Using Strategies to Teach Mathematics Skills to Struggling Students

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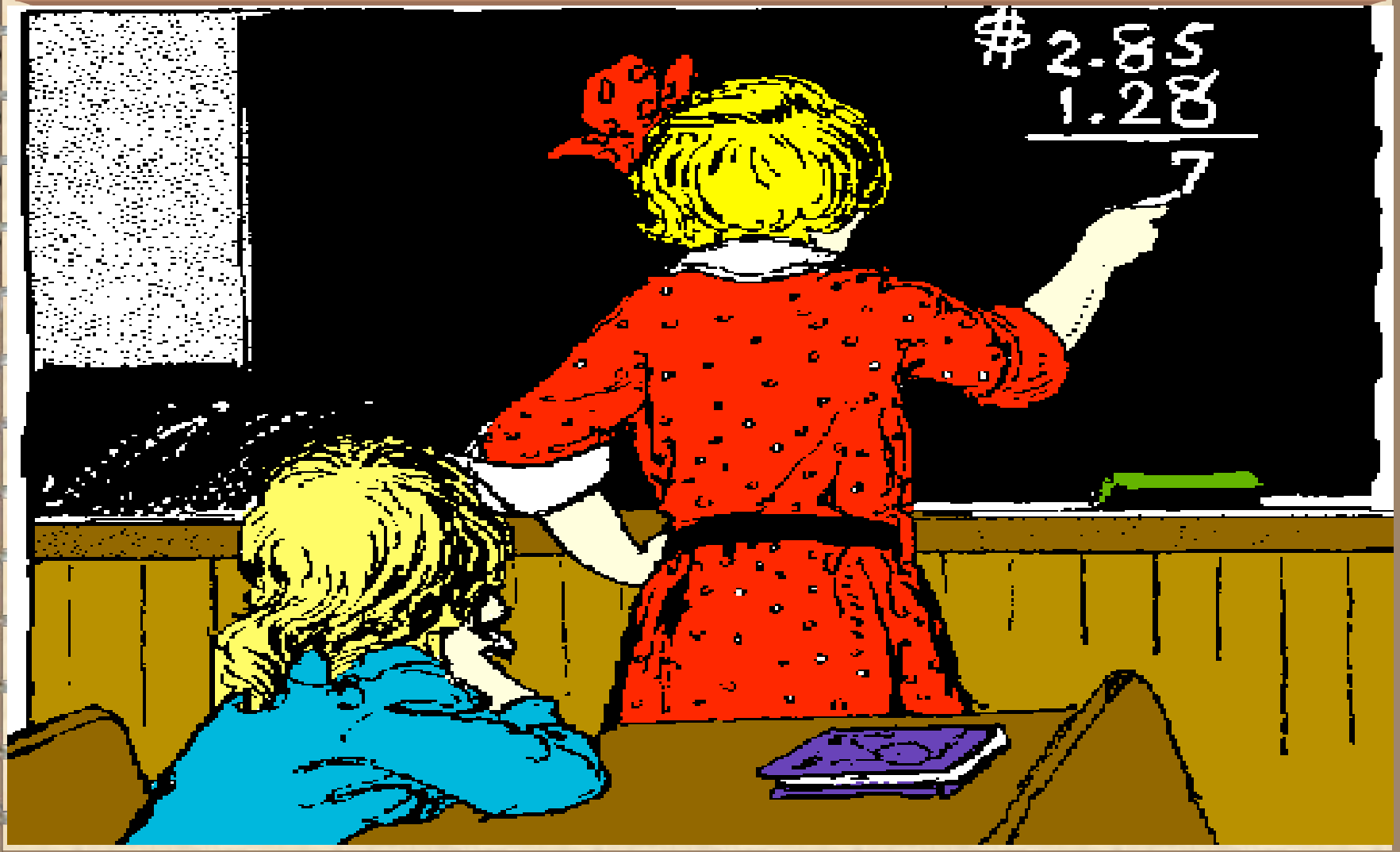
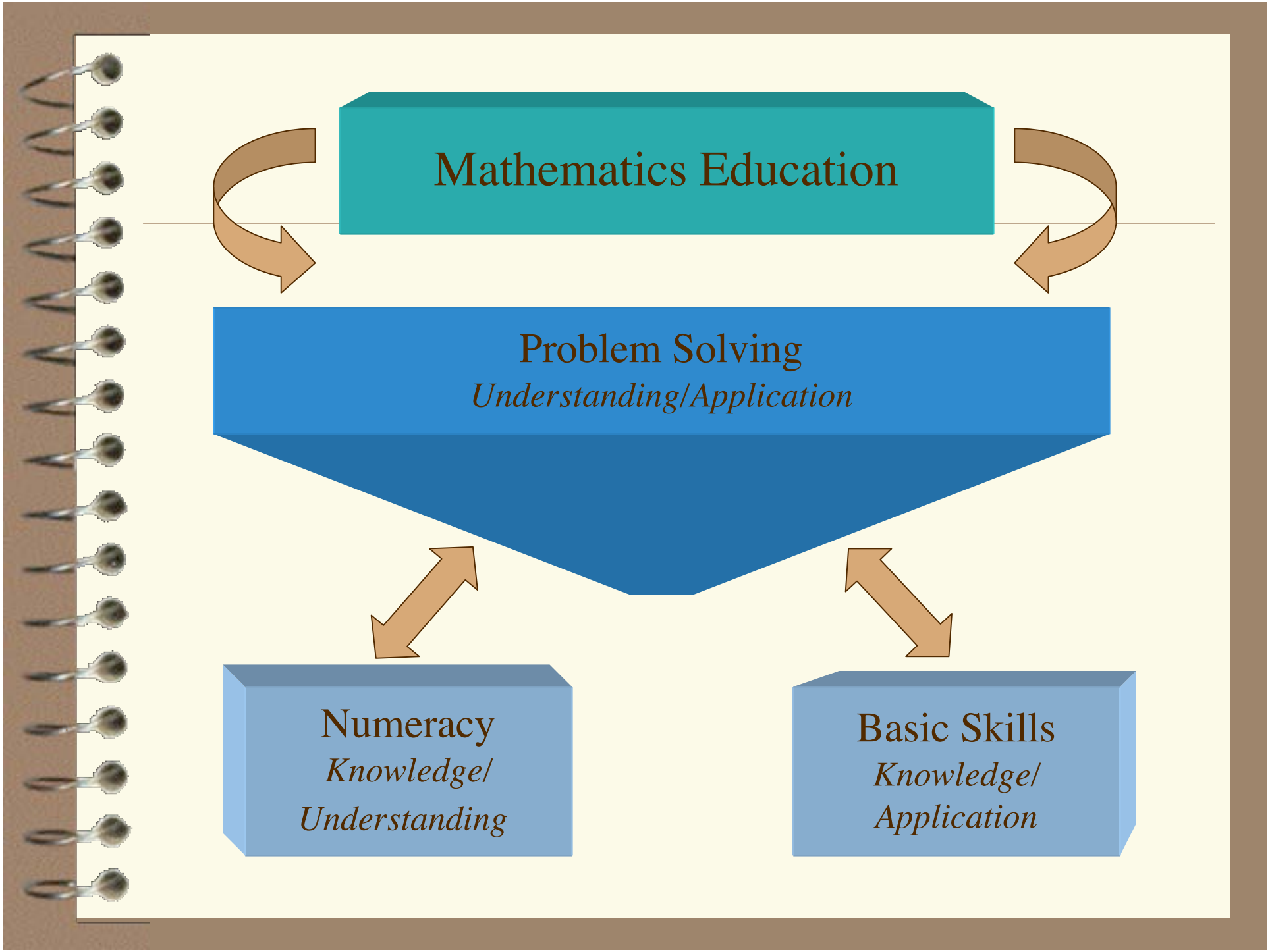



Mathematics Education
Problem Solving
Understanding/Application
Numeracy
Knowledge/
Understanding
Basic Skills
Knowledge/
Application

What do we know about state standards and computation instruction?

- **Number, operation, and quantitative reasoning (fact, wholes number computation, numeracy)**
- **Patterns, relationships, and algebraic thinking**
- **Geometry and spatial reasoning**
- **Measurement**
- **Probability and statistics**
- **Underlying processes and mathematical tools**

(3rd Grade; Texas Essential Knowledge And Skills; Texas Education Agency, 2003)

What do we know about characteristics of students with math problems?

Mathematics performance rating of students with LD and math weaknesses (n = 870) compared to students with LD and no math weaknesses (n = 854) showed significant differences between the two groups on:

- **Basic skills**
- **Higher order mathematical problem solving**

Skills ranked as most problematic for students with LD and math weaknesses:

- **Has difficulty with word problems**
- **Has difficulty with multi-step problems**
- **Has difficulty with the language of math**

What do we know about characteristics of students with math problems?

- Fails to verify answers and settles for first answer
- Cannot recall number facts automatically
- Takes a long time to complete calculations
- Makes "borrowing" (i.e., regrouping, renaming) errors
- Counts on fingers
- Reaches "unreasonable" answers
- Calculates poorly when the order of digit presentation is altered
- Orders and spaces numbers inaccurately in multiplication and division
- Misaligns vertical numbers in columns
- Disregards decimals
- Fails to carry (i.e., regroup) numbers when appropriate
- Fails to read accurately the correct value of multi-digit numbers because of their order and spacing
- Misplaces digits in multi-digit numbers
- Misaligns horizontal numbers in large numbers
- Skips rows or columns when calculating

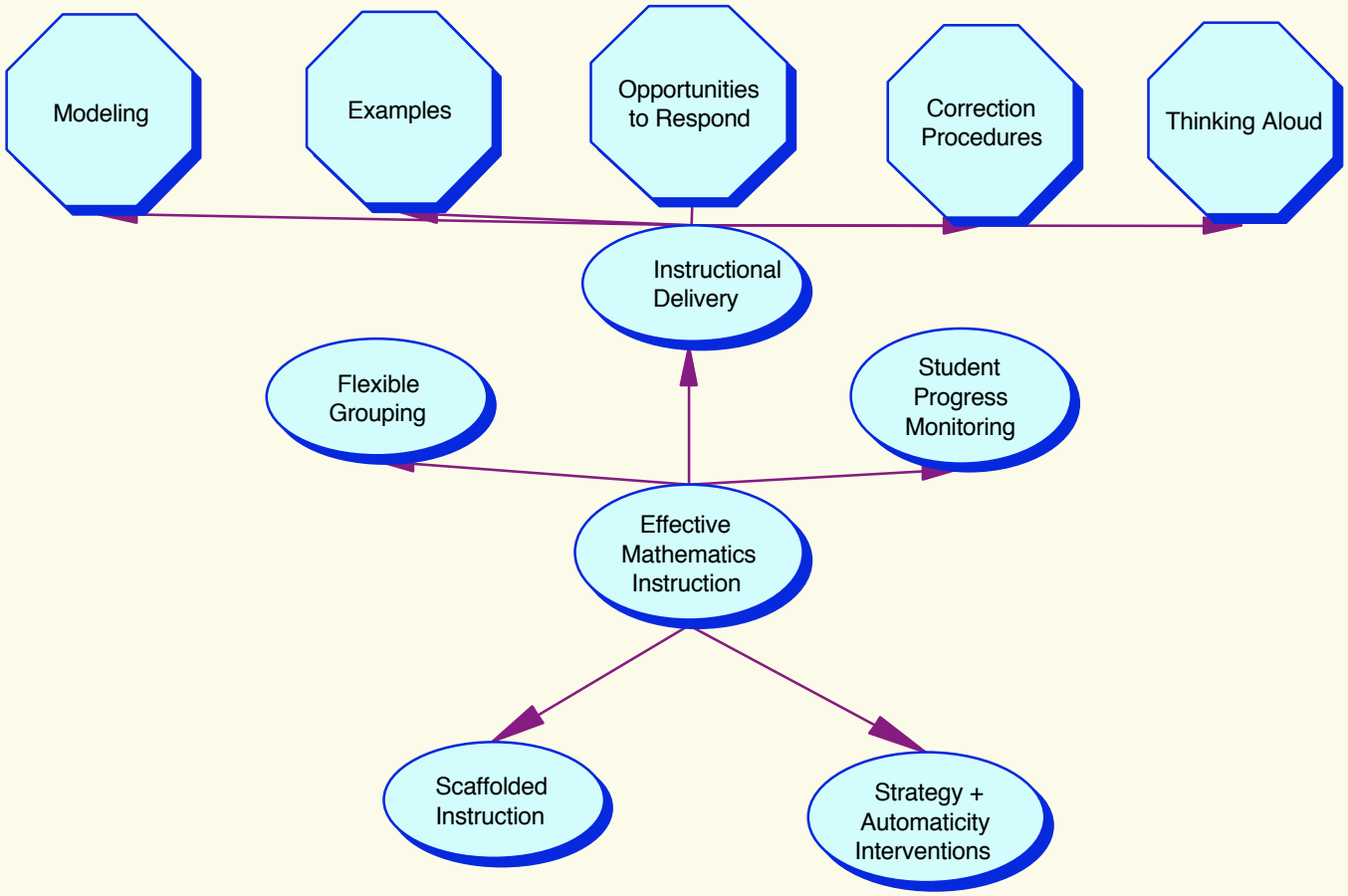
(Bryant, Bryant, & Hammill, 2000)

Effective Instructional Approaches: Combined Approach of Explicit, Systematic Instruction and Strategic Instruction

- **Sequencing of instructional skills: breaking down of the task, fading of prompts or cues, sequencing short activities**
- **Difficulty or processing demands of task controlled:tasks are sequenced from easy to difficult**
- **Instructional routines (e.g., presentation of subject matter, guided and independent practice)**
- **Modeling: teacher provides a demonstration of processes or steps to solve problem or explains how to do a task, makes use of "think aloud"**
- **Drill-repetition and practice-review: daily testing of skills, distributed review and practice, redundant materials or text**
- **Teaching to criterion**

Research: meta-analysis on academic outcomes for students with learning disabilities; identified positive contribution (large effect sizes) of these two instructional approaches compared to others (Swanson, Hoskyn, &Lee, 1999)

What do we know about effective instructional practices?



Instructional Strategies
Whole Number Computation: Demonstration Plus Permanent Model

Problem:

487
+ 356
_____

Steps:

1: teacher selects problems from student work that warrant explicit instruction,
2: teacher demonstrates how to perform the algorithm "thinking aloud" the steps,
3: students imitate the process on similar problems,
4: a completed model remains as a referent on the student's paper as a permanent.

(Rivera & Smith, 1987; 1988; Bryant, Hartman, & Kim, 2003)

Instructional Strategies
Whole Number Computation: Alternative Algorithms

Partial Products (McCoy & Prehm, 1987)

Problem: 428 ÷ 2 = ?

Step 1: Solve	400 ÷ 2 = 200	200
Step 2: Solve	20 ÷ 2 = 10	+10
Step 3: Solve	8 ÷ 2 = 4	4
		214

Expanded Notation (Cawley & Parmar, 1992)

Problem: 428 ÷ 2 = ?

Step 1: Set-Up (400 + 20 + 8) ÷ 2 =

Step 2: Solve (200 + 10 + 4) = 214

Instructional Procedures: **For both types of alternative algorithms, teachers model and "think aloud" how they solve the problem. Students imitate and verbalize the steps in using these algorithms, use manipulatives to represent the process, or work with a partner to solve problems.**

Instructional Strategies
Facts: Building Automaticity

Benchmark (Rivera & Smith, 1997)

The Benchmark strategy is an effective fluency-building technique. Given a worksheet of facts and working in a left to right progression, a fact (Benchmark) is designated as the target to reach by the end of the one-minute timing. The designated fact can be starred, circled, or identified in any manner by students. Rewards can be distributed for students who reach their Benchmark. The Benchmark fact is determined by (a) identifying the number of correct problems previously answered in a one-minute timing, (b) multiplying that number by 10%, and (c) adding the 10% figure to the original figure; this new number becomes the Benchmark for the next one-minute timing. For example, if a student computed 20 problems correct in one minute on Monday, then the Benchmark figure is 22. The Benchmark strategy promotes self-competition ("beat yesterday's score") and can be motivating for some students.

Instructional Strategies
Facts: Building Automaticity

Pacing **(Rivera, 1996)**

This fluency-building strategy involves the use of devices (e.g., prerecorded audiotapes, and metronomes) with an audible signal and adjustable intervals (e.g., 25-beeps/per minute, 40-beeps/per minute). The interval can be set at increasingly faster rates until students attain the desired criterion rate for mastery. Given a worksheet with the targeted problems, the students are instructed to work from left to right, to write an answer on their worksheet each time they hear the beep, and to skip problems they do not know when the sound occurs. Skipped problems become "learning opportunities" rather than errors, and can be taught through error drill procedures, including peer tutoring, Interspersal Drill ratio, and number families.

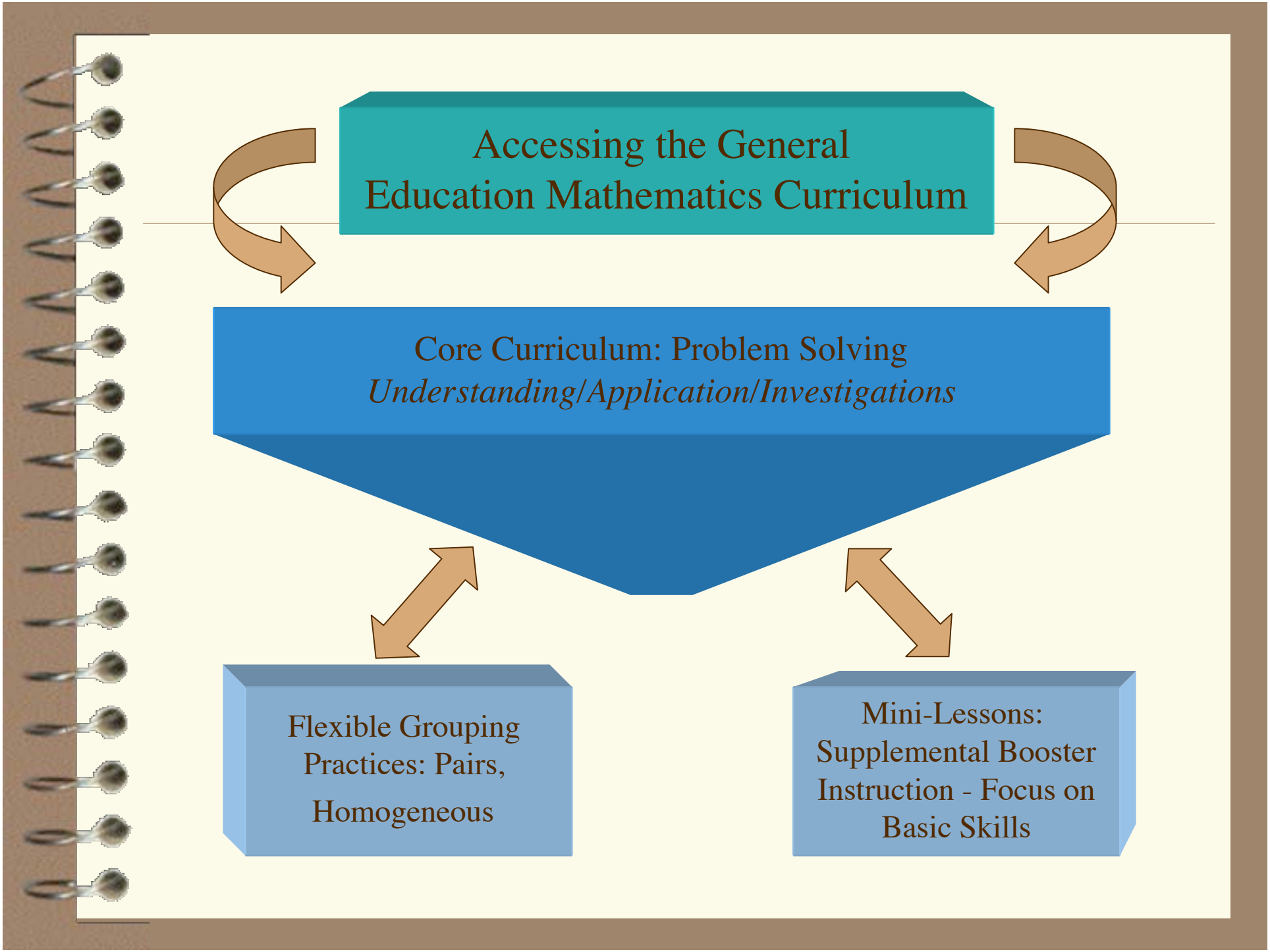
Instructional Strategies
Facts: Building Automaticity

Interspersal Drill Ratios **(Cooke & Reichard, 1996)**

Step 1: Identify facts that are known automatically (e.g., says the correct answer within 3 seconds) and facts that are unknown automatically. The two groups of facts are written on flashcards and separated into two piles.

Step 2: Student pairs are identified to work together in a peer-tutoring format. The format consists of the following procedures: the tutor and tutee work together; the tutor shows the tutee a flashcard with a problem and says the problem; the tutor waits for no more than 3 seconds for a response; depending on the response, the tutor gives corrective feedback or praise; the cards are shuffled and another round is presented. The roles are reversed.

Step 3: At the end of the tutoring session, a mastery test is given. The mastery test consists of each flashcard shown to the student for up to 3 seconds. If the response is correct, then the card is placed in the pocket with a " +; " cards with incorrect responses are placed in the " – " pocket.


Accessing the General Education Mathematics Curriculum
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Understanding/Application/Investigations
Flexible Grouping Practices: Pairs, Homogeneous
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Curriculum & Instruction: *Instructional Decision-Making Procedures for Ensuring Appropriate Instruction for Struggling Students*