

Intervention Taxonomy Brief: Pirate Math

The goal of this brief is to provide educators with information they can use to evaluate the appropriateness of **Pirate Math** for a specific student or group of students who require supplemental and intensive intervention. The brief also may be used to guide decisions about the selection or purchase of a new intervention. We envision that the brief may allow users to examine the extent to which the program aligns to the Taxonomy of Intervention Intensity, a framework used by educators to categorize interventions along key dimensions. The information included in this brief is organized along the seven dimensions of the Taxonomy of Intervention Intensity and can assist educators in answering the following questions:

- Does evidence suggest that this intervention is expected to lead to improved outcomes in the identified area of need (**strength**)?
- Will the group size, duration, structure, and frequency provide sufficient opportunities for students to respond and receive corrective feedback (**dosage**)?
- Does the intervention match the student's identified needs (**alignment**)?
- Does the intervention assist the student in generalizing target skills to general education or other tasks (**attention to transfer**)?
- Does the intervention include elements of explicit instruction (**comprehensiveness**)?
- Does the student have opportunities to develop the behavior skills necessary to be successful (**behavioral support**)?
- Can the intervention be individualized with a data-based process to meet student needs (**individualization**)?

To learn more about the Taxonomy of Intervention Intensity and find resources to support implementation, visit <https://intensiveintervention.org/taxonomy-intervention-intensity>.

Program Summary

Pirate Math is a systematic structured tutoring program for building number knowledge, arithmetic skill, and word-problem solving. With the Pirate Math word-problem solving instruction at Grades 1–3, students learn to identify the underlying conceptual structure of three common types of word problems: total, difference, and change. For total word problems, two or more parts are combined to form a total. For difference word problems, two quantities are compared. For change word problems, an event occurs to increase or decrease a starting amount. Tutors teach the mathematical structure of each problem type using intact number stories, concrete objects, gestures, visual schematics, and equations to represent the mathematical structure. In addition, with Pirate Math instruction, students learn to identify and ignore irrelevant information, set up the number sentence that corresponds to each word-problem type, solve for the missing value in number sentences, and evaluate the reasonableness of solutions.

Exhibit 1. Program Information

Features of program implementation	Program recommendations
Grade level(s)	1, 2, and 3 (separate manual/materials for each grade)
Group size	1–4
Intervention length	48 lessons
Frequency	Three times per week
Session duration	30 minutes
Cost	Book 1, Manual: \$29.00 Book 2, Supplemental Materials: \$35.00 Flash Cards: \$16.00
Training	For information on professional development opportunities and costs, contact FuchsTutoring@air.org .

Evidence of Taxonomy of Intervention Intensity Dimensions

The following section presents definitions for the Taxonomy of Intervention Intensity dimensions and a summary of intervention-specific evidence for each dimension. The evidence comes from the intervention’s vendor or developer. It is accurate as reported to the National Center on Intensive Intervention (NCII); it was not independently verified by NCII. Additional program evidence can be found on the [NCII Tools Chart](#) and might appear on the [What Works Clearinghouse](#). For specific questions about the content, contact the publisher at lynn.a.davies@vanderbilt.edu or visit https://frg.vkcsites.org/what-are-interventions/math_intervention_manuals/.

Taxonomy Dimension: Strength

Strength tells us how well the program works for students with intensive intervention needs, expressed in terms of effect sizes. Effect sizes greater than 0.25 indicate an intervention has value in improving outcomes. Effect sizes of 0.35 to 0.40 are moderate, and effect sizes of 0.50 or larger are strong (preferred).

Exhibit 2 provides the effect sizes for students in need of intensive intervention organized by domain and subdomain. These effect size data are calculated on low-achieving participants, those falling at or below the 20th percentile on pretest measures of achievement. If available, additional effect sizes for disaggregated data can be found on the NCII Tools Chart.

Exhibit 2. Pirate Math Individual Tutoring Effect Sizes for Students \leq 20th Percentile by Domain and Subdomain

Domain	Subdomain	Outcome measures	Effect size ^a
Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Number Combinations	0.55*
Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Procedural Calculations	0.57*

Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Word Problems: Find X	0.39
Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Word Problems: Number Sentences	0.77*
Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Word problems: Key Math	0.23
Mathematics	<ul style="list-style-type: none"> ▪ Math Concepts ▪ Math Computation ▪ Algebra 	Word Problems: Vanderbilt Story Problems	0.75*

^a To ensure comparability of effect size across studies, NCII uses a standard formula to calculate effect sizes across all studies and outcome measures—Hedges *g*, corrected for small-sample bias.

* $p \leq .05$.

Taxonomy Dimension: Dosage

Dosage is the number of opportunities a student has to respond or practice and receive corrective feedback. Dosage may be impacted by the size of the instructional group, the number of minutes each session lasts, the number of student-teacher interactions built into lessons, and the number of sessions provided per week.

Assuming a group size of four students, each student in the group has an estimated 106.88 opportunities to respond and receive corrective feedback.

Taxonomy Dimension: Alignment

Alignment (Exhibit 3) focuses on how well the program (a) addresses the target student’s full set of academic skill deficits, (b) does not address skills the target student has already mastered (extraneous skills for that student), and (c) incorporates a meaningful focus on grade appropriate curricular standards.

Exhibit 3. Alignment with Content Areas Addressed

Instructional grade level(s)	Content area addressed	Skill strands
First grade	Mathematics	<ul style="list-style-type: none"> ▪ Number Knowledge ▪ Arithmetic Skill ▪ Word-Problem Solving
Second grade	Mathematics	<ul style="list-style-type: none"> ▪ Number Knowledge ▪ Arithmetic Skill ▪ Word-Problem Solving
Third grade	Mathematics	<ul style="list-style-type: none"> ▪ Number Knowledge ▪ Arithmetic Skill ▪ Word-Problem Solving

Taxonomy Dimension: Teaching to Promote Transfer

Attention to transfer is the extent to which an intervention is designed to help students (a) transfer the skills they learn to other formats and contexts and (b) realize connections between mastered and related skills.

For solving word problems (a main instructional target), activities are designed to explicitly teach for transfer, providing students instruction and practice in recognizing problems with novel (unexpected) problem features. This includes finding relevant information in graphs and tables; finding and crossing out irrelevant information in word-problem narratives and graphs/tables; solving two-step problems that combine different problem types; and other features. The focus and activities are designed to broaden students' conceptualizations of word-problem categories and promote transfer of word-problem skills.

For solving arithmetic problems (another main instructional target), activities are designed to explicitly teach for transfer, focusing on efficient counting strategies for adding and subtracting; fluency practice to help students commit number sentences to long-term memory; and mixed presentation of problems across formats (vertical and horizontal problem displays) and modes (oral and written responses). This robust set of instructional activities promotes transfer.

Activity 1: Word-Problem Explicit Instruction. Focuses on word-problem features that make problems seem unfamiliar but do not alter the solution strategy for the taught word-problem type. Activities, for example, include word-problem sorting activities, in which students sort problems into word-problem categories (without solving problems) and systematic practice with mixed problem types, in which students solve word problems with novel (unexpected) features.

Activity 2. Teaching efficient counting strategies for adding and subtracting comes in two forms: (a) systematic instruction and practice in counting strategies and (b) the Meet or Beat Your Score (MOBYS) activity, in which children have 60 seconds to answer flash cards, including all combinations of addends and minuends up to 18. Children are taught to “know the answer right off the bat” (retrieve from memory) if confident; otherwise, they must use the taught counting strategies. Children are to aim to answer each problem correctly because, as soon as an error occurs, the tutor requires them to use the taught counting strategy to produce the correct response. To discourage guessing or careless application of counting strategies, seconds elapse as children execute the counting strategy as many times as needed to produce the correct answer. In this way, careful but quick responding increases the number of correct responses. Children have a chance to meet or beat the first score, and the day's higher score is graphed.

Activity 3. Mixing of the presentation of problems across formats (vertical and horizontal problem displays) and modes (oral and written responses) is incorporated within word problem and arithmetic activities.

Taxonomy Dimension: Comprehensiveness

Comprehensiveness is the number of explicit instruction principles the intervention incorporates (e.g., providing explanations in simple, direct language; modeling efficient solution strategies instead of expecting students to discover strategies on their own; providing practice so that students use the strategies to generate many correct responses; and incorporating systematic

cumulative review). Additional information can be found within the NCII [Explicit Instruction course content materials](#).

Dimension: Provide Explanations in Direct, Simple Language

Activity 1: Each lesson is scripted to provide tutors direct, simple language within the program’s explanations. Tutors review and practice scripted explanations. They do not read or memorize scripts.

Activity 2. Throughout the program, students receive corresponding practice using direct and simple language to explain solution strategies.

Dimension: Model Efficient Solution Strategies

Activity 1. Throughout the program, each time a new problem type is introduced, the tutor models the program’s efficient solution strategy for solving that problem type. Each problem type and its solution strategy are thoroughly described in that lesson within the manual. Problem types address word problems and the calculation solutions needed to solve word problems.

Activity 2. Throughout the program, students receive ongoing practice to apply the taught strategies, and problems within a problem type gradually increase in complexity. Help cards provide support for student’s application of the correct solution strategies. Help cards are gradually faded and eventually invoked as needed to help students correct errors.

Dimension: Ensure That Students Have the Necessary Background Knowledge and Skills to Succeed

The program is designed systematically so that (a) problem types are introduced only after the prerequisite skills are taught and (b) activities build fluency with foundational skills to ease students’ cognitive load.

Activity 1. An example of a fluency activity is sorting word problems into problem types.

Activity 2. Another example of a fluency activity is the MOBYS activity, which positions students to free up cognitive resources away from calculation in the direction of conceptual processing of word problems.

Dimension: Incorporate Systematic Review, With Problem Sets That Mix Problem Types

Activity 1. The program is designed systematically so that each session provides students with supervised independent practice that cumulatively reviews previously taught problem types while mixing problem types across the problem sheet. This helps students distinguish among problem types and supports the retention of previously taught material. Independent practice is timed, and corrective feedback is provided for incorrect responses.

Activity 2. Each independent practice set incorporates predetermined bonus problems, known only to the tutor until students have completed work. Students receive bonus points within the program’s motivational system for answering bonus problems correctly. Tutors delay revealing bonus problems to ensure that students are motivated to complete each problem intentionally and carefully.

Taxonomy Dimension: Behavioral Support

Behavioral support addresses the extent to which the program incorporates (a) self-regulation and executive function components and (b) behavioral principles to minimize undesired behavior. Additional information can be found within the [NCII behavioral support course content](#).

Activity 1. *Pirate Math* includes an attention, motivation, and self-regulation system centered on four rules: use inside voice, stay in seat, follow directions, and try hard to answer problems correctly. Tutors set a timer to beep at 3–6-minute intervals. Tutors award a checkmark if the child is following all four rules when the timer beeps. Tutors keep track of checkmarks earned. At the end of the session, checkmarks are converted to stickers on the child’s chart. When the sticker chart is full (~weekly), the child picks a small prize.

Activity 2. Interweaved throughout the program is growth mindset instruction to help students understand that they can improve performance when they work hard.