AIM

Assessment and Instruction in Mathematics

January 2024 | https://bit.ly/UVA_CASTL_AIM

How Do Kindergarten Teachers Differentiate Math Instruction?

An Interim Report from the Assessment and Instruction in Mathematics (AIM) Project

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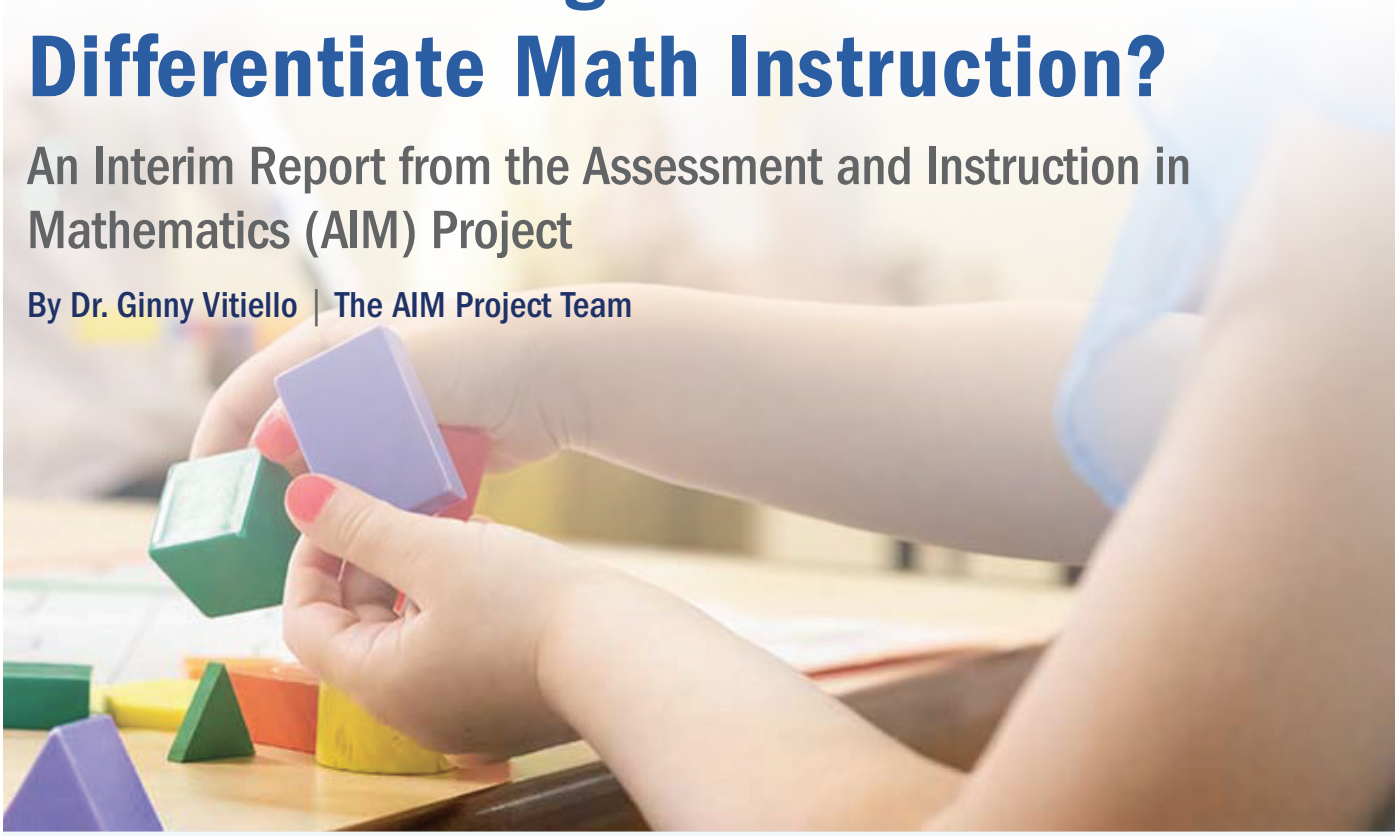

Acknowledgements

The Assessment and Instruction in Mathematics (AIM) project is a research collaboration between University of Virginia (UVA) researchers and Virginia school divisions to study how kindergarten teachers use mathematics assessments in their instruction. This project was funded by a grant from the U.S. Department of Education Institute for Education Sciences (IES). This report summarizes findings from our first year of data collection. The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through the Grant R305A190037.

The opinions expressed are those of the authors and do not represent the views of the IES or the U.S. Department of Education. We are grateful to the students, teachers, math specialists, and principals who participated in this study - this research would not be possible without their engagement.

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Key Takeaways

- **Teachers valued all types of assessments,** but saw most value in the assessments and observations they used day-to-day in their classrooms.
- **Teachers felt very confident in their data use skills**, but some also reported that they could use more professional development in this area.
- **Teachers differentiated instruction in multiple ways.** The most common approaches were using small group instruction and computer-adaptive mathematics programs to meet students' individual needs.
- **Observations and survey responses** indicated that teachers tend to spend more class time working directly with their lower-performing students than with higher-performing students.

Background

Most, if not all, of the school divisions in Virginia encourage teachers to differentiate or individualize their instruction. The motivation is to better meet students' needs, recognizing that all students have different strengths and areas for growth. This approach to teaching, the idea of *matching instruction to each student's needs*, is strongly rooted in our understanding of how children learn subjects like literacy and mathematics. In kindergarten, for example, some students may be working on solving simple addition and subtraction problems using small numbers, while others are working on more complex problems (e.g., find the missing addend) with larger numbers. It seems logical that these different students would benefit from different instruction.

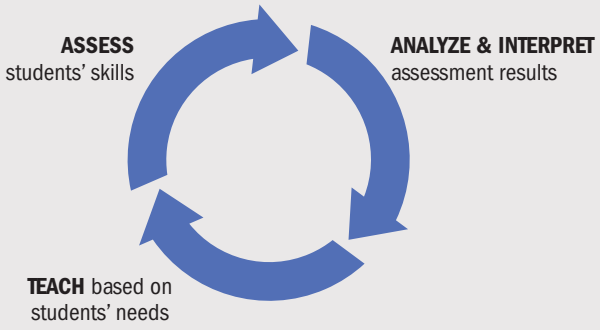
Yet, the evidence for differentiated instruction in the early elementary grades is relatively weak, especially in mathematics. Most research on differentiation focuses on literacy, and most research on math differentiation focuses on older grades. Research suggests that, with support, teachers *can* differentiate instruction in math – but it is less clear whether and how most teachers *do*, and what supports they may need to do it effectively. Differentiation requires substantial effort from teachers, so it is important to understand its feasibility and value to children's learning.

The Assessment and Instruction Mathematics (AIM) Project, funded through the U.S. Department of Education Institute of Education Sciences (IES), and led by a team of University of Virginia (UVA) researchers, seeks to understand the extent to which teachers use differentiated instruction to teach mathematics in kindergarten and whether these practices are associated with students' math gains. We started by conducting interviews in 10 schools to understand how teachers plan for differentiation of math instruction, how they assess students' skills, and what differentiated instruction looks like in classrooms. We are currently conducting a second study to put those pieces together by exploring teachers' assessment, data use, and differentiation practices across the kindergarten year, and how those practices are associated with students' math outcomes.

Our first year of data collection for the current study occurred during the 2022-23 school year. We worked with **40 teachers from 12 Virginia school divisions**. We are currently collecting data in many more classrooms, so the results presented here are preliminary. This report provides a descriptive picture of assessment and differentiated instruction among our first cohort of 40 teachers, drawing on teacher surveys, rating scales, and classroom observations.

Data Use Cycle

A data use cycle describes how teachers use data from assessments to differentiate instruction. First, teachers assess students' skills. Next, they analyze and interpret the information they have collected and make decisions about instruction. Then, they use teaching practices that address students' learning needs. This cycle repeats many times throughout a typical school year. To align with this model, we measured teachers' assessment practices, data use, and classroom instruction.



5 Things We Learned About Data Use in Kindergarten

1. **It's Iterative**
   Teachers were constantly assessing students' math skills: by giving statewide assessments, unit tests, or by carefully observing what children know and can do.
2. **It Takes A Team**
   Teachers met regularly to analyze the data and decide on next steps, often with the support of principals and math specialists.
3. **It Supports Differentiated Instruction**
   Teachers often planned multiple lessons for different levels of student understanding. Teamwork and collaborative planning helped them manage the workload.
4. **It Requires Flexibility**
   Teachers differentiated instruction through small groups. They adjusted the level of challenge based on observing students, often in the moment. Small groups changed frequently.
5. **It's Standards-Driven**
   Assessment, data use, and instruction were driven by state learning standards. Teachers followed a pacing guide; curricula were viewed as resources to help children meet the standards.

Research Questions

In this preliminary report, we address the following questions:

1. **How often did teachers report using assessments in mathematics, what assessments did they use, and which did they find most useful?**
2. **How did teachers use and collaborate around data?**
3. **How (and how much) did kindergarten teachers differentiate mathematics instruction?**

Method

This research was approved by the UVA's Institutional Review Board and by research review boards in participating school divisions. We obtained teacher and parent consent and child consent prior to data collection. After obtaining consent from parents, we randomly selected four children per classroom to participate in assessments and observations. (We refer to these as our "focal students.")

All 40 participating teachers were female and they were predominantly White (87%) or Black/African-American (7%). All teachers had at least a bachelor's degree, and 47% had a master's degree or education specialist diploma. Teachers reported an average of 18.8 children per classroom (*SD* = 3.4, range = 13-25). Many teachers reported that they typically had another adult in the classroom to help during math block (math instruction period), including paraprofessionals (41%) and assistant teachers (15%); although 41% reported having no other adults in the classroom during math block.

Teachers completed surveys in the fall and spring and provided mathematics skill ratings on focal students in the fall and spring. Teachers provided information about math instruction and student grouping in the fall, winter, and spring. Focal students were observed

up to six times across the school year to document specific activities, topics, and materials they engaged with during the math block.

Results and Interpretation

How often did teachers report using assessments in mathematics, what assessments did they use, and which did they find most useful?

Teachers reported using classroom assessments and their own observations much more frequently than statewide or benchmarking assessments (see Figure 1). They also tended to find them more useful; 75% of respondents gave their own observations the highest possible rating of "Very Useful" (see Figure 2).

This finding aligns with prior research showing that teachers largely rely on day-to-day measures or observations of children's skills for planning and modifying instruction. Classroom assessments and teachers' observations occur much more frequently than formal assessments like statewide or benchmarking assessments. So, informal assessments are better positioned to influence instruction on a regular basis. Teachers found value in the formal assessments as well, but those were administered much less frequently and were less useful for informing day-to-day instruction.

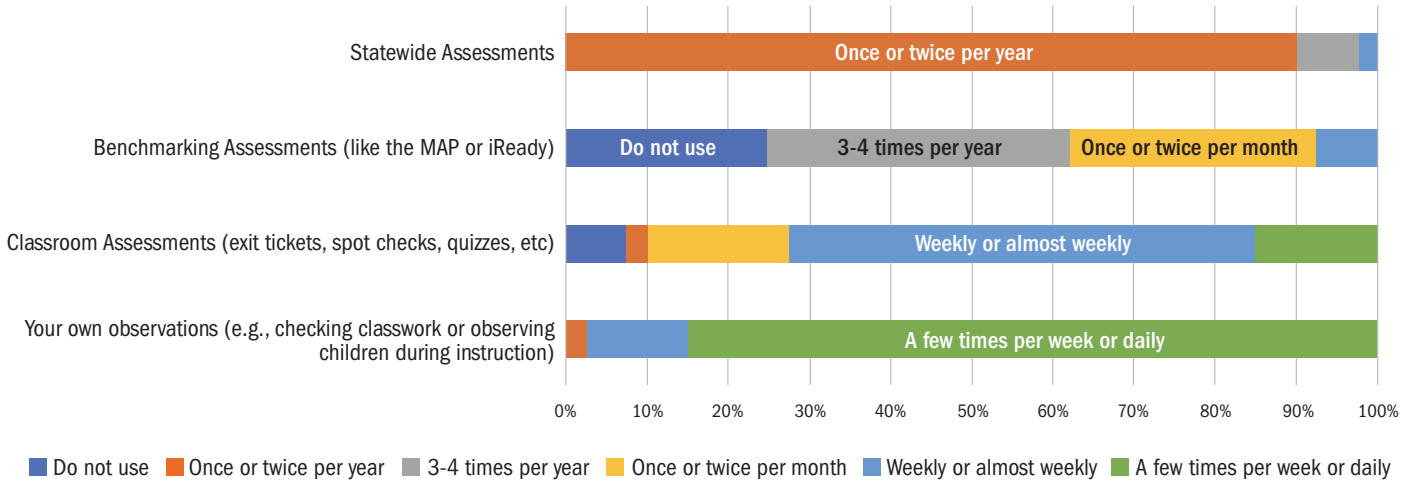
How did teachers use and collaborate around data?

Most teachers (75%) reported meeting at least once a month and reported having positive, trusting relationships with their team members.

Teachers expressed strong agreement about the value of data; for example, "*Students benefit when teacher instruction is informed by data*" had an average rating of 86.6 out of 100 (*SD* = 13.6). They also expressed high self-efficacy related to data use; for example, "*I am good at using data to diagnose student learning needs*" had an average rating of 82.3 out of 100 (*SD* = 17.4). Teachers reported lower levels of agreement with statements about the professional development they received on data use. For example, responses to the statement "*My district provides enough professional development about data use*" had an average rating of 64.0 out of 100 (*SD* = 30.4), indicating lower average agreement and also greater variability in teachers' responses. Likewise, when asked whether their teams engaged in data-driven decision-making, teachers reported lower average agreement and high variability in responses.

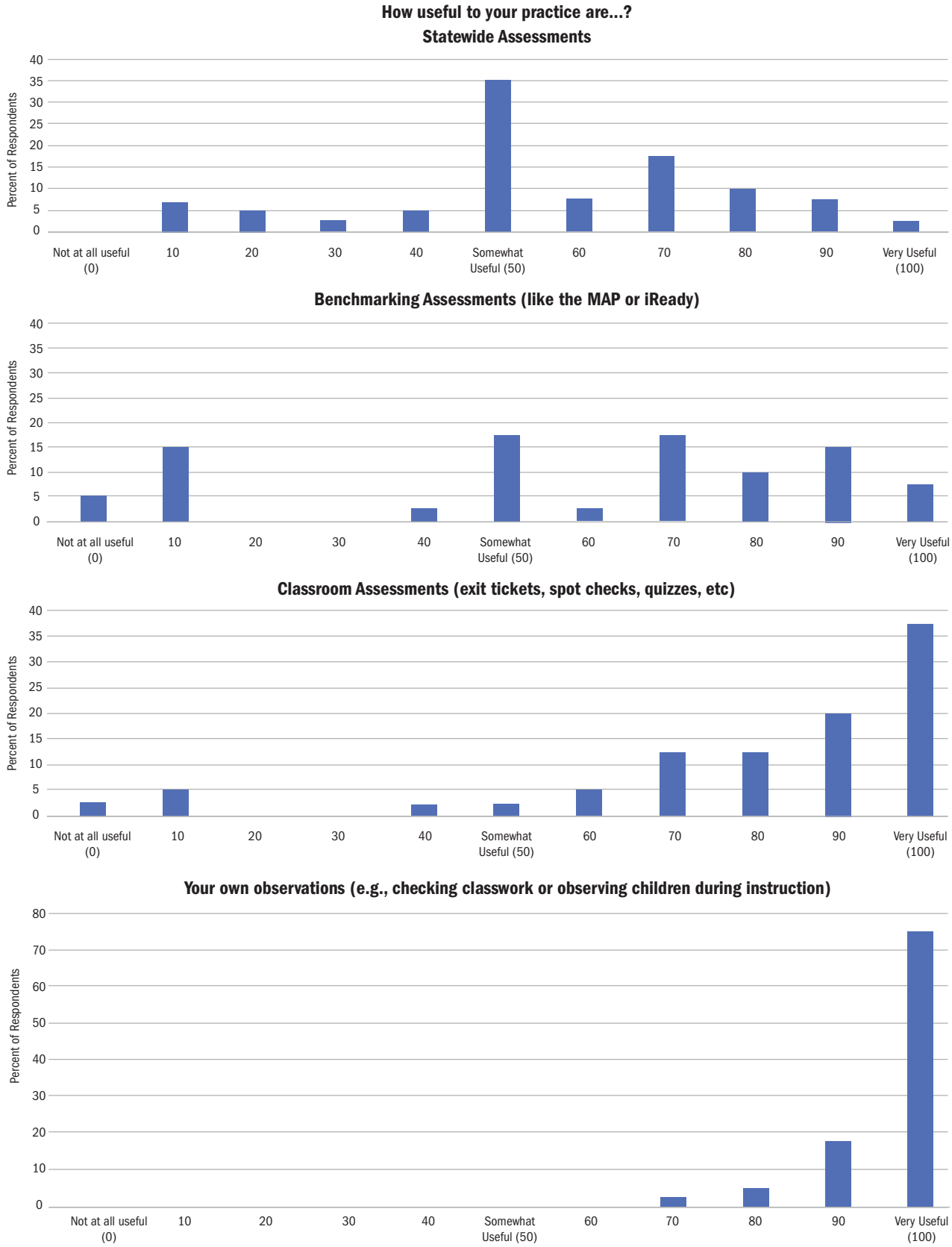
Altogether, these results indicate that teachers value data to inform instruction and feel confident in their ability to use data for instruction. However, their

Figure 1: Frequency and use of different assessment types



Teachers reported using informal assessments most frequently.

Figure 2: Usefulness of different assessment types



Teachers found classroom assessments and their own observations most useful.

responses also indicate value in providing for more professional development related to data use, and suggest that some of their teams are only moderately engaged in data-driven decision-making to inform instruction.

How (and how much) did kindergarten teachers differentiate mathematics instruction?

Ninety-five percent of teachers told us that they differentiate their mathematics instruction. The most common approaches included providing differentiated instruction in small groups (68%) and using computer-adaptive math programs like IXL, Dreambox, or MathSeeds (68%). Additional responses are presented in Figure 3. Notably, more than twice as many teachers reported providing intervention time to lower-performing students than providing enrichment to higher-performing students. This finding is aligned with what we heard from teachers in our qualitative study. Those teachers emphasized their focus on bringing the lowest-performing students up to the level of meeting state standards.

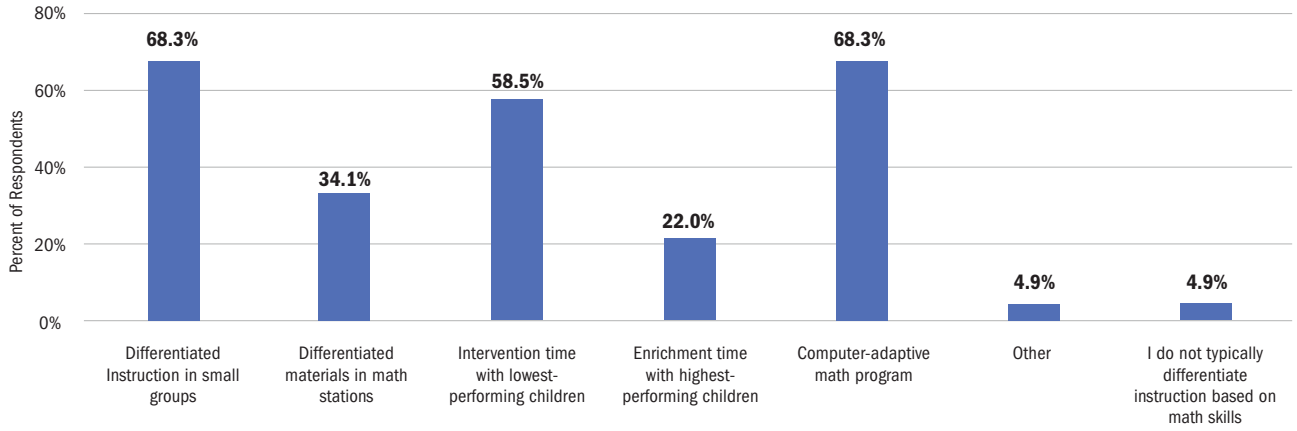
Because so many teachers use small group instruction to differentiate, we were interested in how often they use small groups and how they form them. We asked teachers about the types of groupings they used for mathematics, and how many times per week they used them. The most frequent instructional format was whole-group instruction, used five days per week by 87.8% of teachers. Use of small-group instruction varied across teachers. See Figure 4, p. 7. A plurality of teachers (43.9%) broke into small groups five days per week, but 19.5% reported never using small-group instruction in a typical week. The remaining teachers were distributed across one to four days.

We also asked teachers how they create small groups. Most teachers reported grouping students by skill levels, but many also used other approaches, including making mixed-skill-level groupings (34.1%) and groups based on classroom-management needs (9.8%). See Figure 5, p. 7.

Finally, we looked at what our classroom observations could tell us about differentiation. For the observations, trained observers coded each focal student for two minutes at a time, rotating through all four children multiple times during each classroom's math block. The results presented here include averages across multiple children who each received one to six days of observation.

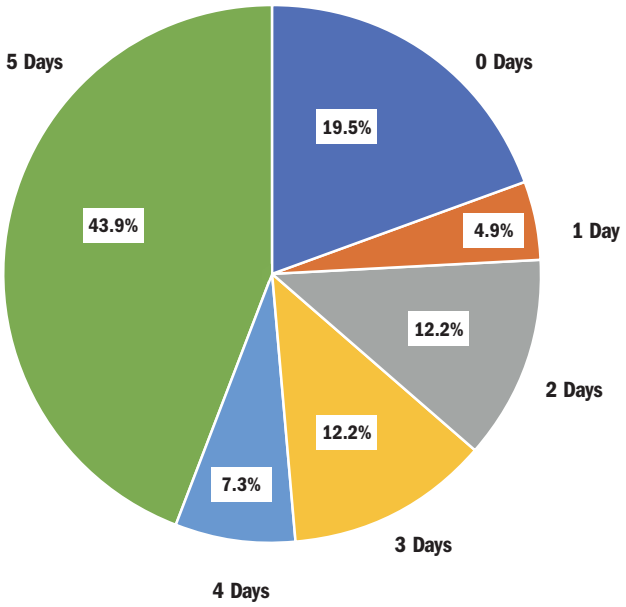
Our focal students, on average, spent 40.7% of their time in teacher-led whole group and 9.3% in small groups. After whole group instruction, the most common activity format was individual work, not led by a teacher (26.4%).

Figure 3: Strategies used to differentiate instruction



Most teachers differentiated instruction using small groups and computer-adaptive math programs.

Figure 4: Days per week of small group instruction

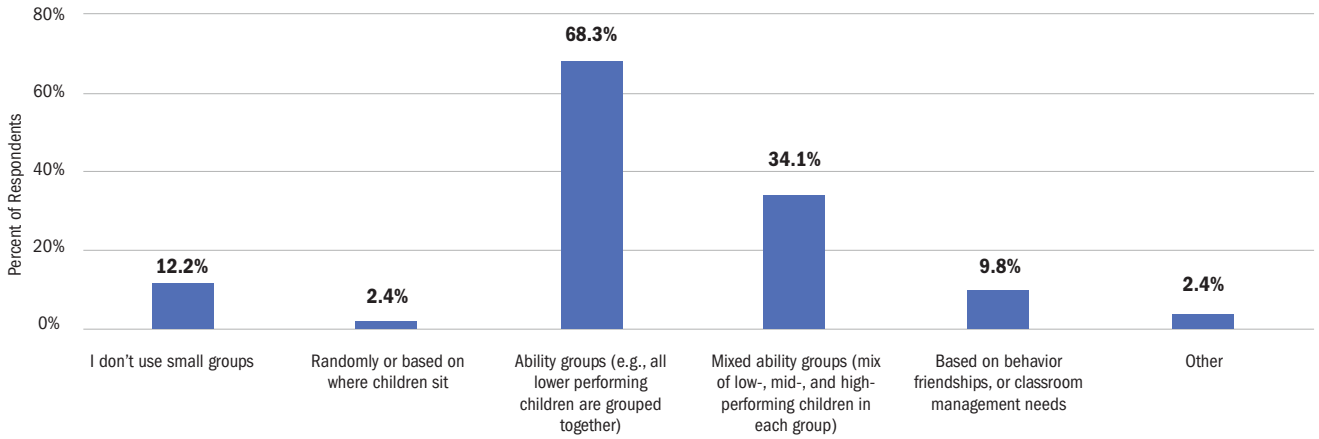


Most teachers use small groups at least four or five times per week.

Children averaged about 23.8% (*SD* = 14.4) of observations using a screen[1], either in whole group, small group, or individual work time. Children often had hands-on materials and manipulatives to use during math block, averaging 26.1% (*SD* = 15.4) of observations. Teachers provided children with specific math scaffolds, including 10-frames, 100s charts and number bonds in about 13.6% of each student's observations (*SD* = 12.4).

To check for evidence of differentiation, we examined whether students' teacher-rated math skills in the fall were correlated with the classroom activities we observed; in other words, did different children receive different classroom experiences based on their fall math skills? Results showed preliminary evidence that teachers differentiated their instruction by providing more direct support to children with lower mathematics skills. Specifically, higher fall math skills were correlated with students spending less time in teacher-led activities ($r = -.210$, $p = .029$) and more time in student-led formats ($r = .262$, $p = .006$), including small group activities without a teacher present and individual work. This means that students with lower math scores spent more time in teacher-led activities and less time on independent or student-led work. These associations are small, and we will need to confirm them with additional data from the 2023-24 school year. However, they suggest that teachers were spending more time working with children with lower initial math scores. This finding is aligned with evidence from the teacher survey and from our qualitative research.

Figure 5: Approaches to creating small groups



Most teachers create groups based on students' ability.

[1]Screen time was not coded when teachers were using the smartboard or a projector to write or display work; it was only coded when students were watching a video, playing a game, etc. on a screen.

Summary and Conclusions

The kindergarten teachers participating in this study value and use assessment data and differentiate mathematics instruction on the basis of students' skills. Teachers assess students' skills very frequently, using formal, state- and division-mandated assessments several times a year and informal assessments more frequently. Most teachers saw value in all types of assessments, although they saw the most value in their own observations of students during class.

The majority of teachers reported having monthly (or more frequent) meetings to discuss mathematics instruction with colleagues. Teachers expressed confidence in their data use skills, but reported possibly needing more support through professional development on data use.

Teachers used small group instruction and computer-adaptive math programs to differentiate instruction, and spent extra time with their lowest-performing students.

It is early to draw conclusions or make recommendations from this data. However, math specialists and principals may consider asking teachers whether they need more professional development on data use for instructional decision-making.

We are continuing to collect data across several Virginia school divisions this school year. We look forward to providing a more comprehensive report that addresses our main research question – whether greater differentiation is associated with greater math gains among students – when that data collection is complete.♦

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THANK YOU to the teachers, principals, and students who participated in this research!

We are so grateful for your time and effort.