WHITE PAPER

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Guided Math in Action: Six Components to Making It Work

by Nicki Newton

Table of Contents

About This Paper

Dr. Nicki Newton is an education consultant who works with schools and districts around the country on elementary math curriculum. She has taught elementary school, middle school, and graduate school. Having spent several years as a bilingual teacher and staff developer, she has an extensive background in Sheltered Instruction and English Language Learner Strategies. She has an EdM and an EdD from the Department of Curriculum and Teaching at Teachers College, Columbia University, specializing in teacher education and curriculum development.

I am currently working with a great group of fifth-grade kids who hate math. We are exploring the concept of dividing whole numbers by fractions. I carefully plan for our guided math session. These kids already think they can't do it, so I start with a story. Their eyes widen . . . they are all in. After all, it's just a story about a bakery they have all been to once. As I share the story, they learn that the baker has a dilemma. She wants to figure out how to sell her amazing cakes. People love them, but they don't want to buy a whole cake. What should the baker do? What tools could help us think about this problem as we consider some options? Listening carefully, I wait, probe, prompt, and question deeply. The students puzzle, talk, discuss, and even argue about their ideas.

The idea emerges that the baker might divide the cake into pieces. What kind of pieces? What are the options? What seems too small? What seems too large? Choosing to work with the fraction circles, they decide that thirds are definitely too large, and tenths might be a bit too small. Using fraction circles, they look at how many pieces they would get if they cut four cakes into sixths or eighths. Throughout the lesson, students are working with the manipulatives, talking and listening, and sharing initial ideas and thoughts.

We then talked about the learning goal, the vocabulary, and defined what they were exploring at the end of the session. This allows the students to explore the concepts, discuss them in depth, and focus on understanding the math. Future lessons will delve deeply into the concept, looking at various bakery scenarios, patterns, and exploring both conceptual and procedural understanding.

This small, flexible, ever-changing guided math group allowed me to get up close and personal with the students about the math they were learning. It created space for the use of manipulatives, the posing of rich questions, and the exploration of a rich task that allowed students to bounce ideas off each other in ways that couldn't possibly happen in whole group instruction. Math class should flex and flow with different instructional structures throughout the period that allows students to learn in different ways. There is a place for whole groups, small groups, partner work, and individual work.

The small group learning environment creates intimate opportunities for students to collaborate with a variety of different students. It also allows teachers to learn about each student's individual strengths, challenges, and mathematical understandings. Guided math sessions offer opportunities for teachers to engage in deeper discussions with students, creating a meaningful, rich, and interactive conversation about their knowing and learning of mathematics. When planned and executed effectively, these sessions can be a powerful instructional strategy for all students. Guided math is meant to get students to think deeply, engage mindfully with the math, learn by doing, to express themselves, and reason about the thinking of others. In guided math sessions, students engage and do math; they never do worksheets and workbook pages unless they are structured as interactive explorations involving thinking with tools and visuals to make the concepts come alive. Different groups do different things. They all puzzle and play around with ideas, pondering different situations as well as discussing, debating, defending, and revising their thinking.

The role of the teacher is not to “show and tell” students how to do math in a guided math session; rather, it is “responsive guidance” in developing pupils’ own thinking. This guidance requires a range of support for pupils’ thought constructions, in a way that develops individual thinking as well as leading to the generation of mathematically valid understandings (Anghileri, 2006). Usually, the teacher meets with one or two groups a day, with three to five students in a group, between 10 and 15 min, depending on the students’ needs. The guided math structure is flexible; some teachers meet with groups every day, while others meet on designated days. Oftentimes, students who are struggling with a topic will meet more often. The following six components are important considerations when implementing the guided math structure:

- Assessment
- Differentiation
- Standards-based
- Academically rigorous
- Scaffolded
- Engagement

Assessment

Actionable data are the key to successful guided math groups. All guided math groups should be formed based on both formative and summative data. At the beginning of the year, assessments of the previous year’s priority standards are essential to see if and where there are any gaps. Research has found that every summer many students lose about 2–3 months or more of math knowledge (Shafer, 2016). The summer slide is real. Therefore, at the beginning of the year, we must know what gaps exist around the priority standards so that we can close them during routines, guided math, and workstations. Throughout the year, exit slips, chapter quizzes and tests, math conferences, anecdotal notes, and student work should all inform which students we will pull and what we do in guided math groups.

Differentiation

Based on the information gained from assessments, teachers are empowered to form small, temporary groups based on the current instructional needs of the students.

Groups are sometimes heterogenous and sometimes homogenous. It isn't either/or—it's both/and. The groups are flexible, and they are formed based on the data. Let's think about a second grade fluency group. After teachers give a *Math Running Record*, they know exactly where students' strengths and challenges are with basic facts (Newton, 2016). Teachers would then pull designated groups and work with students in their area of need to scaffold learning. One set of students might be working on making ten facts and another set of students might be working on doubles facts. Students move fluidly in and out of groups as they progress (not everybody learns on the same date or at the same time, just because that was the lesson of the day).

Another example would be a third-grade rounding lesson. The teacher might pull a heterogenous small group and work with a beaded number line to explore rounding. After a few lessons, some students firmly get the skill and others are still struggling. The teacher would then work with one group still on the beaded number line and pull another group and play a rounding game with cards. Now one group is exploring the skill and developing procedural fluency and the other group is focusing on using their conceptual knowledge to practice mental math work. Differentiation in the guided math groups allows the teacher to address the specific spaces that students inhabit along the learning continuum.

Standards-Based

The teacher should always know what the goal of the lesson is. Hattie (2017) tells us that teacher clarity has a big effect size .75. Dixon (2018a) points out that we don't need to always advertise what we are going for before we do it. Sometimes it is perfectly ok for students to do the exploration and then talk about what they did. In these instances, the "I can" or "I am learning to" statement is discussed at the end of the guided math lesson rather than at the beginning. Furthermore, at the end of the lesson, students should talk about their learning journey. There should be some sort of quick check either at the bottom of a recording sheet or just verbally. For example, today we have been working on adding fractions with unlike denominators. What do you think? Do you get it, kind of get it, or don't get it yet?

Academically Rigorous

It is important to consider the levels of rigor in a guided math lesson. If we do not actually plan for a rigorous lesson, it might not happen. During the lesson, we want to ask not only convergent questions but also divergent ones. The work of Small (2009) gives us a great framework for doing this. For example, in a guided math lesson on rounding, I would not just ask students "What does 47 round to?" I would also ask students to "Give me three numbers that round to 50." If we were doing elapsed time, I might be using an elapsed time ruler to scaffold students into the more abstract number line diagram, I wouldn't only give problems like "Sue went to the store at 1:45 and came back at 2:25. How long was she gone?" I would also ask, "Sue went to the store. She was gone for 40 minutes. When could she have left and when could she have come back?" These are open questions. They make students think. They require them to understand at a depth of knowledge (DOK) Level 1 (recall) but then to stretch and think into a DOK Level 2 (application of skills) or possibly DOK Level 3 (strategic thinking; Webb, 1999, 2002).

Scaffolded

Scaffolding in Hattie's (2017) work suggests high effect .82. We can scaffold in different ways in the guided math groups. Be careful not to over-scaffold though. Also, Dixon (2018b) warns us not to scaffold "just in case" but to scaffold "just in time." Scaffolding, when used wisely, can help students access the mathematics. When thinking about scaffolding, there are a few things to consider. First, scaffold the language. Math is a language and if students don't know the words, they can't speak it. At some point during the lesson, the vocabulary and language frames should be presented so that students can connect it to the math they are learning. Sometimes, if students know the words and have been working with them, this can be done at the beginning of the lesson. However, at other times, the vocabulary can be discussed at the end of the lesson, to tie it to the math that was being done. Dixon (2018c) makes a good argument about how sometimes the language can interfere with students' attempts to communicate the math that they are doing. They can hide behind the words. Having to explain the actual concepts allows students to delve deeper into the math.

Second, provide a variety of manipulatives and tools for students to choose as they work. Remember that manipulatives don't teach students math. They can help them to explore concepts. The practices/processes say that students will be able to choose the tools they need to do the math they are doing (Koestler, 2013). National Council of Supervisors of Mathematics (2013) stated that "[I]n order to develop every student's mathematical proficiency, leaders and teachers must systematically integrate the use of concrete and virtual manipulatives into classroom instruction at all grade levels." They said this in light of the resounding research that manipulatives have a powerful potential to help students explore, play with, figure out, wonder, and know mathematics (National Research Council, 2001; Van de Walle, 2013). Oftentimes, teachers will think because students can get the answer, that they are doing ok. There is a big difference between "getting the answer" and "getting the math." Manipulatives can help students to "get the math." For example, I was working with some fifth graders who knew how to multiply fractions and, in this case, even draw a model (for this operation, both of these things are relatively easy to do). However, they couldn't verbalize or contextualize the math that they were doing. So, I used tools (in this case, play clay) and a story about sharing gum to get them to see what a "piece of a piece" actually means. Manipulatives are for everybody, not just "the struggling learners."

We have to focus on getting students to model their thinking and use tools when helpful, but we have to make sure we use the tools in the best way possible and that we connect them through a cycle of concrete, pictorial, and abstract learning. For example, if I am using a rekenrek/number rack to work on doubles, I would want students to build it, draw it on the rekenrek paper, then write the equation. Another example is teaching fractions with pattern blocks. I might facilitate a discussion where we are working with pattern blocks to explore comparing fractions. I could also then sketch it on pattern block paper or have the students do a sketch and write observational statements.

Third, the teacher should use questioning as a scaffold. Throughout the lesson, the teacher should be listening, questioning, prompting, cueing, and probing to help students delve deeper into the math that they are learning (Anghileri, 2006; Fosnot, 2005; Reinhart, 2000). The goal of the teacher is to use questions to get students to "look, touch and verbalize what they see, think and feel" (Coltman et al., 2002). The teacher is trying to create an environment where students are questioning, explaining, defending, proving, justifying, and thinking about their work (Cobb et al., 1991; Small, 2009; Webb, 2002).

Engagement

Students must be actively engaged in doing mathematics (Dewey, 1938). Engagement is necessary but not sufficient. The lesson should be "hard fun" as Papert (n.d.) pointed out. Students enjoy working on the edge of learning. They want a challenge. They like to be pushed into higher level thinking as long as it is in the productive struggle zone (Hiebert & Grouws, 2007; Jackson & Lambert, 2010). Guided math is another opportunity in the math workshop structure to take a calculated and a safe risk and thrive in a productive struggle–type environment that gives equitable access to every student to expand their thinking and learning of mathematics.

Conclusion

Guided math is an additional opportunity in the math workshop structure for students to move forward on the math continuum toward mathematical proficiency. This means that in guided math sessions, students are *doing* math. They are building conceptual understanding, working on procedural fluency, developing strategic competence, reasoning with each other about the math they are learning, and growing into strong, competent, and confident mathematicians (National Research Council, 2001). Guided math sessions allow students to gather together in small, focused groups to explore big mathematical ideas and grow together one day at a time.

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Author's Note

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