STMath.

Deep Conceptual Learning Resource Kit

Fractions

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Multiplication

Subtraction o

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Measurement

What is Conceptual Understanding?

Conceptual understanding in math is the creation of a robust framework representing the numerous and interwoven relationships between mathematical ideas, patterns, and procedures. This framework can be used to coherently integrate new knowledge and solve unfamiliar problems.

From a neuroscience perspective, <u>conceptual learning requires building schemas</u>. Schemas are all about connections, and building schemas of mathematical concepts gives students the ability to solve problems they haven't seen before.

Building Conceptual Understanding

In this episode of the Inside Our MINDs podcast, Director of ST Math Content Ki Karou delves into how the brain learns, and what kinds of instruction can facilitate schema building for <u>conceptual understanding</u>.



The Neuroscience of Deeper Learning

Neuroscience offers great insight into how people build an understanding of the world around them, from infancy all the way through adulthood. When to developing a deep understanding of mathematical concepts, there are **four neural subsystems** that work together to enable this:

- 1. Perception-Action Schema Building: a continual cycle of perceiving or detecting something, taking an action and then observing the immediate effects of that action and adjusting the action.
- 2. Experiential, Episodic Knowledge: knowledge that results from an experience that's vividly memorable, both emotionally and physically.
- 3. Problem Solving & Creative Ideation: applying facts and concepts in new and novel situations, and even across academic subject areas.
- 4. Academic Discourse and Language Processing: putting ideas into words, and being able to explain justify the reasoning for those ideas.



What are Schemas?

A <u>schema</u> can be conceived as a scaffold, a blueprint, and a representation that describes an object, a string of events, or an idea, but also feelings, and essentially

In math education, we are especially interested in establishing schemas to reduce cognitive load. For example, a schema for fractions can allow students to automatically manipulate numbers in fraction space, without investing precious brain power every time a fraction is encountered. Instead of spending brain power trying to remember how fractions work, students can focus on solving other problems for which a schema has not yet been established.

The Learning Path

Follow these steps help students build conceptual mastery!

Another way of thinking about engaging the four neural subsystems for deeper learning is something <u>we</u> <u>refer to as the learning path</u>. Activities that allow for students to follow these three steps can help them develop conceptual mastery:

- Experience: hands-on, active learning that feeds the perception-action cycle
- Connect: relating previously mastered content to new ideas and problems
- Practice and Apply: practicing math in a variety of ways that require creative problem solving—learning to apply concepts to brand new situations is the key to true understanding

The Learning Path The neuroscientists behind the ST Math' program frame the process of learning as a path containing three key steps:

> Hands-on interaction is key – ust like learning to drive a car. No amount of studying can measure up to the experience of aitting behind the wheel Why should it be any different with math? Active learning leads to deep, conceptual understanding.

Download the Learning Path Poster Now!

DOWNLOAD THE POSTER

The Edtech Ingredients for Conceptual Learning

What are the most <u>common ingredients in math edtech programs</u>? What combination of ingredients should you be looking for? Well, that depends on what you're looking to accomplish. Whether you are looking for extra practice, direct instruction or conceptual learning, this downloadable rubric can help you evaluate the content of edtech programs to ensure you have a recipe for success.

Evaluative Element	Low	Medium	High
Problems	Routine Multiple Choice	Open-ended	Non-routine
Virtual Manipulatives	NONE	Visual image or basic manipulative	Robust and novel virtual math manipulative
Feedback Animations	Correct / Incorrect	Hint with generic text, image, or animation	Rich animation that is unique to student input
Gamification	Disconnected from the task (promotes extrinsic motivation)	Aligned to task	Seamlessly integrated into the task (promotes intrinsic motivation)

Evaluation Criteria for Common Math Edtech Ingredients



Deeper Learning With ST Math

At Jacks Valley Elementary in Nevada, educators were looking for ways to move beyond math drills and fact memorization. Since bringing ST Math into Jacks Valley, teachers have seen students' anxiety go down, and their confidence go up. Read all about how students at Jacks Valley are succeeding with ST Math <u>here</u>.

"They're problem solving on a deeper level, and they're excited about it." - Pam Gilmartin, Principal, Jacks Valley Elementary, Nevada

A Math Class Structure that Fosters Conceptual Learning

Educator Meagan Erwin has been an elementary teacher for 20 years. Her students use ST Math, and Megan has leveraged their experience with the program to develop a 90-minute math model that helps all of her students build deep conceptual understanding.





Use spiral review questions and math talks to get students problem solving right away. Spiral review consists of bringing up questions from previously learned concepts periodically. Math talks are short questions that are fairly direct, but also invite some discussion.



problem solving (20-25 min):

Students each have their own math journal, where they cut and glue in the problem of the day. Students spend a good amount of time working on this one problem to build persistence and dive deep into the topic of the day.



The focus lesson could be a lesson from their math curriculum textbook or a puzzle talk from ST Math. Puzzle talks build confidence, increase number sense, and flexibility with numbers.



During small group intervention time, most students are working at their own pace on ST Math, while the teacher pulls specific groups of students for intervention.

You can read more on Meagan's 90-minute math class structure on the MIND blog.

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