Intervention Name:
Schema-Based Instruction / Schema-Broadening Instruction (SBI) Multiplicative Schemas (Multiplication and Division)*

Common Core State Standards Domain Areas: (check all that apply)

Counting and Cardinality (K)	Operations and Algebraic Thinking (K-5)	Numbers and Operations in Base Ten (K-5)	Numbers and Operations – Fractions (3-5)	Measurement and Data (K-5)	Geometry (K-HS)	Ratios and Proportional Relationships (6-7)	The Number System (6-8)	Expressions and Equations (6-8)	Statistics and Probability (6-HS)	Functions (8-HS)	Number and Quantity (HS)	Algebra (HS)	Modeling (HS)
	X	X	X										

Setting: (check all that apply)

Whole-class	Small-group	Individual
X	X	X

Focus Area: (check all that apply)

Acquisition	Fluency	Generalization
X	X	X

Function of Intervention:

A *schema* is a way to organize or pattern information within a structured framework of known and unknown information. Within word-problem work, the learner identifies the type of problem (i.e., schema), which lends itself to solving the problem using a given organizational pattern.

The main focus of Schema-Based Instruction or Schema-Broadening Instruction (SBI) is to teach word-problem solving using identification of a problem schema, representation using diagrams or equations to represent the schema, and solving the word problem. Scaffolding of student learning is provided throughout.

Brief Description:

Within each unit:

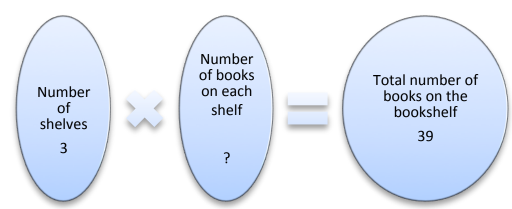
Schema instruction phase- Each type of problem (equal group, multiplicative compare, and combinations) is introduced through explicit instruction and requires students use schematic diagrams or equations, which help students understand the structure of the story problem.

Problem solution phase- Follow-up lessons teach students to solve story problems using a four-step checklist: FOPS

___ F - *Find* the problem type
___ O - *Organize* the information in the problem using a schematic diagram or equation
___ P - *Plan* to solve the problem
___ S - *Solve* the problem

With mastery of the strategy, use of schematic diagrams are faded in favor of equations for each type of problem.

Example for Equal Group: There are three shelves on Sarah's bookshelf. She has a total of 39 books on the bookshelf. If each shelf has the same number of books, how many books are on each shelf?



Group Number in each group (unknown) Product

See below for more examples.

Procedures:

- **Duration:** Students work on lessons utilizing SBI for 50 to 60 minutes each day, although some lessons may be as short as 30 minutes (Jitendra, 2007).
- **Teacher training:** Teachers must be familiar with the instructional scripts for each of the three problem types. It is recommended that teachers assign partners prior to instruction in efforts to maximize time on-task; change partners regularly, and monitor partner discussions and work.
- **Instructional practices:** Teachers should monitor use of checklist and schematic diagram for proper use and

application. Teacher differentiation of lessons is recommended (e.g., more directed instruction, examples, opportunities for response) according to student needs.

- **Monitoring system:** Progress monitoring assessment is recommended every 1 to 2 weeks in addition to ongoing informal assessments and observations. Students should be able to independently verbalize understanding of problem-solving steps and schematic diagrams prior to fading of checklists and diagrams.

Critical Components (i.e., that must be implemented for intervention to be successful):
Teacher scripts are intended to be followed as a framework for language and instruction, allowing teachers the liberty to provide additional scaffolding, explanations, or elaboration when necessary. Assessment should be criterion-based and assess the content that students are expected to learn to ensure mastery (Jitendra, 2007).

Critical Assumptions (i.e., with respect to prerequisite skills): Language contributes to the ability to solve mathematic stories or word problems; consequently students should be able to read and understand the word problem prior to learning to apply the problem-solving strategy. Equally important, students must have ample time to master new skills. Students who have been taught (but not mastered) multiple problem-solving strategies may confuse components. Therefore it may be best to teach a strategy (such as SBI) that allows for multiple opportunities to apply and generalize learned skills (Jitendra, 2007).

Materials:
Teacher script
Schematic diagrams
FOBS checklist (available in Jitendra, 2007)

Multiplicative Examples:

Each example demonstrates a one-step Multiplicative (multiplication or division) story problem.

Equal Groups:

In an equal-groups problem, you have a group or set within a word problem and an equal number within each group. In an equal-groups problem, the unknown can be (a) the groups, (b) number in each group, or (c) the product.

For example:

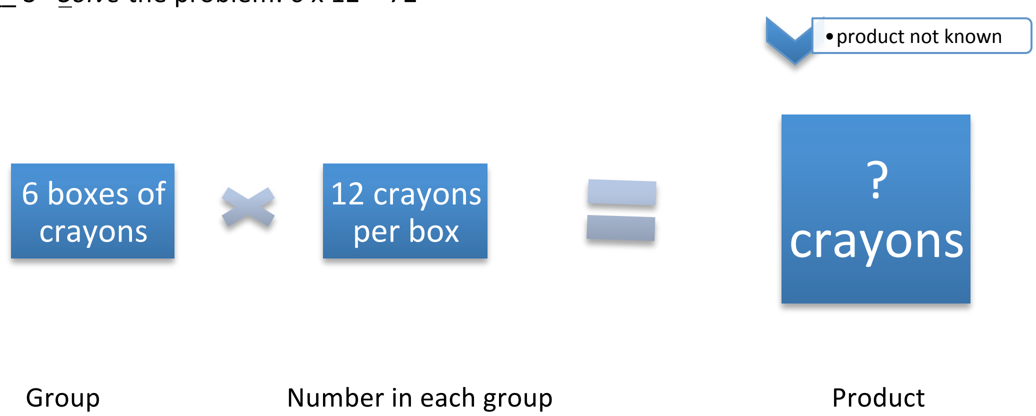
(Multiplication) Alex has 6 boxes of crayons. Each box contains 12 crayons. How many crayons does Alex have?

___ F - *Find* the problem type: In the problem, each box of crayons contains 12 crayons, since Alex has 6 boxes of crayons, he has 6 equal groups of 12.

___ O - *Organize* the information in the problem using the schematic diagram: Since we are finding the final value by showing a specific number of equal groups, we can set the problem up like this: (see below)

___ P - *Plan* to solve the problem: 6 x 12 = ?

___ S - *Solve* the problem: 6 x 12 = 72



Variations of the problem:

(Partition Division)

Alex has 72 crayons he distributes equally into 6 boxes. How many crayons are in each box?

6 x ? = 72

(Measurement Division)

Alex has 72 crayons in total. There are 12 crayons per box. How many boxes of crayons does Alex have?

? x 12 = 72

*Please note, with both the partition division and measurement division problems, students set up the word problem using the schematic diagram or equation. Students then use multiplication or division to solve for missing information in the diagram or equation. *The underlying schema of the word problem is the same in multiplication and division.*

Multiplicative Compare:

In a comparison problem, a set (number) is multiplied a number of times for a product. In comparison problems, the unknown can be (a) the set (b) the number of times, or (c) the product.

For example:

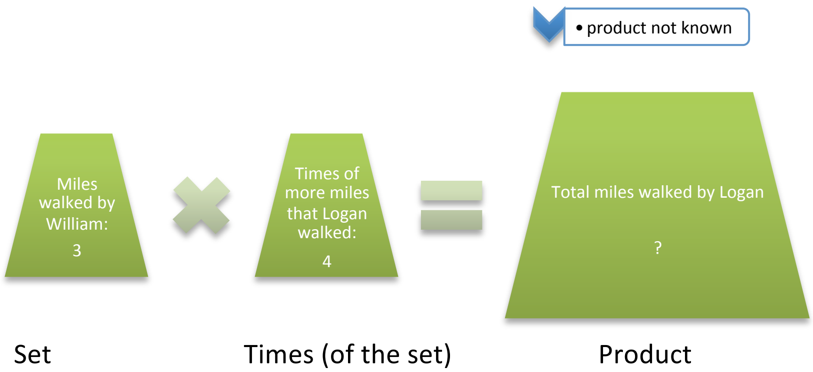
(Multiplication) William walked 3 miles. Logan walked 4 times as many miles as William. How many miles did Logan walk?

___ F - *Find* the problem type: In the problem, we know the distance that William walked and how many times that distance Logan walked. This is a comparative problem because we have the set number (miles William walked) and the number of times that Logan walked that distance. We use this information to find out how many miles Logan walked.

___ O - *Organize* the information in the problem using the schematic diagram: In order to find out how many miles Logan walked, we multiply the set number by a number of times to find the product, as indicated below:

___ P - *Plan* to solve the problem: 3 x 4 = ?

___ S - *Solve* the problem: 3 x 4 = 12 miles



Variations:
(Partition Division)

Logan walked 12 miles. He walked 4 times as many miles as William. How many miles did William walk?

? x 4 = 12

(Measurement Division)

William walked 3 miles, and Logan walked 12 miles. How many times as many miles did Logan walk than William?

3 x ? = 12

Combinations:

In a combinations problem, there is a number of items that are multiplied by another number of items to determine the product, the unknown can be (a) the first set, (b) the second set (or sequential sets after that), or (c) the product.

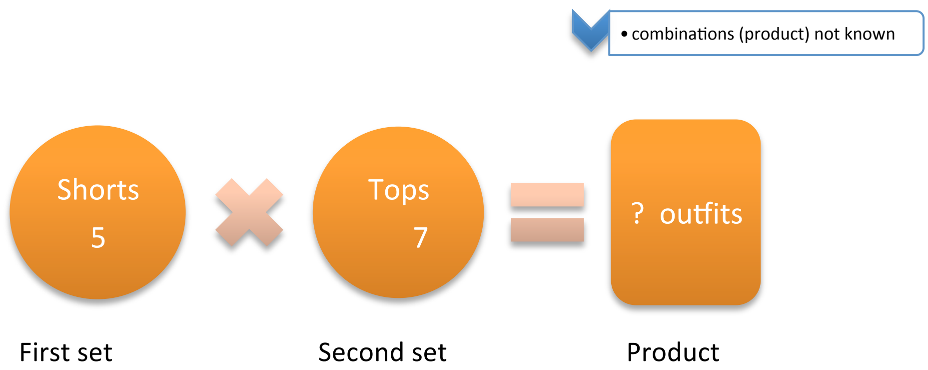
For example:
(Multiplication) Josie is packing her suitcase to go visit her grandparents. She has 5 pairs of shorts. She has 7 different tops. How many different outfits can she wear if she wears one pair of shorts with one shirt at a time?

___ F - *Find* the problem type: In this problem we have two different sets (number of shorts and number of tops) and we have to find out how many combinations we can make using the sets.

___ O - *Organize* the information in the problem using the schematic diagram: Since we know the values of the two sets, we multiply them to determine the product, or number of combinations.

___ P - *Plan* to solve the problem: 5 x 7 = ?

___ S - *Solve* the problem: 5 x 7 = 35



References:

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*Information and Examples for additive SBI (addition and subtraction) are available in a separate EBI Network brief.