

# Teaching Math to Students with Learning Disabilities

Trisha Salisbury and Amarinder Mehta

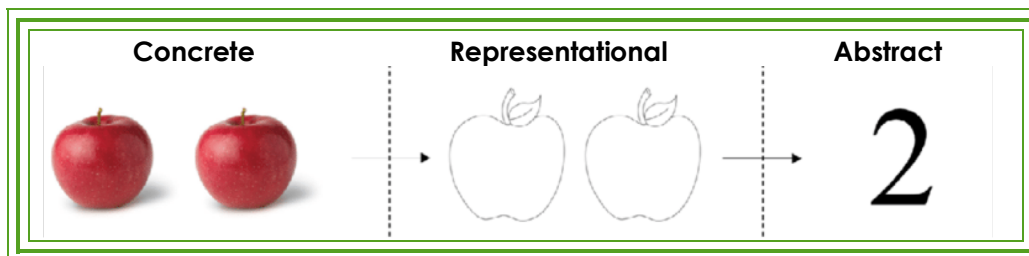
## Many children with learning disabilities (LDs) have trouble with:<sup>1-4</sup>

- conceptual understanding of many foundational mathematics skills
- using retrieval-based skills to solve computations and word problems
- working and long-term memory
- coordinating problem-solving steps
- organization, reading, and place value

Students with LDs benefit from approaches that utilize multiple modes of instruction, such as the Concrete-Representational-Abstract (CRA) sequence<sup>5</sup>

## What is the Concrete-Representational-Abstract (CRA) sequence?

- CRA instructional strategy combines effective components of **direct instruction** (behaviorist approach) and **discovery-learning** (constructivist approach) practices<sup>6</sup>
- Discovery-learning strategies involve representation to help students transition between conceptual and procedural knowledge
- Addresses three stages of conceptual understanding, procedural accuracy, and fluency by employing multisensory instructional techniques when introducing the new concepts
- Incorporates demonstration, modeling, guided practice, independent practice, and teacher feedback
- **Three stages: concrete, representational, and abstract.** Each stage builds upon the knowledge and skills developed in the preceding stage



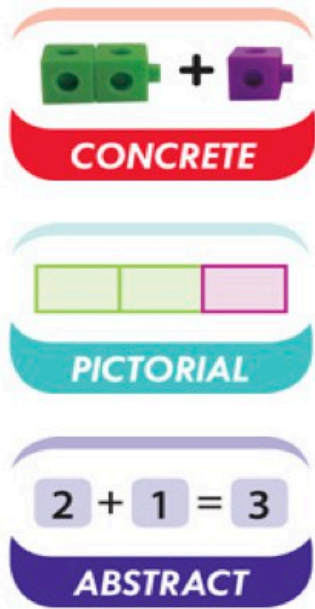
## The CRA has been shown to be effective for:

- **Diverse mathematical concepts:** basic mathematics facts, place value, arithmetic, fractions, algebra, and word problems<sup>6-11</sup>
- **Students with LDs** and students identified as **at risk** for failure in mathematics<sup>1,6-8,11</sup>
- **One-on-one** and **small group** settings<sup>6</sup>
- **Across grade levels**<sup>11</sup>

## What makes the CRA effective?

- **Direct and explicit instruction strategy** introduces thinking strategies that are meant to become routine for problem solving and can be generalized to many math problems<sup>4,6</sup>
- **Verbalizing** thinking allows students to “think-aloud” allow students to scaffold their own thinking through questions and verbally plan the solution to the problem<sup>3</sup>
- **Visual representations** “help alleviate the amount of information students need to process while increasing their understanding of the concepts”<sup>3</sup>
- **Graphic organizers** reduce students' reliance on working memory, facilitating faster information processing, and allowing them to more consistency and efficiently solve math problems<sup>12</sup>

# Utilizing the CRA Approach in the Classroom



## The Three Stages of the CRA

### 1. CONCRETE

Students use 3D manipulatives to assist them while they learning the new math concept. The use of manipulatives increases the number of sensory inputs a student uses while learning the new concept, which improves student's ability to remember the process of solving the problem

### 2. REPRESENTATIONAL

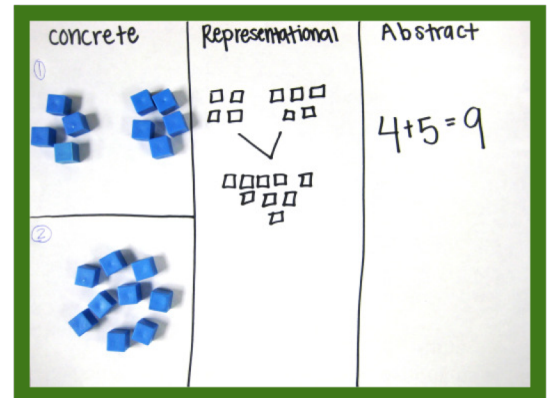
Students are taught to use 2D drawings to represent the same concepts. Manipulations enable students to break down the conceptual mathematical procedures into logical steps. When students encounter a math problem that they have trouble with, they can use this strategy to construct pictorial representations to assist them in finding the solution.

### 3. ABSTRACT

Students are taught how to translate the 2D drawings into the conventional mathematics notation to solve the problem.

## Tips for Using CRA in the Classroom

- **Each lesson relates to the previous lessons.** Explicit connections between lessons is important for students to learn the targeted skill and related concepts, especially since students with LDs need explicit guidance and support when learning concepts<sup>11</sup>
- Researchers recommend taking **at least three lessons** to teach each stage<sup>6</sup> and following the **same format** to maintain consistency
- At the start of each lesson, a **graphic organizer** should be provided to students and the teacher should **(1) demonstrate the new skills** and **(2) give students the opportunity to model the process**
- Students try to solve the problems through **guided practice** and the teacher **provides feedback** throughout to guide their learning
- Finally, students are given time to **practice independently**



## Additional Support for Students with LDs to Transition from Concrete to Abstract

- Explicit inquiry routine (EIR) can help students transition from CRA to abstract technique<sup>4</sup>
- EIR approach uses **explicit, systematic instruction** and **sequences scaffolding** to ensure students master the concept before they proceed to the next step in the curriculum.
- Students are taught how to demonstrate thinking through **dialogue** with the teacher, peers, and themselves. During each dialogue, students use **concrete, representational, and abstract** methods to “drive the conversation”

## References

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