

Teaching Math to Students with Learning Disabilities

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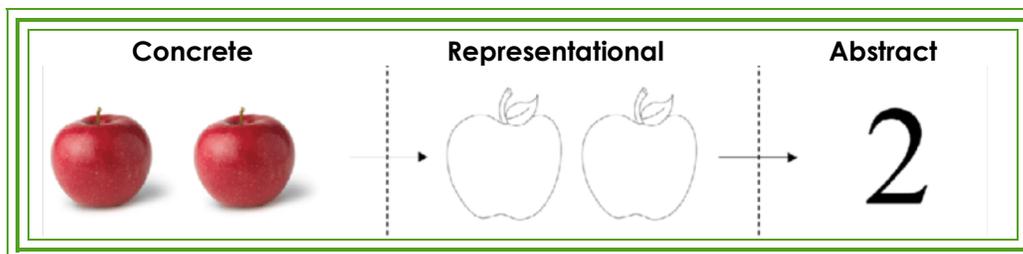
Many children with learning disabilities (LDs) have trouble with:¹⁻⁴

- 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) sequence⁵

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

- CRA instructional strategy combines effective components of **direct instruction** (behaviorist approach) and **discovery-learning** (constructivist approach) practices⁶
- 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



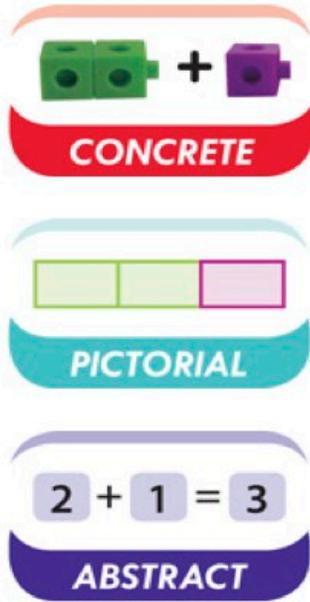
The CRA has been shown to be effective for:

- **Diverse mathematical concepts:** basic mathematics facts, place value, arithmetic, fractions, algebra, and word problems⁶⁻¹¹
- **Students with LDs** and students identified as **at risk** for failure in mathematics^{1,6-8,11}
- **One-on-one** and **small group** settings⁶
- **Across grade levels**¹¹

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^{4,6}
- **Verbalizing** thinking allows students to “think-aloud” allow students to scaffold their own thinking through questions and verbally plan the solution to the problem³
- **Visual representations** “help alleviate the amount of information students need to process while increasing their understanding of the concepts”³
- **Graphic organizers** reduce students' reliance on working memory, facilitating faster information processing, and allowing them to more consistency and efficiently solve math problems¹²

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

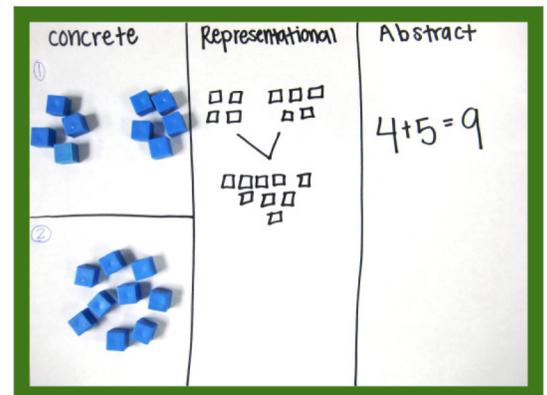
Students are taught to use 2D drawings to represent the same concepts. Manipulations enable students to break down the conceptual mathematical procedures into logical steps. When students encounter a math problem that they have trouble with, they can use this strategy to construct pictorial representations 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 concepts¹¹
- Researchers recommend taking **at least three lessons** to teach each stage⁶ 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 technique⁴
- 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”

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