Differentiating Mathematics Instruction with Middle School Students: Findings in Progress

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Overview

- Describe IDR^{2}eAM project
- Share features of DI we are experimenting with
- Give example of this experimentation
- Solicit feedback about our analytical process

The IDR^{2}eAM Project

- **I**nvestigating **D**ifferentiated Instruction and **R**elationships between **R**ational Number Knowl**e**dge and **A**lgebraic Reasoning in **M**iddle 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?

Project Timeline

- **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

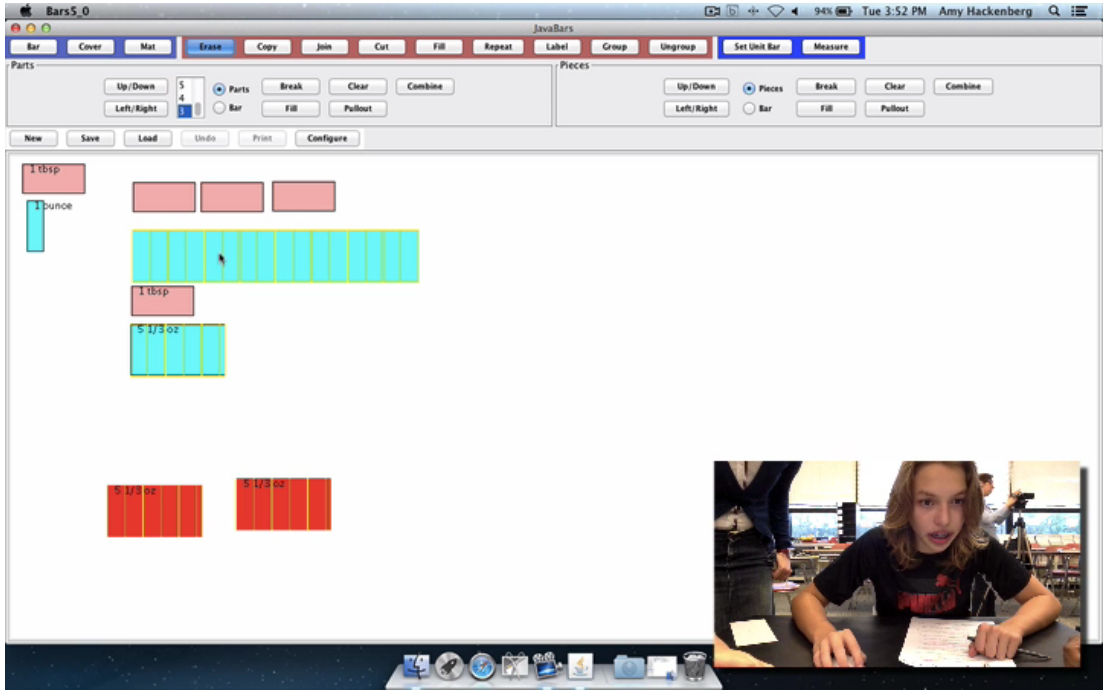
Features of DI in Years 1-2

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



Group roles, spring 2014

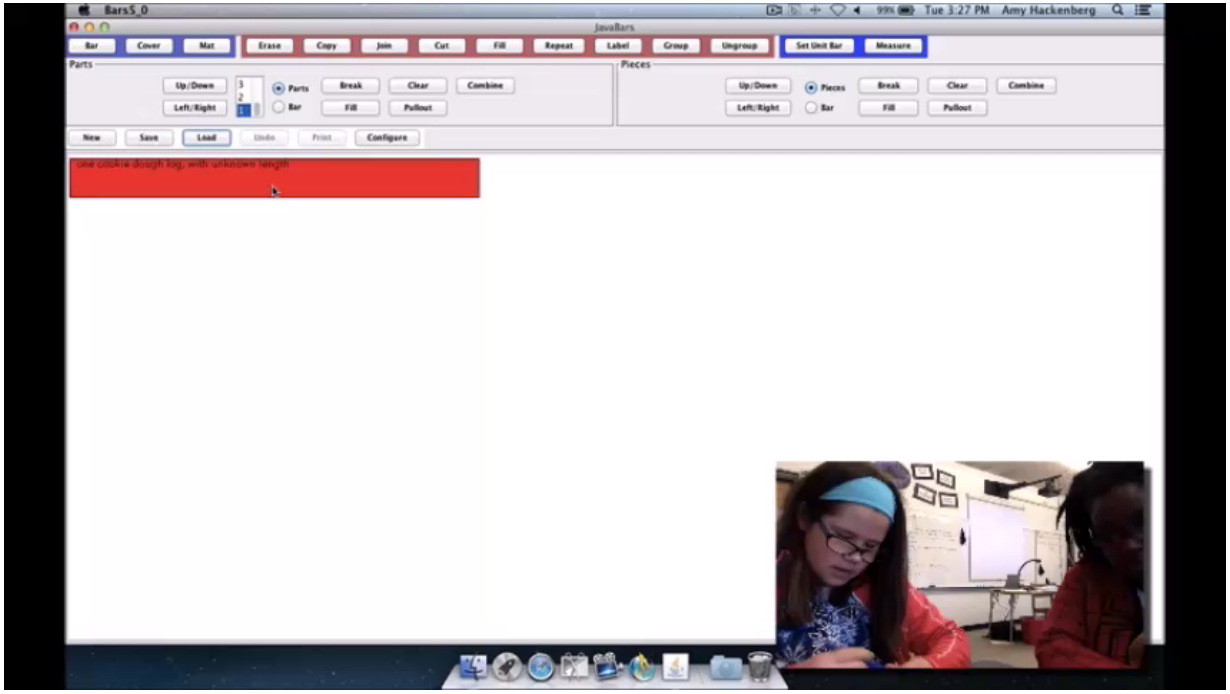
Facilitator	Recorder/Reporter	Questioner
*Keeps group organized, focused, and together. *Makes sure everyone's voice is heard. *Keeps track of time. ***Sounds like? "We haven't heard from Alex yet. What do you think of our idea, Alex?"	*Calls over an adult only for group questions. *Makes sure everyone has time on the computer. *Makes sure that all ideas get recorded on paper/ computer. ***Sounds like? "Are we all stuck on #3? No ideas? OK, I'll ask Ms. H to come over."	*Makes sure everyone understands the task. *Asks questions to clarify ideas and consider alternatives. *Helps find compromises and settle disputes. ***Sounds like? "How about we listen to Alex's idea first, and then we'll get to Susan's."

Group work check-ins, spring 2014

OVERHEARD/SEEN LAST TIME (3/11/14)

- "Is that kind of like what you guys were talking about?" [Group member show 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



Retrospective Analysis

- 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-student interactions, spring 2015

- 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)?

References

- Tomlinson, C. A. (2005). *How to differentiate instruction in mixed-ability classrooms* (2nd ed.). Upper Saddle River, NJ: Pearson.

THANK YOU!

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