Differentiating Mathematics Instruction with Middle School Students: Findings in Progress

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Overview

- Describe IDR²eAM project
- Share features of DI we are experimenting with
- Give example of this experimentation
- Solicit feedback about our analytical process
The IDR²eAM Project

- **Investigating Differentiated Instruction and Relationships between Rational Number Knowledge and Algebraic Reasoning in Middle School**

- **Research goals:**
  - To investigate how to differentiate mathematics instruction for middle school students operating with at least two different levels of reasoning.
  - To understand how students’ rational number knowledge and algebraic reasoning are related for each of these mathematical thinkers.
  - In later years of the project we will also be investigating how classroom teachers learn to differentiate instruction.
Research Questions

- What are constraints in and affordances for differentiating mathematics instruction for middle school students?

- How does DI impact students and teachers, both cognitively and affectively?

- How do teachers develop understanding of and skill at differentiating mathematics instruction for middle school students at different levels of reasoning?
Years 1-2: Conduct design experiments with groups of nine 7th and 8th grade students with diverse cognitive characteristics.
- We began retrospective analysis of Year 1 data in summer and fall 2014.
- We are in our third, iterative experiment in spring 2015.

Year 3: Form a study group with 10-15 middle school classroom teachers in Indiana to explore how to differentiate mathematics instruction in whole classrooms.
- We will also continue retrospective analysis of Year 1-2 data.

Years 4-5: Co-teach with classroom teachers in classroom design experiments to explore differentiated instruction in topics related to rational numbers and algebraic reasoning.
How do we define differentiated instruction?

- Proactively tailoring instruction to students’ different learning needs, such as students’ readiness and cognitive abilities, interests, and learning profiles and backgrounds (Tomlinson, 2005).

- We are focused on students’ cognitive diversity; our definition/characterization of DI is under development.

- An alternative to…
  - Tracking
  - Individualized instruction for all
  - The same instruction for all
  - Labeling one way of thinking as “normal” and others as “advanced” or “slow” and making adjustments for those thinkers.
Why Differentiate?

Student and Teacher needs
- Students are in many different places in their understanding.
- Teachers want to be able to communicate mathematically with a wider range of students.
- Students who are attempting to understand a variety of ways of thinking may improve classroom cohesion as well as mathematical power.

Societal needs
- US classrooms are increasingly diverse.
- Tracking often compounds existing inequalities.
- Undifferentiated classrooms serve few students well.
Features of DI in Years 1-2

1. Formative assessment
2. Mathematics problems with choices: e.g., Parallel Tasks
3. Flexible and intentional small groups
4. Student work in small groups
5. Whole classroom discussion about a topic, across different problems

✍ Important Note: All of the above require developing clarity about Big Mathematical Ideas and Goals.
Example of Experimentation
Small group work, fall 2013
<table>
<thead>
<tr>
<th>Facilitator</th>
<th>Recorder/Reporter</th>
<th>Questioner</th>
</tr>
</thead>
<tbody>
<tr>
<td>***Sounds like? “We haven’t heard from Alex yet. What do you think of our idea, Alex?”</td>
<td>***Sounds like? “Are we all stuck on #3? No ideas? OK, I’ll ask Ms. H to come over.”</td>
<td>***Sounds like? “How about we listen to Alex’s idea first, and then we’ll get to Susan’s.”</td>
</tr>
</tbody>
</table>
OVERHEARD/SEEN LAST TIME (3/11/14)

• “Is that kind of like what you guys were talking about?”
  [Group member shows JavaBars picture to others in group.]

• Group member tries to read the problem aloud to the group
  and other group members talk to each other.

• One group member asks another: “Why do you think that?”

• Two group members “fight” over who gets the mouse.

• One group member starts to make a JavaBars picture right
  away and stays focused on drawing it.

• Ms. H. asks: “Do you agree with what she said?” “Yes,”
  says another group member, “but actually I wasn’t
  listening. Can you say it again?”
Small group work, spring 2014
During the summer and fall after Year 1 we spent time on analysis. We have two strands of analysis underway:

- Student thinking
- The functioning of differentiated instruction
Our Coding Process

- Initially: Open coding by hand, beginning with a whole-class discussion
- Open coding using ATLAS.ti (about 2 months)
- Our assessment of initial coding:
  - Captured student thinking well
  - Captured aspects of teacher-student interactions
  - Did not seem to capture student-student interactions, which appear to be a vital aspect of DI
Student-to-student interaction is key
- Teachers need to help create structure for interaction
- Explicit instruction in how to respond to others may be necessary

Cognitive diversity requires a different sense of ‘productivity’
- With support, students can try to make sense of others’ ways of thinking without being overwhelmed
Seeking Advice

- Can we structure analysis to capture student-student interaction (whole-class and small group)?
  - Navigating issues of open coding vs. structuring coding to capture particular aspects of a class

- How can we code productively with groups (ATLAS.ti)?
THANK YOU!

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