A Strategy for Teaching in a Multi-Level Classroom: Push and Support Cards

By *Eric Appleton*

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Supporting perseverance and productive struggle

In November 2016, I attended Rachael Eriksen Brown's session, *How Can You Use Tasks to Differentiate?,* at the NCTM Regional Conference in Philadelphia. Brown presented a strategy called *push and support cards* that she developed with elementary school teachers. In her work with the teachers, Brown introduced high-cognitive demand tasks, defined as problems with "multiple starting points, no clear direction on getting the 'right' answer, and possibly more than one correct solution" [1]. These problems are also sometimes called low-entry, high ceiling problems, referring to the fact that they are accessible to all students (low-entry) and can be extended for students who are ready for further challenge and exploration (high ceiling). For examples, see MathMemos.org [2].

Brown also introduced the idea of productive struggle (MP1: Make sense of problems and persevere in solving them) [3] to the teachers she was working with. They were ready to use high-cognitive demand tasks in their classrooms, but were having their own struggle: they realized that students benefited from independent problem-solving with these tasks, but they hated to see students suffer and would often jump in to help. When the teachers helped too much, their students turned to them as the experts who would rescue them from struggling.

At the CUNY Adult Literacy/HSE Program in New York City, my colleague, Mark Trushkowsky, and I have been thinking about how to strike the right balance of struggle and support. As Mark wrote in the Fall/Winter 2016 issue of the Math Practitioner [4], we know from personal experience in the classroom that it is really hard to refrain from helping and explaining too much. We also know that it isn't always useful to limit ourselves to broad questions like, "What is the problem asking?" and "What have you tried?" I On the other hand, it can be maddening to students if we give them no information at all when they are stuck. We don't want students to give up completely. Some struggle is necessary, but it's counterproductive to let students flounder.

Brown and her teachers came up with push and support cards as a way to provide guidance and keep students' struggle productive, while also helping teachers keep the discipline of not helping or explaining too much. *Support cards* with carefully constructed questions and suggestions help students get unstuck and move forward, while leaving plenty to explore. Teachers limited their support to the information provided on cards, which were given out strategically depending on what was happening in student problem-solving groups. *Push cards* can be used to extend student thinking for students who are ready, while still keeping the entire class focused on the same problem.

In some classes, differentiation for multi-level classes is accomplished by providing different tasks to different students. We prefer using the same problem with the whole class so that students can present solutions, look for connections between methods, and discuss mathematical strategies and ideas as a group. When the whole class is working on one problem, support cards help students who get stuck or don't know where to start, while push cards provide ready extensions for students who move quickly through the initial phases of a task.

Using push and support cards

My first experience designing and using push and support cards was with the Paycheck Problem, a task I wrote in November 2016, basing it on a TASC readiness test question. After teaching the problem, I published a reflection along with student work on MathMemos.org [2]. See pages 11-13 for student pages on the Paycheck Problem with related push and support cards. I recommend trying the problem on your own before looking at the related push and support cards. If your struggle starts to feel unproductive, you might look at the support cards one at a time and return to your work to see what new ideas you have.

Suggestions for using push and support cards:

- Students should work in small groups and share the cards you hand out. Handing out support and push cards to every student in the class isn't usually feasible.
- Let students work for a while without giving any cards out. When you come around to each group, ask students to explain their thinking and what they have tried. If it seems that they are getting frustrated, you might give them a card. When possible, try to give them a card that supports/connects to the approach they are already attempting.
- Give only one copy of a card to a group so that they share it. Encourage students to talk to each other about the new information you're giving them.
- Once you're confident that the group understands the card, walk away. Don't get pulled into answering students' questions. Answer clarifying questions but beyond that say, "That is a great question for your group to discuss…" and move on.
- Don't give out too many cards. There is no requirement to give out all the cards. It's better that students fully respond to a couple cards.

Writing push and support cards

Writing your own push and support cards before class can help you strike a balance between support and struggle. As you write cards, you can decide how much help you want to give. So, how can we write push and support cards to go with problems we're using? "Brown, et al" recommend stripping scaffolding and extension questions from existing problems and converting them into push and support cards [1]. This allows the teacher to be strategic about when to give hints or extensions. It also simplifies the problem that you give students at the beginning, which may help students get started without being overwhelmed.

Consider the following problem [5].

Crossing the River

Eight adults and two children need to cross a river. A small boat is available that can hold one adult or one or two children (i.e., three possibilities: 1 adult in the boat, 1 child in the boat, or 2 children in the boat). Everyone can row the boat. How many one-way trips does it take for all of them to cross the river? Can you describe how to work it out for 2 children and any number of adults? How does your rule work out for 100 adults?

What happens to the rule if there are different numbers of children? For example: 8 adults and 3 children? 8 adults and 4 children? Write a rule for finding the number of trips for (A) adults and (C) children. One group of adults and children took 27 trips. How many adults and children were in the group? Is there more than one solution?

I made the following support cards after solving the problem myself and thinking about what helped me make progress. I started to make sense of the problem by drawing a diagram. I then tried a simpler version of the problem (0, 1 or 2 adults) and organized the results in a table. My hope is that students will eventually see a pattern in the number of trips and will be able to generalize the number of trips for 2 children and any number of adults (A). I'm not sure if we would get to a generalization for (C) children and (A) adults.

Support cards

<table>
<tr><td>Who should go across the river first?</td><td>Can you draw a picture or diagram to how this works?</td></tr>
<tr><td>Grab some counters (tiles, manipulatives) and show how the trips across the river could work.</td><td>How many trips would it take if there was just 1 adult? What if there was 2 adults?</td></tr>
<tr><td>How many trips would it take if there were 2 children and 0 adults?</td><td>Organize your results with a table.
<table>
<tr><th>Adults</th><th>Children</th><th>Trips</th></tr>
<tr><td>0</td><td>2</td><td></td></tr>
<tr><td>1</td><td>2</td><td></td></tr>
<tr><td>2</td><td>2</td><td></td></tr>
<tr><td>3</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

In the original Crossing the River problem, most of the additional questions are extensions of the original situation, asking students to try other cases, generalize the situation or work backwards from a number of trips to a number of adults and children. I would move all of these to push cards, guessing that I wouldn't get to all of them.

Push cards

Is there a pattern in the number of trips necessary for different numbers of adults?	How many trips would it take to bring 8 adults and 2 children across the river?
Can you describe how to work it out for 2 children and any number of adults? How does your rule work out for 100 adults?	Write a rule for finding the number of trips for (A) adults and 2 children.
It took 45 trips for a group of adults and children to cross the river. There were 2 children. How many adults were there?	What happens to the rule if there are different numbers of children? For example: 8 adults and 3 children? 8 adults and 4 children?
One group of adults and children took 27 trips. How many adults and children were in the group? Is there more than one solution?	Write a rule for finding the number of trips for (A) adults and (C) children.

Suggestions for writing push and support cards

Support cards [1]:	**Push cards** [5]:
• Use simpler numbers • Break task into smaller pieces • Suggest manipulatives • Suggest organization tool like a diagram or table	• What-if questions • Work the problem in reverse (i.e. start with the number of trips) • Generalize the situation (write a rule) • Why does the rule work?

Why use push and support cards?

I believe that there are a number of good reasons for using push and support cards. In our multi-level adult education classes, they allow for differentiation within one task, so that all students are part of the same learning, though they may move at different speeds. As "Brown, et al" (2017) explains, all student groups "can still offer a solution since the support card maintains the context and mathematics of the original task." Push and support cards help teachers let students struggle, while preventing students from getting so frustrated that they give up. In preparing cards, teachers practice intentional, strategic questioning appropriate to the problem and the expected strategies their students will use. Finally, push and support cards support students' work in groups by encouraging sharing of strategies and suggestions. What follows this article is the Paycheck Problem and related push and support cards so you can try out this effective strategy in your classroom.

References:

[1] Brown, R. E., Mackiewicz-Wolfe, Z., & Tily, S. (2017). Using Push and Support Cards for Differentiation. *Ohio Journal of School Mathematics,* 76

[2] http://www.collectedny.org/mathmemos/

[3] http://www.corestandards.org/Math/Practice/#CCSS.Math.Practice.MP1

[4] Trushkowsky, M. (2016). Math Memos: Letting Students Struggle, Letting Students Think. *The MATH Practitioner.* Vol. 22 (1), Fall/Winter 2016.

[5] Driscoll, M. (1999). *Fostering Algebraic Thinking: A Guide for Teachers, Grades 6-10*. Heinemann, 361 Hanover Street, Portsmouth, NH 03801-391