There is More Than One Way to DO Math?! Formative Assessment and Conceptual Understanding with the Enhanced Learning Maps Project

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Enhanced Learning Maps Project Goal

To improve teachers’ ability to use effective formative assessment tools and practices to provide personalized instruction resulting in greater student achievement.
Many paths to student understanding...

- Different start and end points
- Different routes
- Different gaps along the way
Enhanced Learning Map Model

• **Visual display** of concepts and skills

• **Connections** show prerequisites and successor skills

• **Multiple pathways**

• **Granular detail**
Map Views

- Nodes
- Connections
- Standards
- Research based
- Teacher selected
Multiple Pathways of Learning
Teachers Using the Maps
The map alone will not move students forward

**Learning Map Model**  
Visual representation of how students learn

**Formative Assessment**  
Approach to teaching that is a process for moving students forward
Formative Assessment

- A process, NOT a test
- Aims to reveal student thinking
- Occurs within instruction, moment-to-moment
- Continuous, iterative
- Informs instructional decisions
Enhanced Learning Map Models and Formative Assessment

- **Clarify** learning goals
- **Promote** effective learning by focusing on connections
- **Determine** where students are in their learning and move them forward
Formative Assessment
Informed Instructional Framework

Formative Assessment
Approach to teaching that is a process for moving students forward

Learning Map Model
Visual representation of how students learn

Instructional Resources
Set learning goals and create the conditions for noticing where students are

Instructional Resources include:
- Learning Map Model document
- Teacher Notes
- Instructional Activities
- Student Activity
- Solution/Feedback Guide
Learning Map Models and Mathematics Teaching Practices

• Establish mathematics goals to focus learning.
• Implement tasks that promote reasoning and problem solving.
• Use and connect mathematical representations.
• Facilitate meaningful mathematical discourse.
• Pose purposeful questions.
• Build procedural fluency from conceptual understanding.
• Support productive struggle in learning mathematics.
• Elicit and use evidence of student thinking.
Teacher Notes

• Summary of current, peer-reviewed, relevant research

• Include:
  • best practices
  • instructional strategies
  • common misconceptions & errors – and how to avoid or deter them
  • reference list

• Teacher Notes Videos offer additional support
  • Approximately 3 minutes
  • One for each grade level
  • Can be used in classroom or just as a teacher resource

RATIONAL NUMBER ADDITION AND SUBTRACTION

Teacher Notes

This unit includes the following documents:

- Learning Map Information
- Instructional Activity (four lessons)
- Instructional Activity Student Handout (for Lessons 3 & 6)
- Instructional Activity Supplement (for Lessons 1, 2, & 4)
- Student Activity (Word Version)
- Student Activity Solution Guide

Students will first explore integer addition and subtraction through a real-world context of credits and debits in an allowance setting. Students will then use the number line to make sense of signed numbers and their properties, including symmetry, additive inverses, and sums and differences of rational numbers.

RESEARCH

Understanding, graphing, and operating with integers comprise important middle school mathematics topics, but these tasks challenge students’ prior conceptions about numbers and their representations. The learning map section, therefore, models the use of context to provide connections to concrete examples of negative quantities (Gregg and Gregg, 2007; Liebeck, 1998). Students benefit from discussing familiar situations involving assets and debts, sea level, or temperature to help them form a conceptual basis for why negative numbers exist and how they relate to things they already know. For example, cases where students must explain that $5 – $7 results in a debt instead of an asset provide productive opportunities for introducing integers. With this preliminary understanding, students can begin to operate with integers and use appropriate notation, but there are several documented difficulties they may face as they gain new knowledge.

Working with integers challenges students who try to apply their whole number schemes to integers (Bishop et al., 2014). Specifically, students who cling to the whole number property that adding always produces larger numbers become confused when they attempt to add a positive number to a negative number. Even when students experience integers initially through familiar real-world contexts, such opportunities may not require students to acknowledge that negative numbers possess both magnitude and direction, because negative values in context can be labeled differently rather than assigned a negative sign (Peled & Carraher, 2008). Thus teachers should incorporate language that describes how far these numbers are from zero (i.e., magnitude) and whether they are positive or negative (i.e., direction) to help students develop their appreciation for these two aspects of integers.
Instructional Activities
Guiding Questions

• Unique component of the ELM resources
• Link back to the learning map model
• Bring formative assessment into each lesson
• Allow teacher to adjust instruction based on student response
Guiding Questions
Instructional Activities
Student Activity & Solution Guide

• Independent task
• Solution Guide link back to the learning map model
• Bring formative assessment into each unit or lesson
• Allow teacher to adjust instruction based on student response
• Flexible implementation
Locater Tool

- a device or system used for determining the position or location of something
- Grounded in the map model and guided by the instructional units
- Assist teachers in creating personalized learning progressions/maps for students
2. Which expressions are equivalent to `'1/2 x - 12'`? Select two answers.

<table>
<thead>
<tr>
<th>Option</th>
<th>Understood node(s)</th>
<th>Misunderstood node(s)</th>
<th>% answered</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>use properties of operations to generate equivalent expressions involving rational numbers</td>
<td>use properties of operations to generate equivalent expressions involving rational numbers</td>
<td>100%</td>
</tr>
<tr>
<td>B.</td>
<td>apply properties of operations to addition and subtraction of rational numbers</td>
<td>apply properties of operations to addition and subtraction of rational numbers</td>
<td>0%</td>
</tr>
<tr>
<td>C.</td>
<td>use properties of operations to generate equivalent expressions</td>
<td>use properties of operations to generate equivalent expressions</td>
<td>100%</td>
</tr>
<tr>
<td>D.</td>
<td>use properties of operations to generate equivalent expressions involving rational numbers</td>
<td>use properties of operations to generate equivalent expressions involving rational numbers</td>
<td>0%</td>
</tr>
<tr>
<td>E.</td>
<td>factor to create an equivalent algebraic expression</td>
<td>factor to create an equivalent algebraic expression</td>
<td>0%</td>
</tr>
</tbody>
</table>
Teacher video clip
Enhanced Learning Maps Software

elmap.us

User name: jayhawkl@ku.edu

Password: mctm
Questions?

Interested in learning more or participating in the project?

• Contact Enhanced Learning Maps project staff

EnhancedLM@ku.edu

www.enhancedlearningmaps.org
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