Facilitating Collaborative Learning in the Math Classroom

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“How do we teach more students harder mathematics?”

Ilana Horn, 2012
“All students can be pushed to learn mathematics more deeply.”

Ilana Horn, 2012
Why collaborative learning?

- students tend to learn more about concepts and ideas when they have opportunities to talk, listen, explain, and argue with others while working together on rich tasks.

- together, learners can tackle more meaningful and more challenging problems (i.e., those that get at the heart of concepts and allow learners to make connections between important ideas).

- provides a context where students may begin to shift their perceptions about their mathematical abilities.
To learn mathematics with **deep understanding**, students not only need to interact with the **mathematical content**, but **with each other as well**. Mathematics needs to be taught in a dynamic environment where students work together to share and evaluate strategies and understandings.

Students who are involved in a supportive mathematics learning environment that is **rich in dialogue** are exposed to a **wide variety of perspectives and strategies** from which to construct a sense of the mathematical content.”

*Mathematics 9, Saskatchewan Curriculum, 2009, p. 3*
Why collaborative learning?

Communication can support students’ learning of new mathematical concepts as they act out a situation, draw, use objects, give verbal accounts and explanations, use diagrams, write, and use mathematical symbols. Misconceptions can be identified and addressed.

A side benefit is that it reminds students that they share responsibility with the teacher for the learning that occurs in the lesson.”

National Council of Teachers of Mathematics, as cited in Mathematics 9, Saskatchewan Curriculum, 2009, p. 6
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Students working together in groups that are small enough so that everyone can participate, and where they are expected to work on the task without direct and immediate supervision.

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Caveats...

Collaborative learning is **not** about strong students teaching struggling students.

Collaborative learning is **not** a panacea for all instructional goals and challenges.
Collaborative activity in the classroom is supported (or impeded) by teaching tools and teaching actions.
The Shoe Sale

You and a friend decide to take advantage of a *buy two, get one of equal or lesser value free* sale.

You choose two pairs of shoes and your friend chooses one.

What is the fairest way to split the resulting bill? Does your strategy change depending on your choice of shoes?

Source: Nat Banting
“Diversity cannot be assigned or legislated; it must be assumed to be present. Similarly, it is unlikely that diversity, even if expressed, will be recognized and valued if the task set for a collective is trivial.”

Davis & Sumara, 2006, p. 138
Teaching tools to support collaboration

• visibly random grouping

www.superteachertools.us/instantclassroom/

Liljedahl (2014, 2016)
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• “group-worthy” tasks
  • low-floor, high ceiling
  • require some interpretation; promote conversation, debate
  • provide multiple ways of being competent (multiple representations and/or solution strategies)
  • balance between freedom and constraints

Liljedahl (2014, 2016), Horn (2012)
a) A store is having a “Mystery Discount” sale.
You take a $49.95 item to the till, where the cashier spins a roulette wheel to determine your discount. Your total price, with 11% sales tax, comes to $47.13. What percent discount did you win?
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b) A store is advertising the following offers: a) Take 15% off your entire purchase, or b) take $10 off when you spend $50 or more.

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Which is the better deal?

c) You choose an item at a store that’s having a sale. Determine the price that you might pay at the till.
“Students’ engagement or disengagement is not inherent to a given activity. [...] [It’s] not solely about finding the right activity, but also about an appropriate pedagogical response.”

Ilana Horn, 2007
Teaching actions to support collaboration
Coca Cola cans are packaged in the following configuration:

What other configurations are possible for 12 cans? Which of these use less cardboard than the regular Coke box?
Teaching actions to support collaboration

• (prior to the lesson) anticipating strategies, misconceptions, curriculum connections, extensions
  • Which strategies might students use to arrive at a solution?
  • Which curricular concepts might students use to address the prompt?
  • Where might students go wrong?
  • How would you respond to a student who went wrong?
  • How would you extend the problem?
Teaching actions to support collaboration

• (prior to the lesson) anticipating strategies, misconceptions, curriculum connections, extensions

• presenting tasks orally

Liljedahl (2016)
Teaching actions to support collaboration

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• answering “keep-thinking” questions only

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Teaching actions to support collaboration

• (prior to the lesson) anticipating strategies, misconceptions, curriculum connections, extensions
• presenting tasks orally*
• answering “keep-thinking” questions only*
• inviting students into the conversation
  • “Can you summarize what your group has done up to this point?”
  • “What would you do next?”
  • “Would you have done this part another way?”
  • “How can you check that your group’s answer is right?”

*Liljedahl (2016)
Ask for clarification:

“What are we trying to find?” “Can you explain that again?”
Ask for justification:

“How do you know that’s right?” “How did you find that?”
Summarize ideas in your own words:

“So, you’re saying that...”
Check each other’s understanding:

“Is that clear?” “Did that make sense?”
Invite your group members to contribute:

“What do you think?”
“Would you like to add anything?”
• Which **strategies** might students use to arrive at a solution?
• Which **curricular concepts** might students use to address the prompt?
• Where might students go **wrong**?
• How would you **respond** to a student who went wrong?
• How would you **extend** the problem?
Design an expansion for this house that doubles its surface area. The expansion must share some portion of a wall with the original house.
But what about…

• whole-group discussion?
  • Which concepts and strategies would you want to highlight, and how do you ensure that they get brought up?

• assessment?
  • When students are working collaboratively, how might consolidate and check (individual) understanding?
“A key quality of successful lessons is **flexible responsiveness** to events that unfold in the classroom—a responsiveness that is **faithful to stated learning aims**, but that understands that all complex engagements involve **adjustment, compromise, experiment, error, detour, and surprise**.”

Davis, Sumara, & Luce-Kapler, 2008, p. 222
Selected sources


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