight into general best practices of math intervention strategies as identified by national councils, associations, and research centers. The section then specifically examines research regarding interventions for elementary age students.

INTRODUCTION

Due to the rising popularity of Response to Intervention (RtI), the pool of resources describing Scientifically Research-Based Interventions (SRBIs) is focused on this particular practice. Although its features are found throughout many models of interventions, it is generally defined by a systematic and proactive plan to assist struggling students. RtI is more specifically characterized by a multi-tiered early intervention structure comprised of research-based, increasingly rigorous instructional interventions for students who have not responded to frequent student progress evaluations. This model can be applied to many types of interventions and it is discussed intermittently throughout this section.

RESPONSE TO INTERVENTION (RTI)

Figure 1.1: Essential Components of RTI



Source: The American Institutes for Research[1]

The Center on Response to Intervention, a division of the American Institutes of Research, espouses a highly data-driven model of RtI (Figure 1.1), as **data-based decision making** is central to all components. Student data inform educators' screening and program design, as well as individual student movement between varying intensity levels of the support system.[2] The goal of the **universal screening** process is to identify students who need additional support in achieving academic success. Initial assessments should include all students, and should be consistent, evidence-based, and culturally-responsive. Furthermore, this phase must incorporate multiple stages

[1] Contents taken verbatim from: "Essential Components of RTI." Center on Response to Intervention. http://www.rti4success.org/essential-components-rti

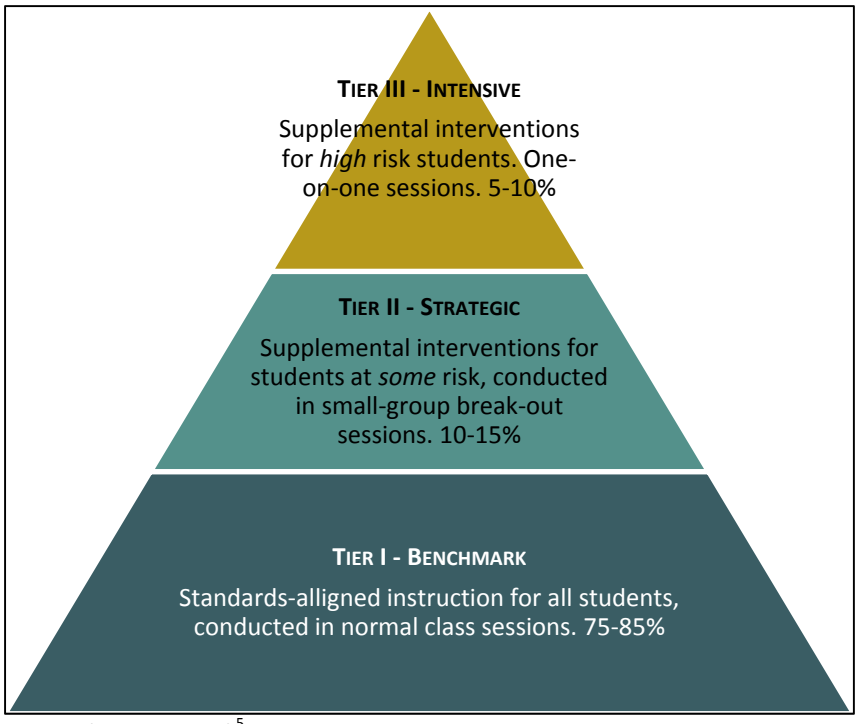
[2] "Data-Based Decision Making." Center on Response to Intervention. http://www.rti4success.org/essential-components-rti/data-based-decision-making

of "additional testing or short-term progress monitoring to corroborate students' risk status."[3] In order to evaluate students' response to intervention, **progress monitoring** should be conducted either on individual students or classes as a whole. Progress monitoring should also be consistent, evidence-based, and culturally-responsive.[4] The structure of the intervention programing is fundamentally based on a **multi-level prevention system.** This framework is explained in full in the following subsection.

Components of RtI

SRBIs comprise three tiers, which increase in intensity. As they experience math interventions, students are evaluated using Curriculum Based Measurement (CBM) methods to determine their progress, and students who are not responding to their current tier are advanced to a more intensive tier.

Figure 1.2: Three-Tiered Intervention Program Levels



Source: The RtI Network[5]

As illustrated in Figure 1.2, SRBI programs are often based on multi-tiered intervention structures that establish specific criteria for defining student success and identifying educational needs, with an emphasis on progressing students to the point at which no

[3] "Universal Screening." Center on Response to Intervention. http://www.rti4success.org/essential-components-rti/universal-screening

[4] "Progress Monitoring." Center on Response to Intervention. http://www.rti4success.org/essential-components-rti/progress-monitoring

[5] Shapiro, E. S. "Tiered Instruction and Intervention in a Response-to-Intervention Model." RTI Action Network, National Center for Learning Disabilities. http://www.rtinetwork.org/essential/tieredinstruction/tiered-instruction-and-intervention-rti-model

interventions are required. Each tier represents a different model of instruction that varies based upon a student's academic needs.[6] While such interventions are most frequently based on a three-tiered model, this is not always the case. For example, some schools or districts may subdivide individual tiers and decide to offer more than three levels of intervention.[7] Broadly speaking, the levels of an RtI model represent the closeness with which an instructor, counselor, or other school administrator must work with a student in order to produce the standardized ("benchmark") results.

In Tier I, instruction is standards-based and delivered to the general classroom, utilizing both small-group and whole-class delivery formats. Tier II provides targeted, supplemental instruction to students whose assessment data suggest they are not making adequate performance in response to Tier I instruction. Tier III provides intensive, research-based instruction for students who do not adequately respond to Tier II interventions. Tier III level interventions may serve as either a supplement or a replacement for core classroom and Tier I and Tier II level instruction. Tier III supports are provided as a replacement for traditional classroom instruction only when the student's performance is significantly below grade level standards.

ACADEMIC EVALUATIONS

In reviewing mathematics interventions, Hanover sought the findings of meta-analyses conducted by the Best Evidence Encyclopedia and the What Works Clearinghouse. The Best Evidence Encyclopedia (BEE) from Johns Hopkins University School of Education's Center for Data-Driven Reform in Education aims to equip educators and researchers with useful, evidence-supported information about the merit of a variety of educational practices across the K-12 spectrum. While the BEE has not published an exhaustive review of mathematics programs targeted at struggling students (as it did in 2009 for literacy intervention programs), it has produced three general reviews of mathematics programs: "Effective Programs in Elementary Mathematics: A Best-Evidence Synthesis" (2007), "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis" (2008), and "The Effectiveness of Educational Technology Applications for Enhancing Mathematics Achievement in K-12 Classrooms" (2011).[8]

Another valuable source for meta-analyses is The What Works Clearinghouse (WWC), an online database provided by the U.S. Department of Education's Institute of Education

[6] Shapiro, E.S., Op. cit.

[7] "Essential Components of RTI – A Closer Look at Response to Intervention." National Center on Response to Intervention. April 2010, p.1. http://www.rti4success.org/sites/default/files/rtiessentialcomponents_042710.pdf

[8] [1] Slavin, R. and Lake, C. "Effective Programs in Elementary Mathematics: A Best-Evidence Synthesis." Best Evidence Encyclopedia, February 2007. http://www.bestevidence.org/word/elem_math_Feb_9_2007.pdf

[2] Slavin, R., Lake, C., and Groff, C. "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis." Best Evidence Encyclopedia, October 2008. http://www.bestevidence.org/word/mhs_math_Oct_21_2008.pdf

[3] Cheung, A. and Slavin, R. "The Effectiveness of Educational Technology Applications for Enhancing Mathematics Achievement in K-12 Classrooms: A Meta-Analysis." Best Evidence Encyclopedia, July 2011. http://www.bestevidence.org/word/tech_math_Apr_11_2012.pdf

Sciences (IES). The IES has produced reports reviewing 226 math intervention studies, each based on an exhaustive search of published and unpublished research.[9] The WWC reviews the effects of math programs on student outcomes in mathematics achievement. The effects of an intervention are rated within a given outcome domain by the WWC as positive, potentially positive, mixed, no discernible effects, potentially negative, or negative.[10]

The WWC developed a math intervention practice guide for RtI based on recommendations from a diverse, expert panel of instructors and researchers, as well as a body of "high quality experimental and quasi-experimental studies" that met criteria established by the WWC.[11] This combination of expert opinions substantiated and supported by evidence-based study results indicated a set of recommendations and their classification into varying levels of effectiveness: strong, moderate, or low. Figure 1.3 summarizes these recommendations and their established level of supporting evidence.

Figure 1.3: Recommendations and Corresponding Levels of Evidence

Recommendation	Level of Evidence
Tier I	
1. Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk.	Moderate
Tiers II and III	
2. Instructional materials for students receiving interventions should focus intensely on in-depth treatment of whole numbers in kindergarten through grade 5 and on rational numbers in grades 4 through 8. These materials should be selected by committee.	Minimal
3. Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.	Strong
4. Interventions should include instruction on solving word problems that is based on common underlying structures.	Strong
5. Intervention materials should include opportunities for students to work with visual representations of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas.	Moderate
6. Interventions at all grade levels should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts.	Moderate
7. Monitor the progress of students receiving supplemental instruction and other students who are at risk.	Minimal
8. Include motivational strategies in tier 2 and tier 3 interventions.	Minimal

Source: What Works Clearinghouse and the Institute of Education Sciences[12]

[9] "Math." What Works Clearinghouse. http://ies.ed.gov/ncee/wwc/topic.aspx?sid=9
[10] "Glossary." What Works Clearinghouse. http://ies.ed.gov/ncee/wwc/glossary.aspx
[11] "Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools." What Works Clearinghouse, 2009. http://ies.ed.gov/ncee/wwc/pdf/practice_guides/rti_math_pg_042109.pdf
[12] Table contents taken verbatim from: Ibid., p. 6.

Research from the National Council of Teachers of Mathematics (NCTM) conducted a meta-analysis encompassing over 50 studies on mathematics interventions in search of effective strategies for increasing the performance of special education and low-achieving students. Although researchers were clear in their disclaimer that these results were not definitive, they indicated that their conclusions are applicable to students of many ability levels.[13] Researchers examined six instructional strategies and calculated effect sizes for each. Effect sizes of 0.2 are considered small (comparable to a possible increase of students' standardized test scores by eight percentile points), 0.4 moderate, and 0.6 or greater large (a possible increase of students' standardized test scores of 25 percentile points).

As indicated by results presented in Figure 1.4, systematic and explicit instruction was the only strategy to register a large or moderate to large effect on both low-achieving and special education students. The other five strategies did not translate across student group type. Peer-assisted learning and formative data-sharing with students produced moderate to large effects in low-achieving students that were not experienced by their counterparts in special education. Researchers considered techniques "systematic and explicit" when teachers demonstrated a specific strategy for tackling a problem, which students then used in independent work. Demonstrations typically involved extremely clear procedures and questions. Contrarily, "student think-alouds" were more student-centric and involved asking students to articulate their thinking process as they solved math problems.

Figure 1.4: Effect Sizes of Instructional Strategies

Instructional Strategy	Effect Size	
	Special Education Students	*Low-Achieving Students*
1. Visual and graphic descriptions of problems	0.50	N/A
2. Systematic and explicit instruction	1.19 *	0.58 *
3. Student think-alouds	0.98 *	N/A/
4. Use of structured peer-assisted learning activities involving heterogeneous ability groupings	0.42	0.62 *
5. Formative assessment data provided to teachers	0.32	0.51
6. Formative assessment data provided directly to students	0.33	0.57*

*Indicates a large or moderate to large effect size.
Source: The National Council of Teachers of Mathematics[14]

NCTM provides a qualitative summary of these results, suggesting that math intervention programs adhere to a set of recommendations, including that instruction should:

- Be in a small group of no more than six
- Address skills that are necessary for the unit at hand
- Be quite explicit and systematic

[13] "Effective Strategies for Teaching Students with Difficulties in Mathematics." The National Council of Teachers of Mathematics, 2007. http://www.nctm.org/uploadedFiles/Research_News_and_Advocacy/Research/Clips_and_Briefs/Research_brief_02_-_Effective_Strategies.pdf

[14] Table contents taken verbatim from: Ibid., p. 1.

- Require the student to think aloud as she or he solves problems or uses graphic representation to work through problem-solving options
- Balance work on basic whole-number or rational-number operations (depending on grade level) with strategies for solving problems that are more complex[15]

The National Association of Elementary School Principals also provides recommendations to school principals regarding math instruction in the form of a white paper. The white paper, which adapted content from the Department of Education's Doing What Works, outlines Response to Intervention implementation processes in elementary and middle school math, providing specific action items for instructors and administrators.[16] This comprehensive guide provides several concrete recommendations for instructional practices, including dedicating at least 10 minutes to "fluent retrieval of basic arithmetic facts," helping students develop a systemized approach to all problem types, and building confidence and motivation through praise.[17] Recommendations specific to principals and other leaders in school administration include providing implementation support at all levels of multi-tiered systems and allowing individual schools to select intervention programming that suits their specific core curricula.[18]

The National Center on Intensive Intervention (NCII), a subdivision of the American Institutes for Research, conducted an evaluation of math intervention practices at five exemplary school districts: Hancock, West Virginia; Okaloosa, Florida; Scituate, Massachusetts; Alton, Illinois; and Jenison, Michigan.[19] The evaluation focused on students with severe learning difficulties, but the findings may be applicable to all students:

- In all sites, intensive intervention was defined as a component of a multi-tiered system of support. These systems provided an infrastructure to support services for students with the most intensive needs, including those with disabilities, within the general education system.
- The use of data to drive instructional decision making was pervasive in all sites, especially with respect to academic progress monitoring. In contrast, the use of diagnostic assessment data and behavioral progress-monitoring data was less defined and consistent.
- All sites placed a heavy emphasis on capacity-building practices related to intensive intervention, including creating and maintaining broad stakeholder buy-in, building staff expertise, being flexible with scheduling, and making connections between intensive intervention and other related initiatives.

[15] Bulleted items adapted from: Ibid., p. 2.
[16] "Response to Intervention in Elementary-Middle Math." The National Association of Elementary School Principals. http://www.naesp.org/sites/default/files/Math_Intervention_blue.pdf
[17] Ibid., pp. 4-6.
[18] Ibid., pp. 7-8
[19] "Implementing Intensive Intervention: Lessons Learned from the Field." National Center on Intensive Intervention, October 2013, pp. 1-68. http://www.intensiveintervention.org/sites/default/files/Lessons_Learned_From_Field_0.pdf

- Meaningful engagement and involvement of families in decisions about program planning was important for supporting implementation of intensive intervention.
- Identification and service delivery for special education occurred separately from and after a student received intensive intervention within the tiered intervention system.
- Staff defined intensive intervention as a process involving adaptation of a secondary intervention (Tier 2), consistent with components of NCII's data-based individualization framework. However, staff spoke more frequently and concretely about making quantitative rather than qualitative adaptations to interventions.
- Although all sites described using secondary intervention programs (Tier 2) as a foundation for intensifying intervention, fidelity of implementation of these programs was inconsistent.[20]

EARLY DETECTION

While math interventions at the middle and high school levels are vital, general consensus among researchers suggests that interventions at the elementary school level are essential to avoiding later difficulties. This body of work is united by the belief that early detection and remedy of math difficulties eliminates future struggles with increasingly complex and abstract mathematical concepts studied throughout secondary grades. As such, this section of the report focuses on the nature and effect of math interventions among students in the primary grades.

Much of the research within this general topic is dedicated to identifying effective screening methods that reliably detect kindergarteners and first graders who experience difficulties. Studies concerned with early mathematics indicate that students who enter first grade with gaps in mathematical understanding are likely to experience continued effects of this deficiency throughout their educational careers.[21]

A 2005 article published in the *Journal of Learning Disabilities* compiled available research on mathematics difficulties (MD) and identified the importance of "**fluency and proficiency with basic arithmetic combinations and the increasingly accurate and efficient use of counting strategies**"[22] Lack of basic mathematic fluidity (i.e., immediate access to basic arithmetic combinations such as 3+6) is limited for almost all young students who struggle

[20] Taken verbatim from: Ibid., p. 1.

[21] [1] Gersten, R., et al. "Screening for Mathematics Difficulties in K–3 Students." Center on Instruction at RMC Corporation, 2011, p. 3. http://www.centeroninstruction.org/files/Screening%20for%20Math%202nd%20Ed%202-3-12.pdf
[2] Jordan, N. C. et al. "Early Math Matters: Kindergarten Number Competence and Later Mathematics Outcomes." *Developmental Psychology,* 2009, 45, pp. 850–867. Accessed via ProQuest.
[3] Morgan, P., L., Farkas, and Q. Wu. "Five-Year Growth Trajectories of Kindergarten Children With Learning Difficulties In Mathematics." *Journal of Learning Disabilities*, 2009, 42, pp. 306–321. Accessed via ProQuest.
[4] Duncan, G. et al. "School Readiness and Later Achievement." *Developmental Psychology*, 2007, 43, pp. 1428–1446.

[22] Gertsen, R., N. Jordan, and J. Flojo. "Early Identification and Interventions for Students with Mathematics Difficulties." *The Journal of Learning Disabilities*, August 2005, 38:4, pp. 302. http://udel.edu/~njordan/jordan_JLD2005.pdf

with math. Researchers produced a causal claim that the mechanics of finger-counting methods, necessary when students cannot automatically compute basic math concepts, cause delays in understanding classroom-based demonstration of advanced math functions.[23]

Using these observations and further analysis, Gertsen, et al. proposed valid indicators of potential MD in kindergartners, which included the following areas: difficulty with arithmetic combinations (including poor integer magnitude comparison skills, hesitation in identifying numbers, and poor memory span) and undeveloped counting methods.[24] The study identified The Number Knowledge Test as a screening exam that researchers consider to be a broad assessment that strongly predicts MD. A description of the tool is provided below, and Figure 1.5 on the following page provides sample items from the assessment.

> **The Number Knowledge Test** is an individually administered 10–15 minute measure that assesses students' procedural and conceptual knowledge related to whole numbers. The test examines students' understanding of magnitude, their counting ability, and their competence with basic arithmetic operations.[25]

Figure 1.5: Sample Items from the Number Knowledge Test

SAMPLE ITEM	LEVEL
I'm going to show you some counting chips. Would you count these for me?	0
Here are some circles and triangles. Count just the triangles and tell me how many there are.	0
How much is 8 take away 6?	1
If you had 4 chocolates and someone gave you 3 more, how many chocolates would you have altogether?	1
Which is bigger: 69 or 71?	2
Which is smaller: 27 or 32?	2
What number comes 9 numbers after 999?	3
Which difference is smaller: the difference between 48 and 36 or the difference between 84 and 73?	3

Source: Gertsen, Jordan, and Flojo (2005)[26]

A later literature review, also conducted by Gertsen and a team of researchers for The Center on Instruction at RMC Corporation, developed the following set of conclusions about early mathematics screening for students in grades K–3:

- There are notable differences between the needs of kindergarten students and first-grade students. Screening tools can identify these differences, which may be due to lack of exposure to mathematics before elementary school or the transition to a formal educational environment.

[23] Ibid.
[24] Ibid., p. 293.
[25] Taken verbatim from: Ibid., p. 297.
[26] Ibid., p. 298.

- **Constant changes to curricula, which are common occurrences, may contribute to students' "late-onset" need for mathematic interventions.**
- The literature reviewed in this study does not indicate strategies to detect which students, despite the fact that they have mastered elementary mathematical skills, will later struggle with more advanced and abstract concepts (i.e., fractions, ratio, proportion and geometry) in fourth and fifth grade.
- **Working memory continues to be an accurate indicator of mathematical proficiency,** although there is not a clear consensus about how to improve working memory among students in mathematics.
- There is a scarcity of research that addresses multiple proficiency assessment batteries and timed assessments, as well as the role of assessment tools within an RtI framework.[27]

[27] Gertsen, R., Clarke, B., and Jordan, N. "Screening For Mathematics Difficulties in K–3 Students." RMC Research Corporation, Center on Instruction, 2007, pp. 17-19. http://www.nysrti.org/docs/ScreeningforMathematicsDifficultiesinK-3Students.pdf

SECTION II: PROGRAM PROFILES

The following section examines seven math instruction and intervention programs that have been determined to be effective by a credible authority. For each tool, this section provides a description of the program and the results of research evaluating the efficacy of the program. After a brief overview of the program, each profile consists of two sections:

Program Description examines target ages and program focus, delivery methods, the frequency and typical length of sessions, and the curricular design.

Evaluation and Assessment identifies research and assessment results of the program. Although Hanover mentions a range of studies, we emphasize the most scientifically reliable and methodologically sound studies, which are identified by established, independent organizations. These include three previously discussed organizations: The Best Evidence Encyclopedia (BEE), the What Works Clearinghouse (WWC), and the National Center on Intensive Intervention (NCII). Each organization's evidence standards are indicated below.

- The BEE criteria include the following requirements:
  - Studies involved children within the target age range.
  - Studies used control groups.
  - Studies used random assignment in placing students into the test or control group.
  - Though studies could take place in any country, reports had to be available in English.
  - Studies were a minimum of 12 weeks in duration. [28]
- The WCC's evidence standards vary slightly based on academic grade level, but largely align with the BEE's requirements and include the following elements:
  - **Topic Area Relevance.** The study must focus on the effects of a mathematics intervention on one or more measures of mathematics achievement.
  - **Sample Relevance.** The WWC High School Mathematics area appropriately reviews interventions for the specified age group (either elementary, middle, or high school grades).
  - **Geographic Relevance.** The study must have been conducted in the United States (including the 50 states, the District of Columbia, territories, and tribal entities).
  - **Outcome Relevance.** The study must include at least one student achievement measure that demonstrates sufficient reliability or face validity.[29]

[28] Adapted from: Slavin and Lake, Op. cit.

[29] [1] Bulleted items taken verbatim from: "WWC Evidence Review Protocol for High School Mathematics Interventions, Version 2.0." The What Works Clearinghouse, 2010, p. 2. http://ies.ed.gov/ncee/wwc/pdf/reference_resources/hsm_protocol_v2.pdf

[2] See also: "WWC Evidence Review Protocol for High School Mathematics Interventions, Version 2.0." The What Works Clearinghouse, 2012. http://ies.ed.gov/ncee/wwc/pdf/reference_resources/esm_protocol_v2.0.pdf and

- The NCII conducted a meta-analysis of program evaluations, which resulted in the identification of five programs with convincing positive evidence based on the following criteria:
  - **Participants have been identified as "at-risk"** (i.e., within the bottom 30th percentile on a local or national norm, or sample mean below 25th percentile on local or national test; or students with identified disability).
  - **Evaluation design was based on responsible methodology,** including random assignments, statistically and demographically comparable treatment and control groups, and no attrition bias.
  - **Fidelity of implementation** was measured satisfactorily and reached levels of 75 percent or greater.
  - **Targeted and broader measures of effectiveness are reliable**. All measures of both types must be psychometrically reliable with consistency coefficients greater than 0.59.[30]

Regression analyses in the NCII examination revealed various effect sizes of the programs in question. Effect sizes of 0.25 or larger are considered to be "substantively important," indicating a strong relationship between participation in a particular intervention and attainment of an increased academic outcome. As seen in Figure 2.1, NCII found *Fraction Face-Off!* and *Hot Math Tutoring* to be the most effective across targeted and broader measures.

Figure 2.1: Effect Sizes of NCII-Evaluated Programs

Program Name	Study	Number of Outcome Measures	Mean Effect Size	
			Targeted Measures	Broader Measures
focusMATH Intensive Intervention	Styers & Baird-Wilkerson (2011)	15	0.23*	N/A
Fraction Face-Off!	Fuchs, Schumacher, Long, Namkung, Hamlett, et al. (2012)	4	1.81*	0.92*
Hot Math Tutoring	Fuchs, Fuchs, Craddock, Hollenbeck, Hamlett, et al. (2008)	3	1.15*	0.60*
Number Rockets	Fuchs, Compton, Fuchs, Paulsen, Bryant, et al. (2005)	7	0.45*	0.10
Pirate Math Individual Tutoring	Fuchs, Powell, Seethaler, Cirino, Fletcher, et al. (2009)	6	0.65*	0.56*

*Effect Size is statistically significant for at least one measure, greater than .25
Source: American Institutes for Research[31]

"WWC Evidence Review Protocol for Middle School Mathematics Interventions, Version 1.1." The What Works Clearinghouse, 2009. http://ies.ed.gov/ncee/wwc/pdf/reference_resources/msm_protocol_1.1.pdf

[30] "Instructional Intervention TRC." National Center for Intensive Intervention. http://www.intensiveintervention.org/chart/instructional-intervention/headers#field_part

[31] "Academic Intervention." The National Center on Intensive Intervention. http://www.intensiveintervention.org/chart/instructional-intervention-tools?grade=all&subject=math

FRACTION FACE-OFF!

Fraction Face-Off!, which was developed, tested, and distributed by Vanderbilt University, aims to improve fourth grade students' knowledge and comprehension of fractions.[32] It is intended for use among small-group tutoring programs and each session takes approximately 30 minutes with a recommended three sessions per week for 12 weeks.[33] Instructors are encouraged to undergo a day-long training program to prepare, although very detailed teacher's manuals accompany the program. There are no technology requirements for the program.

PROGRAM DESCRIPTION

Fraction Face-Off! "uses explicit instruction to address two types of understanding about fractions: the part/whole interpretation of fractions and the measurement interpretation of fractions."[34] Program developers Lynn Fuchs (Ph.D.), Robin Schumacher (Ph. D.), and Doug Fuchs (Ph.D.) view fraction-mastery as essential for later success in algebra and higher level mathematics, which was the guiding philosophy of the program design.

The *Fraction Face-Off!* model uses an engaging athletic theme, with students playing the imaginary role of professional athletes. Each lesson requires teamwork (in activities like The Relay and Fraction Sprint) and individual effort. Students' fraction proficiency is expanded by opportunities to earn "fraction money," which can be redeemed for prizes at "The Fraction Store" only after demonstrating understanding of fraction denominations that equal one whole dollar.

EVALUATION AND ASSESSMENT

As previously mentioned, a study conducted by the program's designers – Fuchs, Schumacher, and Fuchs – was recognized by the NCII as a methodologically sound evaluation that indicated promising mean effects. This study was conducted at a site in Nashville, Tennessee over one year.[36] Participants included 281 students, of which 130 were assigned to a control group and 129 underwent the program. Students were all defined as "at-risk," meaning below the 35th percentile on the Wide Range Achievement Test–4. This group was further delineated into severe risk (less than 17th percentile) and less severe risk (between the 18th and 34th percentiles). The study collected

Figure 2.2: *Fraction Face-Off!* Evaluation Effect Sizes

MEASURE	EFFECT SIZE
Targeted Measures	
Comparing Fractions	1.64***
Fraction Number Line	1.07***
Fraction Calculations	2.48***
Broader Measures	
NEAP Performance	0.85***

***p ≤ .001
Source: Vanderbilt University[35]

[32] "Fraction Face-Off!" Vanderbilt University. http://kc.vanderbilt.edu/pals/pdfs/fraction_face_off.pdf
[33] "Fraction Face-Off! (previously Fraction Challenge)." The National Center on Intensive Intervention. http://www.intensiveintervention.org/chart/instructional-intervention-tools/12928
[34] "Fraction Face-Off!" Op. cit.
[35] Ibid.
[36] "Fraction Face-Off! (previously Fraction Challenge)," Op. cit.

information about students' race and ethnicity, socio-economic status, disability status, and gender.[37] As is evident in Figure 2.2, *Fraction Face-Off* indicated the largest effect on students' ability to compare and calculate fractions. It had a lesser but significant effect on students' success using a fraction number line and increased performance on the National Assessment of Educational Progress (NEAP) Exam.

HOT MATH TUTORING

Hot Math is designed to help third grade students improve their mastery of word problems. It is intended for use in small-group tutoring programs. Like *Fraction Face-Off!, Hot Math* was developed, evaluated, and distributed by researchers at Vanderbilt University.[38] Each session lasts approximately 20-30 minutes, and the program is delivered three times per week for 13 weeks. Although this program is intended for use in tutoring programs, it can also be implemented alongside the *Classroom Hot Math* program, which is used two times per week for 30-45 minutes.[39] Instructors are encouraged to undergo a day-long training program to prepare, although very detailed teacher's manuals accompany the program. There are no technology requirements for *Hot Math.*[40]

PROGRAM DESCRIPTION

Lynn Fuchs describes *Hot Math* as a combination of "explicit instruction and self-regulation strategies with instruction on transferring solutions to novel math problems."[41] She explains that this program, which is based on schema theory, supports:

- Solution strategies for four word-problem types, and
- How to transfer those solution strategies to word problems with unexpected features, such as problems that include irrelevant information, or that present a novel question requiring an extra step, or that include relevant information presented in charts or graphs, or that combine problem types, and so on.[42]

Figure 2.3 describes the *Classroom Hot Math* curriculum, which indicates a foundation for the tutoring program. *Hot Math* is comprised of five, three-week units that explore a different aspect of word problems:

[37] Ibid.
[38] "Mastering Mathematics: Improving Mathematics Outcomes for Students." *The Conversation*, February 4, 2014. http://leadspartnership.ca/theconversation/289/
[39] "Hot Math Tutoring." The National Center on Intensive Intervention. http://www.intensiveintervention.org/content/hot-math-tutoring
[40] Ibid.
[41] "Groundbreaking Work from Vanderbilt: Response to Mathematics Intervention." Special Edge, 2006, 19:2. http://www.calstat.org/publications/article_detail.php?a_id=51&nl_id=6
[42] Bulleted items taken verbatim from: "Mastering Mathematics: Improving Mathematics Outcomes for Students," Op. cit.

Figure 2.3: *Hot Math Classroom* Curriculum

Unit	Description
Checking your work	Focuses on the basics of checking over finished work covering these areas: Sense, Lining Up, Math, Labels, and Signs.
Buying Bags	Teaches students specific strategies on how to solve word problems that deal with buying things in groups. (e.g. If lollipops come in bags of 10, and Judy needs 23 lollipops, how many bags does she need to buy?)
Shopping List	Teaches students how to solve multi step problems dealing with buying multiple things at multiple prices (e.g. I need to buy 2 apples for $1 each and 4 bananas for $2 each, how much will I spend?)
Half	Teaches students a specific strategy for finding half of a group of objects.
Pictograph	Teaches students how to 'solve' pictographs and use the information to answer questions.

Source: Vanderbilt University[43]

Evaluation and Assessment

A study conducted by the program's designers was recognized by the NCII as a methodologically sound evaluation that indicated promising mean effects.[44] The study examined the effects of *Hot Math Tutoring Intervention* on 84 third grade students across 120 classrooms. All participants scored below the district criterion designating risk for math learning disabilities (below the 24th percentile) on the Test of Computation Fluency.[45] Fifty-six students were in the treatment group and 28 students were in the control group. The study collected information about students' race and ethnicity, socio-economic status, disability status, and gender. Measures captured students' comprehension across three problems types that ranged from problems that closely-related to learned math content to those that required creative application of skills. Figure 2.4 presents the study's findings, which indicate that *Hot Math Tutoring* has the strongest effect on improving student's performance on problems that are directly related to its content. This strength decreases as questions require more advanced applications. The following list summarizes each measure:

Figure 2.4: *Hot Math Tutoring* Evaluation Effect Sizes

Measure	Effect Size
Targeted Measures	
Immediate Transfer	1.15*
Broader Measures	
Near Transfer	0.82*
Far Transfer	0.38

*$p \leq .001$
Source: Vanderbilt University

- **Immediate Transfer:** Number correct (0-44), Incorporates novel problems in the same format as the problems used for problem-solution instruction; none of the cover stories are used for instruction.

[43] "Hot Math: Teaching Math Problem Solving with Explicit Instruction to Transfer and Self-Regulation Strategies." https://kc.vanderbilt.edu/pals/pdfs/hot_math.pdf

[44] [1] "Hot Math Tutoring," Op. cit.
[2] Fuchs, L. et al. "Effects of Small-Group Tutoring with and without Validated Classroom Instruction on At-Risk Students' Math Problem Solving: Are Two Tiers of Prevention Better Than One?" *The Journal of Educational Psychology*, 2008, 100:3, pp. 491-509. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2536765/pdf/nihms-62377.pdf

[45] "Hot Math Tutoring," Op. cit.

- **Near Transfer:** Number correct (0-79), Incorporates novel problems that vary from the problems used for problem-solution instruction in terms of one or more of the transfer features addressed in Hot Math Tutoring: unfamiliar vocabulary, different question, irrelevant information, or combination of problem types.
- **Far Transfer:** Number correct (0-72), Designed to mirror real-life problems; varies from the problems used for instruction in multiple ways; is formatted to look like a commercial, standardized test; presents a multi-paragraph with four questions; some of the information needed to answer the question is removed from the multi-paragraph narrative and placed in figures or question stems; contains multiple pieces of numeric and narrative irrelevant information; provides opportunities for students to formulate decisions.[46]

NUMBER WORLDS

Number Worlds is an intervention program targeted at students that are one to two grades below grade-level in mathematics. Lessons take 45-60 minutes and are intended to supplement students' daily mathematics instruction. A placement test assigns students to the appropriate level and unit. *Number Worlds* offers a prevention program for students in pre-kindergarten through first grade, an intervention program for students from first through eighth grade, and an algebra readiness program for students in sixth through eighth grade.[47]

PROGRAM DESCRIPTION

Prevention Levels A-C, detailed in Figure 2.5, are targeted at students in pre-kindergarten through first grade who enter school with an "impoverished math understanding" and who are at risk of math failure in later grades.[48]

Figure 2.5: *Number Worlds* Program Description, Levels PK-1

LEVEL A PRE-KINDERGARTEN	LEVEL B KINDERGARTEN	LEVEL C GRADE 1
Children acquire well-developed counting and quality schemas	Children develop a well-consolidated central conceptual structure for single-digit numbers	Children link their central conceptual structure of number to the formal symbol system

Source: Number Worlds[49]

Figure2.6 details Intervention Levels D-J, as well as the Algebra Readiness intervention. These are intended for students in first through eighth grade that are at least one level behind in math. Students take six four-week intensive units per grade, with the goal of developing "on-level mathematical proficiency."[50] A selection of sample lessons is available

[46] Bulleted items taken verbatim from: Ibid.
[47] "Scope & Sequence." Number Worlds. http://sranumberworlds.com/scopesequence.html
[48] Ibid.
[49] Table contents taken verbatim from: Ibid.
[50] Ibid.

online alongside guidelines for implementing Number Worlds (and Everyday Mathematics, another McGraw Hill product) within an RTI framework.[51]

Figure 2.6: *Number Worlds* Program Description, Grades 1-8

LEVEL D GRADES 1-2	LEVEL E GRADES 2-3	LEVEL F GRADES 3-4	LEVEL G GRADES 4-5	LEVEL H GRADES 5-6	LEVEL I GRADES 6-7	LEVEL J GRADES 7-8	ALGEBRA READINESS GRADES 6-8
Number Sense	Number Sense	Number Sense	Number Sense	Number Sense	Number Sense	Number Sense	Whole Numbers and Operations
Number and Pattern Relationships	Number and Pattern Relationships	Number and Pattern Relationships	Number and Pattern Relationships	Number and Pattern Relationships	Operation Sense and Computation	Expressions and Equations	Rational Numbers
Addition	Addition	Addition and Subtraction	Multiplication	Fractions, Decimals, and Percents	Proportional Reasoning	Proportional Reasoning	Operations on Rational Numbers
Subtraction	Subtraction	Multiplication and Beginning Division	Division	Multiplication and Division	Algebra	Algebra	Equations and Functions
Geometry and Measurement	Geometry and Measurement	Geometry and Measurement	Geometry and Measurement	Geometry and Measurement	Geometry and Measurement	Geometry and Measurement	The Coordinate Plane and Graphing
Data Analysis and Applications	Data Analysis and Applications	Data Analysis and Applications	Data Analysis and Applications	Data Analysis and Applications	Data Analysis and Applications	Data Analysis and Applications	Algebra

Source: Number Worlds[52]

EVALUATION AND ASSESSMENT

The *Number Worlds* website states that, since its development in the mid-1980s, the intervention "has been the only such program to show proven results through years of rigorous field testing. These tests show how students who began at a disadvantage surpassed the performance of students who began on-level with their peers, simply with the help of the *Number Worlds* program."[53] The website links to an article titled "Program Lifts Students' Math Scores: Officials Statewide Gains Are Dramatic." This article highlights the performance of students in kindergarten and first grade at three Kentucky elementary schools. These students were placed in a *Number Worlds* math intervention program and

[51] [1] "Sample Lessons." Number Worlds. http://sranumberworlds.com/sample.html
[2] "Response to Intervention: Everyday Mathematics with SRA Number Worlds." The McGraw Hill Companies. https://docs.google.com/viewer?a=v&q=cache:8IzV6W3iVWAJ:www.asdk12.org/depts/titleone/binder/Everyday_math_w_numberworlds.pdf+&hl=en&gl=us&pid=bl&srcid=ADGEESh4Ek5ARNjQnSBp_VSiVt8HkLSRxnuzgneFcr3LkrRMZEUhgUD5YIR9AgwwxrvxTYisCnxZg7H_wpFLyLN3WMOS3EHg80jKjIEguBz__4ND5gm7LEn_K1kxXe97RlDrde8KQuq5&sig=AHIEtbTH_Q3OpD-IU0RDcHWixVh7VP7RlQ&pli=1
[52] Ibid.
[53] "Effective Results." Number Worlds. http://sranumberworlds.com/results.html

subsequently "posted one to two years of growth in math skills in one year and outscored their peers on norm-referenced tests."[54]

In addition, the creator of *Number Worlds*, Sharon Griffin, Ph.D., has published a number of papers on the program and math education in general.[55] Aside from papers authored by Griffin, Hanover found the following studies on *Number Worlds* conducted by SKF Educational Services:

- "The Effectiveness of SRA/McGraw-Hill Number Worlds Program on Fluency in Math Calculation for Middle School Students Identified with Special Needs"[56] This study sample consisted of 23 students enrolled in a low-income middle school in central Ohio. The study determined that "for approximately 83% of students in this sample, *Number Worlds* is highly to moderately effective."[57]
- "The Effectiveness of SRA/McGraw-Hill Number Worlds: A Response to Intervention Model of Service Delivery"[58] This study sought to investigate the impact of *Number Worlds* on the achievement of at-risk kindergarten and fourth grade students. The study sample consists of three kindergarten students and three fourth-grade students enrolled in a low-income elementary school in central Ohio. Preliminary results showed "that the Number Worlds program increases fluency in identifying numbers for Kindergarten students and in completing multiplication facts for fourth graders."[59]

However, it must be noted that these reports appear to have been specifically funded by McGraw-Hill. Additionally, the small sample sizes used in each study do not suggest that they are particularly reliable indicators. Neither the WWC nor the BEE identifies studies on *Number Worlds* that meet their methodological qualifications.

I CAN LEARN PRE-ALGEBRA AND ALGEBRA

I CAN Learn Pre-Algebra and Algebra is tailored to the need of ethnically diverse, inner-city students in grades 6-12 and is designed to meet general state and national math standards.[60] However, the fact that *I CAN Learn* is computer-based makes it an expensive form of math intervention: a 30-seat technology lab can cost at least $100,000, with an additional $150,000 for the software, according to estimates from a group of researchers

[54] Campbell, J. "Program Lifts Students' Math Scores: Officials: Statewide Gains are Dramatic." October 29, 2007. Messenger-Inquirer. http://sranumberworlds.com/downloads/news/MessengerInq-NW_v4.pdf
[55] "Program Authors." Number Worlds. http://sranumberworlds.com/authors.html
[56] "The Effectiveness of SRA/McGraw-Hill Number Worlds Program on Fluency in Math Calculation for Middle School Students Identified with Special Needs." SKF Educational Services, LLC. http://www.mheresearch.com/assets/products/6ea9ab1baa0efb9e/Number_Worlds_effectivewithspecialneedsstudents.pdf
[57] Ibid.., p. 10
[58] "The Effectiveness of SRA/McGraw-Hill Number Worlds: A Response to Intervention Model of Service Delivery" SKF Educational Services, LLC. http://www.mheresearch.com/assets/products/6ea9ab1baa0efb9e/shannon_flaum.pdf
[59] Ibid., p. 9.
[60] "I CAN Learn Pre-Algebra and Algebra." Promising Practices Network. http://www.promisingpractices.net/program.asp?programid=195

whose article featuring *I CAN Learn* was published in the *American Economic Journal: Economic Policy*.[61] This estimate does not include yearly maintenance costs.

PROGRAM DESCRIPTION

Mark Dynarski, the director of the Center for Improving Research Evidence at Mathematica Policy Research, indicated that the power of this program lies in its use of technology, as it targets students who are struggling academically, frequently due to missed class time, and allows them to work at their own pace. "That's a power of technology," Mr. Dynarski said. "That is one of its real strengths."[62]

The pre-algebra curriculum, which also incorporates elementary aspects of geometry and statistics, comprises 130 lessons and 45 hours of instructional video.[63] Its units include the following:

- Numbers and Operations
- Mathematical Reasoning
- Algebraic Expressions and Equations
- Integers, Decimals, Fractions and Percents
- Ratios and Proportions
- Square Roots
- Measurement
- Basic Geometry
- Graphs and Functions[64]

The structure of the *I CAN Learn Math* algebra curriculum is largely similar; however, it presents more complex and abstract content than the pre-algebra program. It places a larger emphasis on preparing students for success in "high-stakes tests," such as state exit exams and college readiness assessments like the SAT and ACT.[65] Its curriculum comprises 180 lessons that address the following elements:

- Algebraic System of Numbers and Operations
- Algebraic Expressions
- Graphing Equations and Inequalities
- Foundations of Functions
- Systems of Linear Equations and Inequalities
- Polynomial Operations
- Quadratic Equations and Functions
- Probability and Statistics
- Matrices
- Logarithms[66]

EVALUATION AND ASSESSMENT

The What Works Clearinghouse identified a study conducted on *I CAN Learn Pre-Algebra and Algebra* interventions that meets its methodological qualifications. WWC indicated there is "strong evidence of a positive effect with no overriding contrary evidence."[67]

[61] Cavanagh, S. "Computer-Aided Instruction Led to Algebra Gains." *Education Week,* March 10, 2009. http://www.edweek.org/ew/articles/2009/03/10/25adapt.h28.html
[62] Cavanagh, Op. cit.
[63] "Pre-Algebra." I CAN Learn Education Systems. http://www.icanlearn.com/pre_algebra.html
[64] Bulleted items taken verbatim from: Ibid.
[65] "Algebra." I CAN Learn Education Systems. http://www.icanlearn.com/algebra.html
[66] Bulleted items taken verbatim from: Ibid.
[67] "Middle School Math." *The What Works Clearinghouse*, July 30, 2007, p. 2. http://files.eric.ed.gov/fulltext/ED497626.pdf

Researchers designed a randomized study of 2,400 students in eighth grade across 13 schools in Orleans Parish schools, with one portion of classes using *I CAN Learn* programs, and others using the standard curriculum. Specifically, 1,082 students were administered the *I CAN Learn Pre-Algebra and Algebra* programs, and 1,318 students acted as a control group and received traditional mathematics instructional methods.[68] Student's progress was measured against pre- and post-test results in the Louisiana Educational Assessment Program (LEAP).[69]

A separate study, published in 2009 by the *American Economic Journal: Economic Policy,* found similar, positive effects. This study was a randomized study of late middle- and early high school students in urban districts across 17 schools.[70] Their performance was measured against pre- and post-test results in state standardized exams and designed algebra exams. Researchers addressed its high price point and suggested that this program may offer the same success at a lower price point than costs associated with decreasing class sizes.[71] This study was not acknowledged by the WWC as one that met evidence standards.

DREAMBOX LEARNING

DreamBox Learning, developed by DreamBox Learning, Inc., provides another example of an online program, but is intended for younger students in grades K-6. Its homepage indicates that the program is broadly focused on numbers and operations, place value, and number sense. Additionally, it is aligned to Common Core State Standards and seeks to create a "seamless integration" of instruction time with formative and summative assessment.[72] DreamBox recommends that students spend 90 minutes per week with the program.[73]

PROGRAM DESCRIPTION

This program is anchored by its Intelligent Adaptive Learning capabilities, which are highly data-driven. *Dreambox* collects over 50,000 data points per hour for each student, which are analyzed to determine individual students' problem solving methods. This allows the program to adapt the lesson and the "level of difficulty, scaffolding, sequencing, number of hints, and pacing as appropriate."[74] *Dreambox* espouses the transparency that its program brings as being essential to engaging teachers, administrators, and parents. Ease of information about "how students are moving through the curriculum, with up-to-date

[68] "I CAN Learn Pre-Algebra and Algebra." *The What Works Clearinghouse.* http://ies.ed.gov/ncee/wwc/pdf/intervention_reports/wwc_icanlearn_031009.pdf
[69] Ibid., p. 3.
[70] Barrow, L., L. Markman, and C. Rouse. "Technology's Edge: The Educational Benefits of Computer-Aided Instruction." *American Economic Journal: Economic Policy,* 2009, 1:1, pp. 52-74. http://www.aeaweb.org/articles.php?doi=10.1257/pol.1.1.52
[71] Ibid.
[72] "How to Successfully Plan for CCSS for Math." DreamBox Learning. http://www.dreambox.com/white-papers/successfully-plan-ccss-math
[73] "DreamBox Learning." The *What Works Clearinghouse*. http://hepg.org/hel/article/556
[74] "Intelligent Adaptive Learning." DreamBox Learning. http://www.dreambox.com/intelligent-adaptive-learning?q=/adaptive-learning-overview

achievement levels against multiple standards" aids all stakeholders in making decisions that best prepare students for academic success.[75]

Figure 2.7 provides greater detail about the program's curricular content, broken down by grade level and unit. This information is found on the *DreamBox* Quick User Guide, which also provides example screenshots of a variety of lessons.

Figure 2.7: *DreamBox* Unit Descriptions by Grade Level

GRADE LEVEL	UNITS	
Kindergarten	▪ Comparisons and Ordering ▪ Counting	▪ Addition and Subtraction ▪ Problem Solving
First Grade	▪ Counting ▪ Addition and Subtraction ▪ Comparisons and Ordering	▪ Place Value ▪ Ordering
Second Grade	▪ Comparisons and Ordering ▪ Place Value	▪ Addition and Subtraction ▪ Problem Solving
Third Grade	▪ Addition and Subtraction ▪ Multiplication	▪ Division ▪ Fractions
Fourth Grade	▪ Addition and Subtraction ▪ Multiplication and Division	▪ Place Value ▪ Fractions ▪ Integers
Fifth Grade	▪ Multiplication and Division ▪ Fractions	▪ Decimals ▪ Fractions and Decimals
Sixth Grade	▪ Percentages	▪ Distributive Property

Source: DreamBox Learning Inc.[76]

EVALUATION AND ASSESSMENT

DreamBox Learning, Inc. has conducted a large number of case studies including several in Kentucky, Texas, New Mexico, California, and Delaware, as well as national studies. However, these studies cannot be considered unbiased.

WWC identified one study of *DreamBox Learning* that meets its evidence criteria without reservations and determined that *DreamBox* has "potentially positive results" on mathematics achievement for elementary students due to a limited extent of evidence.[77] It is important to note that this study was only demonstrative of kindergarten and first grade students. Furthermore, these students were enrolled in charter schools, which tend to serve non-representative populations of students, with fewer numbers of special needs and ELL students.[78] The study, conducted by SRI International, examined the effects of *DreamBox*

[75] Ibid.
[76] "Unit Descriptions: Quick User Guide." DreamBox Learning. http://www-static.dreambox.com/wp-content/uploads/2013/01/DreamBox-Learning-Unit-Descriptions.pdf
[77] "DreamBox Learning," Op. cit.
[78] [1] "Making Charter Schools More Inclusive." Harvard Education Letter, February 2013, 29:1. http://hepg.org/hel/article/556
[2] Buckley, J. and C. Sattin-Bajaj. "Are ELL Students Underrepresented in Charter Schools? Demographic Trends in New York City, 2006-2008." New York University. http://www.ncspe.org/publications_files/OP188.pdf

Learning on 557 such students in San Jose, California, who were randomly assigned to either the treatment or control group. Outcome data, based on Measures of Academic Progress math scores, were evaluated and researchers determined a statistically significant positive difference between the two groups of students.[79] Ultimately the WWC assigned a rating of "potentially positive effects, with a small extent of evidence" to the *DreamBox Learning* program evaluation.

ENVISIONMATH

enVisionMATH, developed and published by Pearson Education, Inc., is a classroom- and computer-based, Common Core State Standards-aligned program for students in grades K-6.[80]

PROGRAM DESCRIPTION

Lessons are composed of a review session, a small-group, problem-based exercise, followed by individual learning activities. Daily assessment of all students help teachers recognize which skills are coming easily to students and identify which students need extra help to achieve mastery. Pearson does not provide a wealth of information about the program's curricular design. However, a 2008 promotional video explains the guiding philosophy behind *enVisionMATH*.[81] It caters to 21st century students' technological skills and their proclivity towards digital media. Program designers identified a potential flaw of common math instruction: it avoids technology, interpreting engagement with technology as a distraction from learning.[82] *enVisionMATH* provides synchronized print and digital resources to guide students through interactive and technology-based activities. The video proposes that less direct teacher involvement allows teachers time to target the individual needs of their students. Students' assignments and progress can be accessed at home via the internet, permitting parents to engage in their students learning process. enVisionMATH appears to be a very concerted form of instruction, with a limited emphasis on creative problem-solving.

EVALUATION AND ASSESSMENT

In a 2008 study, the Planning Research & Evaluation Services (PRES) Associates, Inc., an independent evaluation company, examined the effects of *enVisionMATH* on 1,156 second and fourth grade students in eight elementary schools across several states: Colorado, Kentucky, Massachusetts, Montana, New Hampshire, North Carolina, and Tennessee.[83] Teachers were randomly assigned to either the control or treatment groups and would

[79] Ibid.
[80] "enVisionMATH Common Core 2012." Pearson Education, Inc. http://www.pearsonschool.com/index.cfm?locator=PS1zHe&PMDbSiteId=2781&PMDbSolutionId=6724&PMDbSubSolutionId=&PMDbCategoryId=806&PMDbSubCategoryId=25741&PMDbSubjectAreaId=&PMDbProgramId=76981
[81] "enVision MATH." Pearson Education Inc., Youtube Video. https://www.youtube.com/watch?v=se-5y43CAF4
[82] Ibid.
[83] "enVision MATH." *The What Works Clearinghouse,* p. 6. http://ies.ed.gov/ncee/wwc/pdf/intervention_reports/wwc_envisionmath_011513.pdf

either instruct their students using the established math curriculum or using *enVisionMATH* program. These students' progress was observed throughout the following year of the trial. Student improvement was measured across four standardized tests including two subtests of the Metropolitan Achievement Test (MAT 8), a subtest of the Group Mathematics Assessment and Diagnostic Evaluation (GMADE), and the Open-Ended Assessment of Problem Solving and Reasoning Skills (also known as the Balanced Assessment in Mathematics).[84] *enVisionMATH* was found to have potentially positive effects on math achievement with its students attaining an average improvement index of +6 percentile points, representing a range of +1 to +9. The extent of this evidence was deemed by the WWC to be small.[85] Figure 2.8 presents findings across all measures. WWC independently calculated mean differences, effect sizes, and improvement indexes for all measures.

Figure 2.8: PRES enVisionMATH Evaluation Results

Outcome Measure	Mean Difference	Effect Size	Improvement Index
GMADE: Concepts and Communication	2.34	0.22	+9
MAT 8: Math Computation	9.79	0.16	+6
MAT 8: Math Concepts and Problem-solving	1.86	0.04	+1
Open-Ended Assessment of Problem Solving and Reasoning Skills	3.15	0.18	+7

Source: Planning Research & Evaluation Services Associates Inc.[86]

Do The Math

Do The Math is a mathematics intervention program focused on numbers and operations. The program has modules available for first through sixth grade and further material targeted at students from sixth grade and up. The program description states: "*Do The Math* offers comprehensive teacher support and helps students develop the skills they need to compute with accuracy and efficiency, the number sense they need to reason, and the ability to apply their skills and reasoning to solve problems."[87] The program website describes how *Do The Math* can support the Common Core State Standards in mathematics, comparing content, structure, conceptual understanding, and practice standards.[88]

Program Description

Do The Math for grades one through six is organized into "13 scaffolded modules that focus on whole numbers and fluency with fractions."[89] Each module contains a series of 30 half-hour, step-by-step lessons. The module-based design gives the program the flexibility "to address all tiers of intervention" in first through sixth grade.[90] Do The Math's website

[84] Ibid., p. 8.
[85] Ibid., p. 1.
[86] Ibid., p. 9.
[87] "Do The Math." Scholastic. http://teacher.scholastic.com/products/dothemath/
[88] "Do The Math and the Common Core State Standards." Scholastic.
[89] "Do The Math Modules." Scholastic. http://teacher.scholastic.com/products/dothemath/dtm6.htm
[90] "Do The Math." Op. cit.

provides detailed information on program content, structure, materials for teachers and students, and implementation, along with sample downloads for many modules.[91] Figure 2.9 presents *Do The Math's* modules.

Figure 2.9: *Do The Math's* Modules and Content

MODULES	CONTENT
Addition and Subtraction	▪ Addition with sums up to 100 ▪ Subtraction with numbers up to 100 ▪ Numbers greater than 100 ▪ Number Core (Numbers and Operations)
Multiplication and Division	▪ Basic Concepts ▪ Facts through 100 ÷ 10 ▪ Dividends to 1,000
Fractions	▪ Basic Concepts ▪ Equivalence and Comparison ▪ Addition and Subtraction

Source: Scholastic[92]

Do The Math Now!, which is distinct from *Do The Math*, is a new yearlong mathematics intervention course developed for middle and high school students to rebuild foundational skills and prepare for algebra. The course instructs "key foundational concepts in ten organized units, each with fifteen lessons that include step-by-step teaching support, games, suggestions for differentiation, and embedded assessments." [93] A focus is maintained on the topics of multiplication and division and fraction fundamentals.[94]Sample downloads of course material are available on the program website.[95]

EVALUATION AND ASSESSMENT

Neither WWC nor BEE references any studies on *Do The Math*. However, the program's website hosts a Research section with three related publications:[96]

- Response to Intervention Alignment Guide, which provides an overview of RTI, an overview of Do The Math, and an alignment of Do The Math to RTI Core Components.
- Research Foundations, which discusses "the eight guiding principles that drove the development of *Do The Math*."[97]
- Do The Math: Math Intervention in New York City Schools is an impact study produced through the collaboration of Scholastic's Research and Validation Department and

[91] "Do The Math Modules: Foundational Topics." Scholastic. http://teacher.scholastic.com/products/dothemath/dtm6_foundational.htm
[92] "Do The Math Modules." Op. cit.
[93] "Do The Math." Op. cit.
[94] "Do The Math Now!: Scope & Sequence." Scholastic. http://teacher.scholastic.com/products/dothemath/dtmn_scope_sequence.htm
[95] Ibid.
[96] "Do The Math Research." Scholastic. http://teacher.scholastic.com/products/dothemath/research.htm
[97] "Do The Math Arithmetic Intervention by Marilyn Burns: Summary of the Research." Scholastic Research & Results. http://teacher.scholastic.com/products/dothemath/pdfs/DTM_Arithmethic_Intervention.pdf

independent research consultants. A multi-site study conducted in six New York City schools showed that *Do The Math* "raises student achievement," "can be easily implemented by all teachers," and "works in multiple settings."[98] However, as Scholastic is the publisher of the *Do The Math* intervention, this study should not be considered an unbiased evaluation.

[98] "Do The Math Research." Op. cit.

Project Evaluation Form

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