

MATHEMATICS TEACHING PRACTICE 3:

Use and connect mathematical representations

Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

Strategy and Process for Students with Disabilities	Digital Learning Experience
<p>Using multiple representation graphic organizers</p> <ul style="list-style-type: none"> • Create or select a graphic organizer for students. • Explicitly teach expectations for problem solving with the graphic organizer. • As students work to solve problems, ask probing questions to prompt student thinking about the connection between different representations. • Celebrate diverse thinking by comparing different representations and strategies to solve problems with the whole group and fostering a culture of learning. 	<p>Use interactive graphic organizers as they implement this strategy in digital learning environments by using virtual tools to deliver organizers to students.</p> <p>During synchronous meetings with students, ask students to work on a physical or digital whiteboard and show their board on camera as they solve problems. Physical whiteboards can be included in “take home” math kits.</p>
<p>Using the Concrete, Semi-Concrete and Abstract (CSA) approach to mathematics</p> <p>Concrete:</p> <ul style="list-style-type: none"> • In the concrete stage, students use physical manipulatives to explore, build and experience math. • In the early years, this includes students building understanding of quantities and foundational numeracy topics. • The concrete tools are used so students can literally show their thinking. <p>Semi-Concrete:</p> <ul style="list-style-type: none"> • In this stage, students translate their thinking to drawings or pictures instead of using concrete tools. • For example, instead of using counters, students may draw circles or tallies to help them solve problems. <p>Abstract:</p> <ul style="list-style-type: none"> • Students who have a solid foundational understanding of a math idea in the concrete and semi-concrete stages move to the abstract stage. • Students in this stage are ready to work with numbers, symbols and equations because they have developed a clear understanding of what each of those abstract symbols mean. 	<p>Regardless of the setting, students need explicit instruction in how to use manipulatives, whether they are concrete or virtual tools. Provide clear expectations and appropriately model using math tools.</p> <p>Virtual manipulatives are available in a variety of programs and platforms:</p> <ul style="list-style-type: none"> • Kentucky Center for Math Virtual Instruction Resources • Virtual Manipulatives <p>Video lessons may show students how to access and use these virtual math manipulatives. Embedded how-to videos in assignments may help students select and use the correct tools.</p> <p>Take-home math kits might also be beneficial for students, particularly for young learners. Class kits can be created so each student has the same math tools, helping streamline the conversation about which tools to use and when to use them.</p>

<p>Implementing a visual math task to support, explain or justify thinking</p> <ul style="list-style-type: none"> • Pose a problem or scenario for students to solve. • Ask students to include a “build it,” “draw it” and “write it” portion as their solution. It might be helpful to provide students with a graphic organizer. • Monitor as students work individually to identify examples that highlight key mathematical ideas that will help achieve lesson goals. • Determine the sequence in which to share solutions and invite students to share with the class. • Ask questions to help students make connections among the various representations. <p>There are resources to help support these types of tasks at youcubed. Sample visual mathematics activities also are available to help support students in their thinking.</p>	<p>Regardless of the setting, students need explicit instruction in how to use both concrete and virtual manipulatives. Teachers must provide clear expectations for using math tools and model appropriate usage.</p> <p>Virtual manipulatives are available in a variety of programs and platforms:</p> <ul style="list-style-type: none"> • Kentucky Center for Math Virtual Instruction Resources • Virtual Manipulatives <p>Video lessons may show students how to access and use these virtual math manipulatives. Embedded how-to videos in assignments may help students select and use the correct tools.</p>
<p>Using progression videos and explanations</p> <ul style="list-style-type: none"> • Clarifications for each content standard are included in the Kentucky Academic Standards document. • Clarifications include the progression of the standard (making a connection from the grade level standard to the learning that was outlined in previous grade levels, as well as the learning that will take place in later grade levels). • Video progressions include modeling with physical manipulatives and semi-concrete representations, demonstrating how these mathematical experiences build to an abstract understanding of the topic. • Use representations provided in progression videos and explanations to enhance direct instruction. <p>There are recorded sessions available online that may provide additional insight of the connections between multiple representations in many domains at KCM Virtual Support.</p>	<p>For virtual lessons, consider using a program or platform that will allow modeling the use of manipulatives, drawing of models and visual representations and transitioning quickly between various types of representations and models. It also may be helpful to begin lessons with a model of the concrete representation of a math concept to activate students’ prior knowledge.</p> <p>There are various tools that can aid in this type of instruction:</p> <ul style="list-style-type: none"> • Use a document camera with a virtual platform to show the use of concrete manipulatives during instruction. • Embed videos of concrete or semi-concrete representations in slides or other assignments. • Use virtual manipulatives during instruction.

Contact your special education regional cooperative for more information on using virtual tools and additional resources.

Reflection Questions

1. Have I made sure that students have access to more than one representation within this concept?
2. Have I made sure that students have explored the connections between representations, including the abstract?
3. Have I asked probing questions to prompt students to make connections?
4. Have I provided explicit instruction in the use of manipulatives, drawings and other forms of representation so that students can demonstrate their learning and understanding?

Principles to Actions: Ensuring Mathematical Success for All, copyright 2014, by the National Council of Teachers of Mathematics.

