Drexel University

Research Brief no. 6

Doing Math: A case study of one 5th grade teacher's use of centers to develop math skills and mathematical literacy

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December 2019

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Volume 4 Number 6 December 6, 2019

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Abstract

Students' ability to move from skill-based mathematics to being mathematically literate is a challenge. This case study explores the deliberate use of centers to promote this movement. Findings are presented from one center on big numbers showing the students' growth over the twelve weeks of observations and collected student work product.

Problem

According to the most recent Programme for International Student Assessment (PISA) data provided by the Organization for Economic Co-operation and Development (OECD), students in the United States perform below the international average in mathematics (OECD, 2019). This has been consistent since the launch of PISA in 2000. This test is given to 15-year olds, thus it is imperative to address this disparity at an earlier age due to the impact it may have on students' futures.

In fifth grade classrooms, students are studying math skills such as understanding place value, using basic operations with multi digit whole numbers, fractions, and decimals, converting measurements, and using the order of operations. However, due to the often siloed nature of content, as it is taught in schools, these skills are often taught and assessed in isolation. Math literacy is defined by the Organization for Economic Co-operation and Development (2013) as the ability to use mathematics in a variety of contexts that includes reasoning and use of mathematical concepts to solve problems. When the connection between mathematical concepts is not built in a way that allows students the ability to transfer their knowledge between concepts, a competency necessary for developing math literacy. Akbasli, Sahin, and Yaykiran (2016) argue that students should build math skills, use of vocabulary, and expresses understanding in order to utilize math skills actively beyond the classroom. This dissertation will explore how fifth graders participation in math activity centers designed specifically to scaffold the development of that set of math skills may actively support the development of math literacy (see figure 1).

Building on Stein et al.'s (2000) classification of tasks as "doing math," tasks that are intended to explore a mathematical concept in depth, this dissertation aims to investigate how the fifth graders' work in math centers, centers intentionally designed to promote "doing math," can support the development of their math literacy. These centers are designed to promote student engagement with concrete experiences of counting and measuring various items (e.g. money, weight, length, area) and quantities (e.g. fractions, decimals, whole numbers, larger numbers). Additionally, as part of these centers students write sentences and word problems about the items and quantities they count and measure. The activities that are part of these centers are designed to support fluid movement between concrete and abstract representations that will allow students to build mathematical knowledge and comfort with mathematics in meaningful ways.

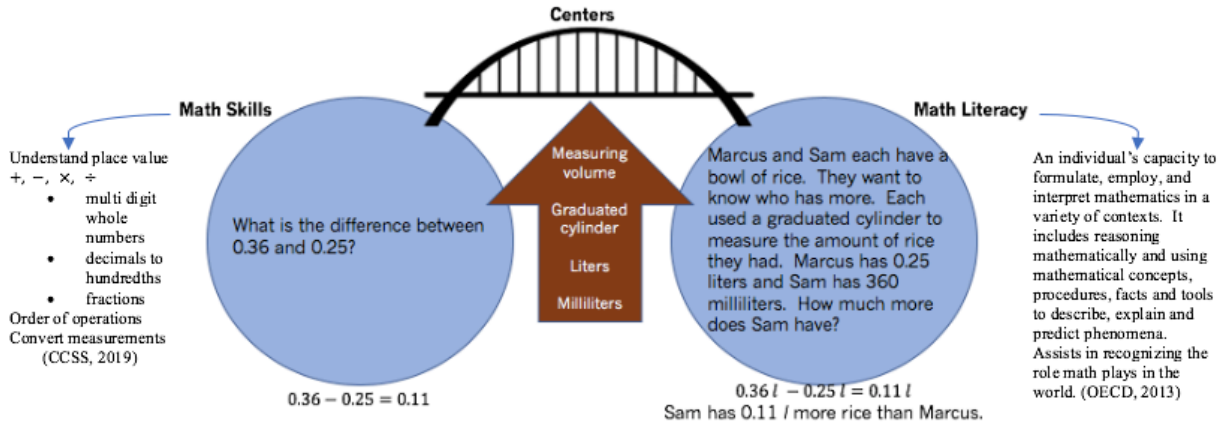

Figure 1. Centers as the bridge from math skills to math literacy. This figure illustrates example problems from math skills and math literacy spaces and highlights the work centers do to bridge this gap. It also includes the definitions of math skills and math literacy.

This preliminary study sought to understand how students' math skills and math literacy develop as they participate in a center intentionally designed to promote their understanding of big numbers and writing about them (see figure 2). A case study design (Yin, 2012) was utilized to analyze this center approach in a fifth-grade teacher's classroom. Observations and student work analysis were conducted to address the research question:

Research Question: How do centers, designed for students to count and measure, change their understandings of mathematics?

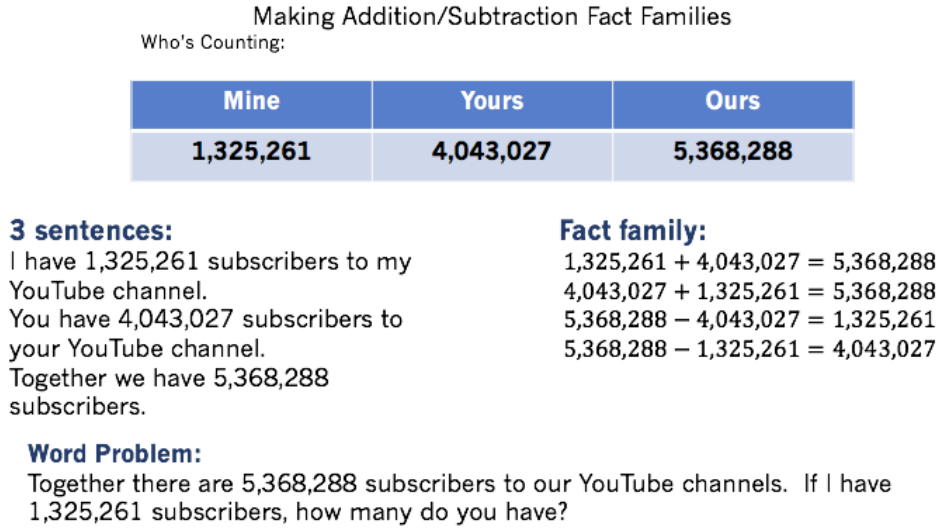

Figure 2. Sample of big numbers center information. This figure displays the work a student would complete when participating in the big numbers center.

Study Design

Setting. The study took place in a charter school in the greater Philadelphia area. In this school, approximately 94% of the students identify as Black, and 73% come from low-income households. Within the school, the classroom observed was a fifth-grade multi-tiered system of supports class where all fifth-grade students receive on average, 90 extra minutes of math support a week.

Methods. Over the course of 12 weeks, observations were conducted twice a week. During these observations, the researcher was a participant observer (Ravitch & Carl, 2016) and took detailed notes on student interactions with the center work. Along with these notations, select student work was reviewed for content based on the four sections of the center document: creating numbers and adding, writing narrative sentences, writing fact families, and writing word problems (figure 2).

Preliminary Findings

Through working in a center designed specifically to increase students' ability to work with and understand big numbers (numbers in the millions), as well as write narrative sentences, fact families, and word problems, there are three key findings.

1. When writing the narrative sentences, students struggle to give units to the numbers. In essence, what can be counted in millions? This was discussed in class, and students gave suggestions of dollars, viewers or subscribers, books, etc. The discussion led to an increase in students using appropriate ways to describe a number in the millions.
2. When writing the fact families, some students could immediately complete the work, while others needed to be reminded of what a fact family was and how the numbers were related. By sharing a single-digit fact family, many students were able to grasp the concept with the big numbers.
3. Writing word problems is difficult for students. While the students are progressing, there is little variation in the problems they write. They also don't always write in complete sentences, include periods or capitals, and organize their thoughts well.

Conclusions

This preliminary review of observations and select student work demonstrates that by participating in the centers, the students' math skills and mathematical literacy abilities are increasing. It also shows that the students are (a) counting and measuring objects to complete work that allows them to access mathematics in an authentic way, (b) building their vocabulary by using items they may not otherwise use, and (c) writing their own word problems, thus creating the work they will be asked to do on a test. In essence, the students are "doing math" in ways that allow for connections and transfer to happen.

Next Steps

Moving forward this study will expand to explore (1) select students' growth over time as they work in the centers, (2) teacher feedback to the students and what it looks like, how it has changed, and if students are using it, (3) state assessment data to make comparisons year over year, and (4) student context of their sentences and what it means to give students open access to use their own context.

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Author Biography

Amanda Reinsburrow is a doctoral candidate in the School of Education at Drexel University with a concentration in STEM education. Her research interests include exploring definitions of mathematics literacy, relationships between teacher pedagogical beliefs and practices, and professional development to support teachers' use of student thinking to inform mathematics instruction. In particular, Amanda is interested in closely examining how mathematics' teachers understanding of literacy pedagogies can support learners in the mathematics classroom. Currently, Amanda serves as a teaching and research assistant in the School of Education. This position allows her to teach education courses at the undergraduate and graduate level, supervise students in the field, and contribute to research. Prior to attending Drexel, Amanda spent ten years teaching middle and high school mathematics in California and Florida.