Analysis of Middle School Math Systems (AMS) Interim Report

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Executive Summary

The Bill & Melinda Gates Foundation created a set of investments, the Coherent Instructional Systems portfolio, that envisions broad availability of evidence-based product design principles and market information. Together these investments are intended to help entities involved in both supply and demand develop and select the best possible solutions for students who are Black, Latino, multilingual learners, or experiencing poverty. This portfolio is grounded in the belief that these priority students will succeed in coherent instructional systems that are built on effectively implemented evidence-based solutions. Paramount to the foundation's vision is understanding and defining dimensions of quality that make individual solutions effective and translating them into information about the key drivers of curricular efficacy. In particular, the education field does not know enough about how teachers use, transform, and ultimately deliver curriculum to students. The field would also benefit from advancing its understanding of how the characteristics of standards-aligned materials relate to implementation quality and student outcomes.

The Analysis of Middle School Math Systems (AMS) study aims to assess (1) the characteristics of curricula rated "green" by EdReports as compared to "non-green" curricula (including one curriculum not rated by EdReports; see text box), (2) the contribution and characteristics of professional learning (PL) to support teachers in delivering curricula, and (3) how and why curricula transform in teachers' hands. Ultimately, the study aims to understand both the enabling and disabling conditions under which teachers can or cannot implement high-quality math curricula as well as the conditions under which students can or cannot thrive. A core goal is to investigate whether certain investments or practices can improve conditions for teaching and learning and thereby make middle school math experiences more enjoyable and productive for priority students. The study is organized around five broad inquiry areas (see text box).

Middle School Math Curricula in the Study

Green-rated curricula

- Illustrative Math
- Into Math
- Eureka Math

Non-green- or not-rated curricula

- CA Math (Glencoe)
- Big Ideas
- Key Elements of Mathematics Success (KEMS)

Study inquiry areas

- Curricular efficacy
- Curriculum characteristics that influence instructional enactment
- Characteristics of professional learning that supports teacher needs and effective instructional enactment
- Adaptations in instructional enactment

The AMS study team has partnered with four districts to conduct the study. This report presents preliminary findings from data collected during the first year of data collection, school year (SY) 2021–2022—principally from teacher and student surveys. Ratings that characterize the grade 6 materials from the six middle school math curricula in the study serve as an additional data source for the report.

Key implications, supported by the study's initial findings, include:

Curriculum is an important lever in middle school math instructional delivery. While curricula inevitably transform once in the hands of teachers, our findings make clear that the curriculum itself plays an important role in influencing what does—and does not—get taught in the classroom.

There are differences between curricula, but measures used to assess aspects of their quality differ. Curricula differ in topic coverage, cognitive demand of student tasks, and attention to culturally responsive teaching approaches. How we assess the quality of curricula depends on what measures are used, but such measures don't report consistent information. For example, while both the Surveys of Enacted Curriculum (SEC) and EdReports assess a curriculum's alignment with the Common Core State Standards (CCSS), the reports differ in their assessment of the extent of topic coverage or cognitive demand of student tasks. Further, neither the SEC nor EdReports include measures of a curriculum's cultural responsiveness. Differences between curricula include:

- On average, green curricula are more aligned with the CCSS than non-green curricula. Among the green curricula, Eureka Math is the most aligned with state standards. Two of the green curricula—Illustrative Math and Eureka Math—are more cognitively demanding than the non-green curricula.
- On average, green curricula place more emphasis on measurement, geometric concepts, and data displays, while non-green curricula place more emphasis on number sense and operations. However, both green and non-green curricula are less cognitively demanding than the CCSS recommends.
- Teachers using green curricula are significantly more likely to believe that their curricula are too cognitively demanding for their students and that they have insufficient time to reasonably cover curriculum content during the school year.

Curriculum developers need to focus on supporting culturally responsive math teaching practices. The six study curricula promote culturally responsive teaching practices to a very limited extent. If this is a priority for the field, our analysis strongly suggests that this is an area where curriculum developers need to focus. We found that:

- None of the study curricula meet the Culturally Responsive Math Teaching (CRMT) tool's standards for cultural responsiveness. Green curricula score slightly higher than non-green curricula, with the exception of the green Eureka Math curriculum, which scores the lowest of all six study curricula.
- Teachers using non-green curricula are significantly more likely to adapt their instructional materials to make them more culturally responsive or more appropriate for multilingual learners.

As an important lever in instructional delivery, PL falls short of meeting teachers' needs. PL often focuses on core areas of importance, and teachers seem to recognize its value. Many indicators, however, suggest PL supports could do much more to help teachers translate curricula effectively, meet their own aspirations in delivering culturally responsive instruction, and provide greater individual differentiation. We found that:

- Teachers are most likely to receive PL that focuses on culturally responsive practices and analyzing student work or assessment data.
- Teachers are most likely to perceive PL activities as valuable to their math instruction; their understanding of how students learn math; their responsiveness to students' backgrounds, cultures, and points of view; their mindset and biases about students and setting higher expectations for all students; and strategies that improve their math instruction.
- However, on average across all areas of PL, teachers feel that their supports positively impact their math instruction (including improving their strategies to respect students' cultural backgrounds) only to a limited extent, suggesting ample room for a better impact.
- Less than half of teachers feel that their PL is aligned with feedback from observations of their teaching or connected to their daily lessons.

Many teachers are making adaptations in their instructional delivery, but it is unclear whether or not these adaptations are productive. We found that:

- The majority of teachers report that they make productive adaptations to their curricula, including modifying lessons to ensure a more equitable experience for their students. This includes differentiating instruction not only for students performing below grade level and multilingual learners, but also for students performing above grade level.
- Most teachers report adapting lessons at least a few times a week. Teachers who adapt their curriculum frequently are significantly more likely than infrequent adapters to change the way content is delivered or change the sequence in which it is delivered.
- Among teachers who frequently adapt their curriculum, most also say that they adapt by *removing* content or materials, which could potentially compromise rigor.
- Only a small percentage of the teachers who modify their curriculum to promote culturally responsive mathematics teaching also report employing strategies that explicitly leverage students' cultural and community funds of knowledge.

Our findings suggest the *potential* for the intended curriculum and PL supports to support effective instruction but also *shortcomings* that invite adaptation. Shortcomings that induce adaptations generate more variability in instructional quality. Adaptations also demand more teacher time—a resource in critically short supply. Unless the adaptations are productive, they risk undermining critical goals around student equity, identity, enjoyment, perseverance, growth mindset, and self-efficacy.

We acknowledge this study has important limitations that impact the interpretation of findings. The analyses present a useful starting point for describing the relationships between curriculum, PL, and instructional practice. However, the study design does not allow us to control for important confounding variables such as teacher experience, school demographics, and district characteristics. We will explore more sophisticated analytic techniques in future work.

I. Introduction

The Analysis of Middle School Math Systems (AMS) study aims to assess (1) the characteristics of curricula rated "green" by EdReports as compared to "non-green"-rated curricula, (2) the contribution and characteristics of professional learning (PL) to support teachers in delivering curricula, and (3) how and why curricula transform in teachers' hands. Ultimately, the study aims to understand both the enabling and disabling conditions under which teachers can or cannot implement high-quality math curricula as well as the conditions under which students can or cannot thrive. Examples of enabling conditions are ongoing and embedded instructional coaching and a culture of collegiality and collaboration among teachers. Examples of disabling conditions include a culture of low expectations for students and COVID-19-related school closures.

We are particularly interested in exploring how instructional contexts affect the math classroom experiences of middle school students who are Black, Latino, multilingual learners, or experiencing poverty. Race, ethnicity, and poverty are among the most significant predictors of taking rigorous math courses (Sciarra 2010). Students' mathematical beliefs are also a predictor of math performance. Students who do not believe they can perform well tend to perform at lower levels than students who believe they can excel in math (for example, Chen 2003; Cleary and Chen 2009; Mason and Scrivani 2004; Schommer-Aikins et al. 2005). Moreover, students who are Black, Latino, multilingual learners, or experiencing poverty often disengage from school and, with math in particular, during the middle school years in ways that have long-term implications for their academic and economic success (Balfanz and Byrnes 2006). A core goal here is to investigate whether certain investments or practices can improve the conditions for teaching and learning and thereby make middle school math experiences more enjoyable and productive for these priority students.

The study is guided by a theory of action and a set of hypotheses about how curricula, PL, and instruction interact to affect students' math experiences (Exhibit I.1), based on the research literature.

Exhibit I.1. Hypotheses guiding AMS study research questions

IF	THEN
Teachers use high-quality math curricula that are embedded in coherent instructional contexts, and if	Teachers will plan curricula that align with standards, are cognitively demanding, are culturally responsive, and support students' math language development and language diversity
Teachers receive high-quality PL support that aligns with intended curricula and develops their mathematical knowledge for teaching and culturally responsive math teaching	Teachers will enact curricula with integrity and make productive adaptations Teachers' beliefs and instructional capacity will improve, and then Students who are Black, Latino, multilingual learners, or experiencing poverty will have a better classroom experience in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset

The study's research questions are organized into five broad inquiry areas:

- **Inquiry area 1 (curricular efficacy).** To what extent do each of the six curricula engage priority students in meaningful math learning (as measured by local and state assessments)? Produce other equitable student outcomes (such as math identity and beliefs)? How does curricular efficacy relate to characteristics of the curricula and their instructional delivery and context?

- **Inquiry area 2 (curriculum characteristics that influence instructional enactment).** How does each curriculum support or challenge culturally responsive math teaching? Provide opportunities for students to demonstrate math competence in holistic[1] ways? What curriculum characteristics support or hinder high-quality instructional delivery? What curriculum characteristics are drivers of and barriers to equitable use of the content?
- **Inquiry area 3 (characteristics of PL that supports teacher needs and effective instructional enactment).** What PL supports help teachers productively adapt and enact culturally responsive and ambitious pedagogies within the context of the curriculum? How should PL supports vary to address different teacher needs and classroom contexts?
- **Inquiry area 4 (adaptations in instructional enactment).** How and to what extent do math teachers' adaptations of curricula promote culturally responsive math instruction? How and to what extent do math teachers' adaptations of curricula promote equitable engagement and minimize status issues in the classroom? How and to what extent do math teachers' adaptations of curricula connect to students' multiple mathematical knowledge bases?
- **Inquiry area 5 (what influences planned and unplanned adaptations in instructional enactment).** How are planned and unplanned adaptations influenced by the alignment between PL supports and the curriculum? By teacher knowledge, background, and beliefs? By the social contexts among students and between teachers and students? What knowledge, skills, beliefs, and dispositions do math teachers possess in those classrooms where students have positive experiences?

This report presents preliminary findings from data collected during the first year of data collection, school year (SY) 2021–2022, principally from teacher and student surveys. As further context for this report, it is important to note that during SY 2021–2022, our sample of districts and schools continued to feel a number of challenges from the COVID-19 pandemic which affected how they approached instruction and their engagement with PL. Teachers reported that an increase in student absences created more instructional challenges (81 percent), they had to focus more time on meeting students' non-academic needs than usual (77 percent), they have struggled more to cover material in the expected time frame (66 percent), and they experienced more classroom management issues (67 percent). Teachers also reported they had fewer PL opportunities (40 percent) and less availability for PL (35 percent).[2] Given that our focus is on instructional practice in the context of PL supports, these pandemic-related challenges created some conditions that are important to keep in mind throughout our analyses.

This report is the first in a sequence of "findings" reports, with plans for later reports incorporating additional analyses that include the efficacy analysis of administrative records data in District 1 and analyses of the rich qualitative data also collected in this first year. Following the second (and final) year of data collection (SY 2022–2023), we will then produce another round of findings reports. In the sections that follow, we discuss the sample, data sources, and methods for our analyses, present our preliminary results by the selected inquiry areas (above) that we investigate, and the implications from this first round of analysis along with next steps.

[1] Consistent with our study's theory of action, "holistic" refers to culturally responsive and equitable opportunities that (1) engage students in authentic, real-world inquiry; (2) allow them to express multiple ways of knowing and doing math; (3) engage students in rigorous mathematical discourse; (4) provide appropriate academic literacy support and scaffolding for multilingual learners; (5) leverage students' funds of knowledge for individual and collective learning; (6) draw connections between math and other content areas; (7) allow students to pose questions about societal challenges of importance to them; or (8) increase or develop their growth mindset, math identity, persistence, enjoyment, self-efficacy, and engagement.

[2] These figures come from the Spring 2022 Teacher Survey, question 29. The percentages are calculated from among those who responded to this question and do not include non-responders.

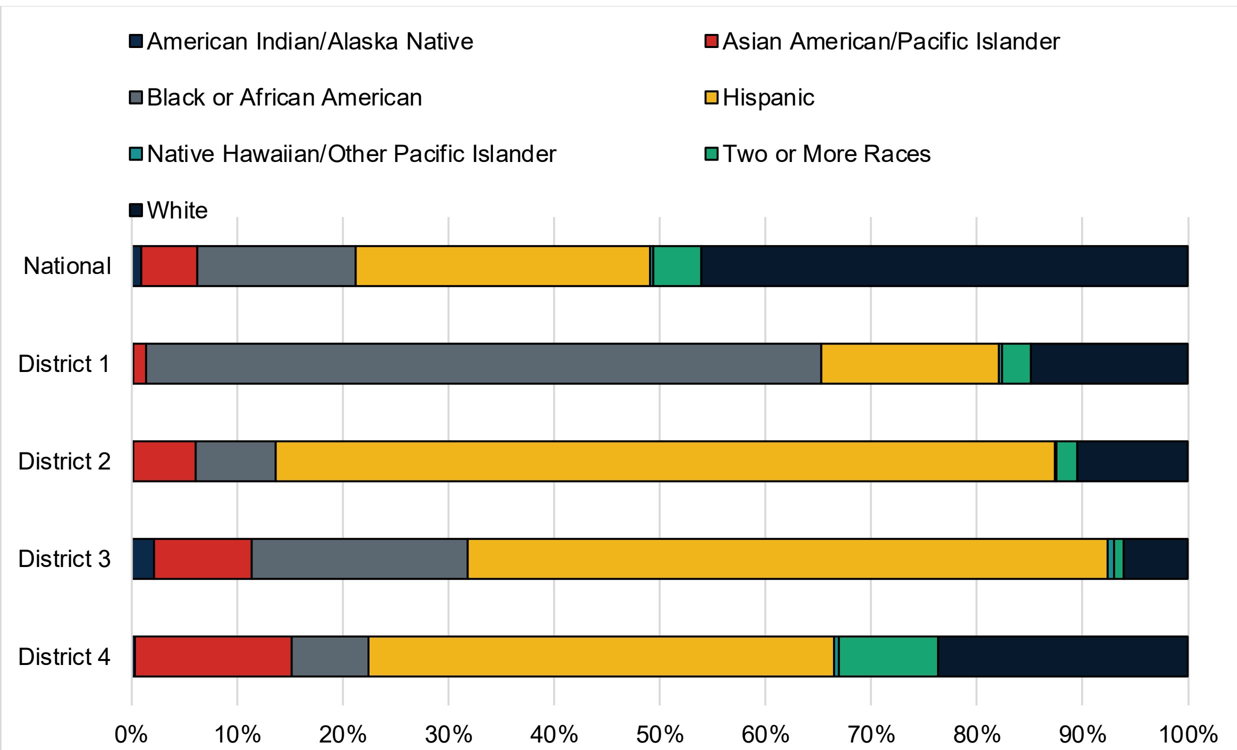
II. Interim Report Sample, Data Sources, and Methods

A. District sample

The AMS study team partnered with four districts to conduct the study. These districts bring their own policy, demographic, and instructional contexts, and are in a range of stages in formulating and implementing a vision for middle school math. As districts among the largest in the nation, they experience challenges common in education across the United States, not least of which is how to support students in engaging with and making progress in math, particularly during the critical middle school years.

Though our study is being conducted in a small set of middle schools in each of these districts, we provide contextual information on each district in figures that follow to provide broad context. As Exhibits II.1–II.4 show, there are both similarities and differences across the districts. For example, District 1 has a much larger percentage of Black students and more students scoring below the state's proficiency level than other districts; District 4 has a higher percentage of students who exceed the national average proficiency level in grades 6 and 7 and has many fewer new teachers than the other districts; and Districts 2 and 3 have many more students who are eligible for free and reduced-price lunch.

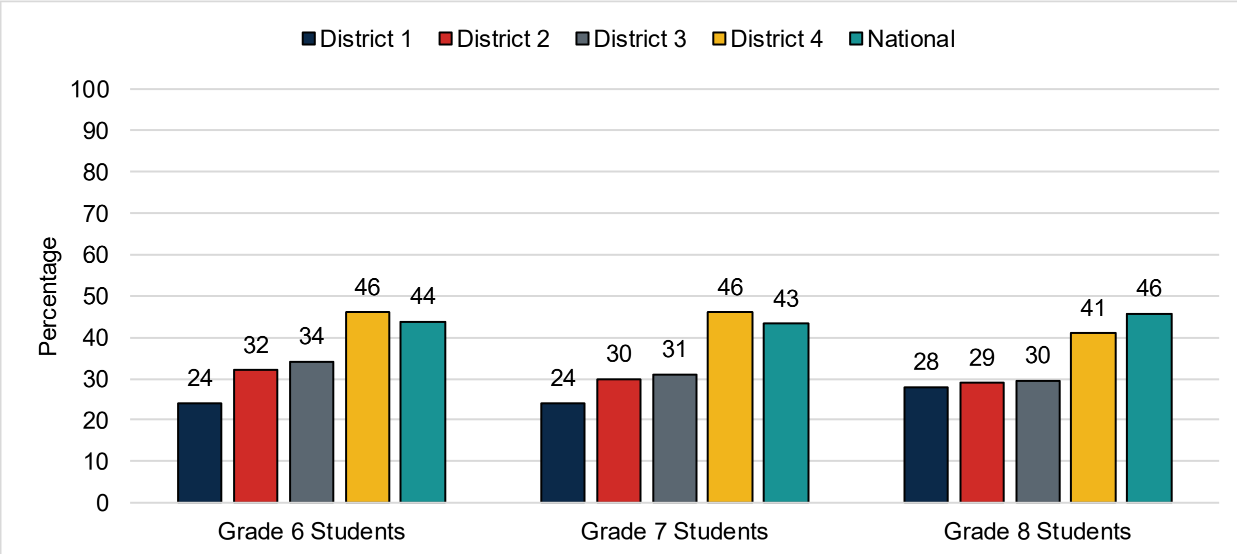
Exhibit II.1. Race and ethnicity of students in the AMS study districts



Source: SY 2020–2021 Common Core of Data.

Note: The percentages are based on data for all students in Districts 1, 2, and 4 and a subset of students in District 3.

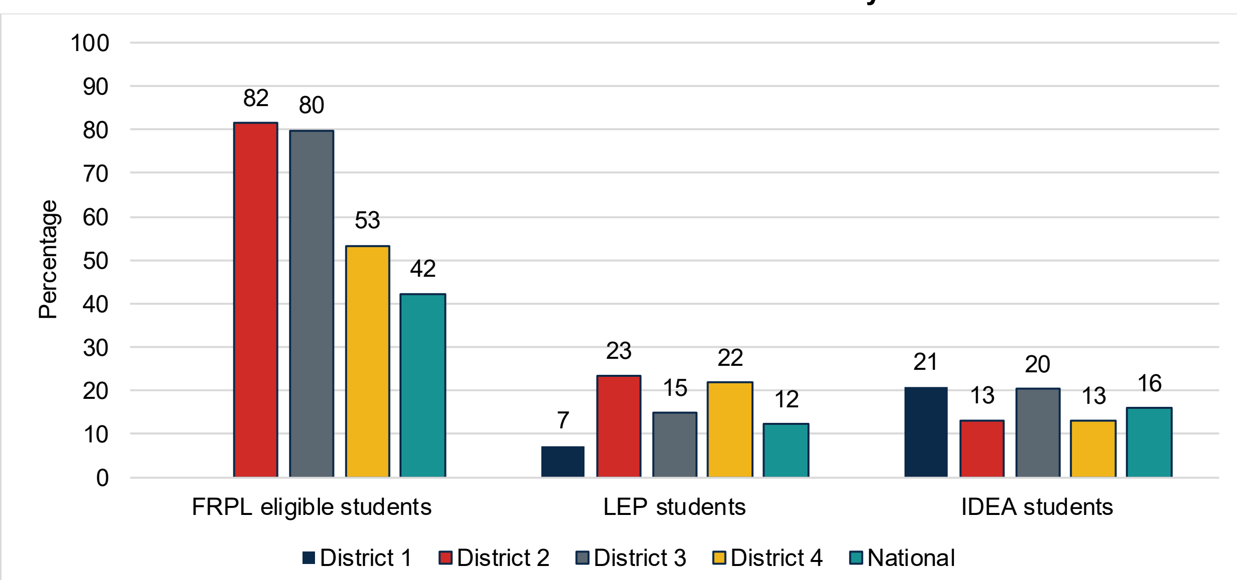
Exhibit II.2. Students in grades 6 to 8 scoring at or above the state's proficiency level in math across the AMS study districts



Source: EDFacts SY 2018–2019 Achievement Results for State Assessments in Mathematics.

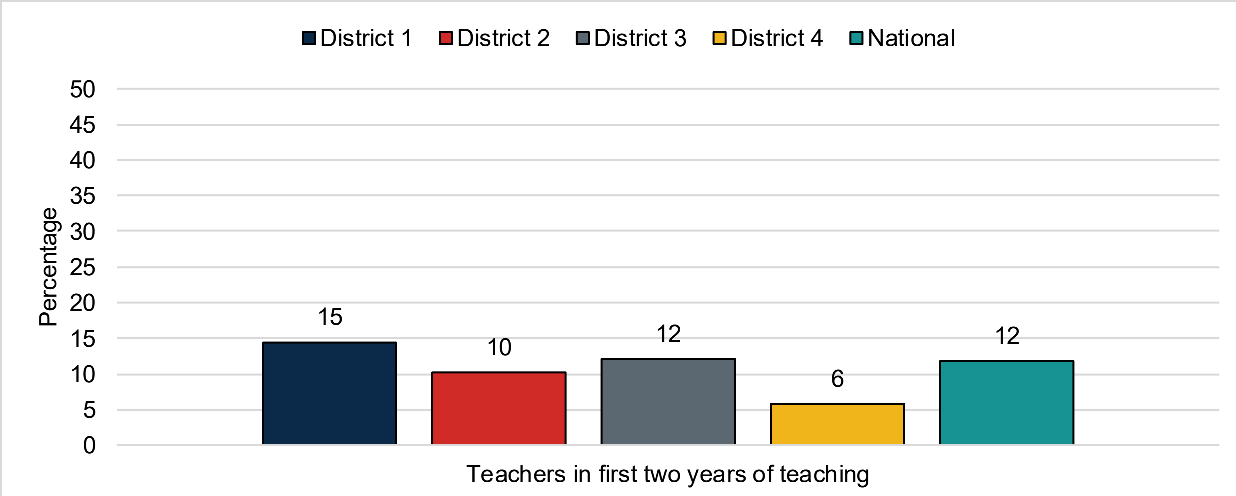
Note: States must report student achievement results on math and reading/language arts state assessments to the U.S. Department of Education. To protect the privacy of students, EDFacts reports the percentages of students who score proficient or above. In calculating these percentages, the denominator is the total number of students who completed the state assessment and were assigned a proficiency level, and the numerator is the number of students who scored proficient or above according to state standards. Standards of proficiency performance vary by state.

Exhibit II.3. Students eligible for free- and reduced-price lunch and limited English proficiency and Individuals with Disabilities Education Act services in the AMS study districts



Source: Data on free- and reduced-price lunch (FRPL) come from SY 2020–2021 Common Core of Data. Data on limited English proficiency and Individuals with Disabilities Education Act services come from SY 2016–2017 Civil Rights Data Collection [Enrollment]. District 1 does not report FRPL data and is thus not included on that variable in this figure.

Exhibit II.4. Teachers in their first two years of teaching in the AMS study districts



Source: SY 2016–2017 Civil Rights Data Collection [School Support].

B. Data sources and methods

Data sources for this report include (1) ratings that characterize the grade 6 materials from the six middle school math curricula that we are studying and (2) teacher and student surveys. This section describes these data sources and the methods used to analyze them.

1. Math curricula ratings

The study team, in partnership with the foundation, chose six middle school math curricula for the study: three curricula that were rated "green" by EdReports—Illustrative Math (IM), Into Math, and Eureka Math—two curricula that were rated other than green—CA Math (Glencoe) and Big Ideas—and one curriculum that was not included in ratings conducted by EdReports—Key Elements of Mathematics Success (KEMS). To be rated "green" EdReports determines that instructional materials align with learning standards, facilitate student learning, and enhance a teacher's ability to differentiate and build knowledge within the classroom. Our analyses of these green and non-green curricula use data we collected from two sources, both focused on the grade 6 materials in these curricula. The first source is a set of scores that assessed the extent to which each curriculum aligns with Common Core learning standards and student performance expectations. The second source is a set of scores that evaluated the cultural responsiveness of each curriculum.

Standards alignment. To understand whether, how, and what features of the study curricula support or challenge high-quality instructional delivery, a team of math education experts with the Center for Curriculum Analysis (CCA) scored the study curricula using the Surveys of Enacted Curriculum (SEC) analysis tool. The tool assesses each curriculum's emphasis on content coverage and the cognitive demand of student performance expectations. For content coverage, the SEC measures the curriculum's emphasis on different mathematical topics (such as probability, basic algebra, and operations). For cognitive demand, the SEC categorizes the cognitive demand of student performance expectations specified in a curriculum along five dimensions: (1) memorize or recall, (2) perform procedures, (3) demonstrate understanding, (4) conjecture, generalize, or prove, and (5) solve nonroutine problems or making connections. CCA then compares these findings to the topics and cognitive demands of the

Common Core State Standards (CCSS) for grade 6 math as a reference point for our analysis.[3] Appendix A provides a more detailed description of the SEC tool, our analysis, and more detailed scoring results than what we present in our findings later in this report.

Cultural responsiveness. To understand whether and how the study curricula facilitate culturally responsive instruction and create opportunities for students to demonstrate their learning in holistic ways, we used an adaptation of the Culturally Responsive Mathematics Teaching (CRMT) Lesson Analysis Tool (Aguirre and del Rosario Zavala 2013).[4] This adapted tool covers seven core constructs:

1. **Cultural and community funds of knowledge (CFoK),** which is how the lesson helps students connect math with relevant and authentic issues or situations in their lives
2. **(Re)humanizing,** which is how the lesson supports creativity, broadens what counts as mathematical knowledge, and affirms positive mathematical identities for all students
3. **Maintaining rigor,** which is how the lesson maintains high rigor with high support for all students
4. **Affirming multilingualism,** which is how the lesson positions multilingual learners as competent learners in math activities
5. **Distributing intellectual authority (IA),** which is how the lesson distributes math authority and makes space for multiple forms of knowledge and communication
6. **Disrupting status and power**, which is how the lesson disrupts status differences, entrenched stereotypes, and inequitable power relationships present in all math classrooms
7. **Analyzing and taking action,** which is how the lesson supports students' use of math to analyze, critique, and address power relationships and injustice in their lives (economic, social, environmental, legal, political, patriarchal)

We used this rubric to code nine lessons within one unit in each curriculum. We chose a unit with common occurrence across the six curricula, covering expressions, equations, or inequalities. We selected three lessons from the beginning of the unit, three lessons from the middle of the unit, and the last three lessons of the unit (excluding test days).[5]

2. Teacher and student surveys

To create the sample of schools for study participation (and data collection activities), the team worked with each of the four participating districts to identify and recruit a set of schools with grades 6–8 that were using the curricula of interest and were willing to participate. This resulted in 10 participating schools in District 1, six schools in District 2, eight schools in District 3, and 15 schools in District 4.

Within these schools, to identify the classrooms, teachers, and students for participation in our surveys, we then obtained a list of all middle school math classrooms from each study school. For each classroom, we received information such as grade (6, 7, or 8), teacher name, class level (for example, below grade level, general education, advanced), and number of students. We excluded classrooms designated as below grade level or advanced, as well as classrooms with fewer than 12 students. Among the remaining

[3] The CCA uses the CCSS for the respective state in which each curriculum is implemented.
[4] The tool was adapted because the original tool was designed to be used in dialogue with teachers rather than as a means of quantitatively scoring materials. We used the tool's original constructs, though dropped several that had a high degree of overlap with constructs captured in the SEC.
[5] Because KEMS is designed for 80- to 90-minute lessons, we coded six lessons in order to code an equivalent amount of content to the other curricula.

classrooms, all math teachers were asked to complete a survey. We randomly selected one classroom per grade per school, for a total of three classrooms per school, from which we collected student surveys.[6]

To understand teachers' and students' experiences with math classrooms, we administered surveys to both teachers and students in the fall and spring of SY 2021–2022. We administered the teacher survey to 207 teachers in the four districts. We had a 61 percent response rate to the fall survey and a 42 percent response rate to the spring survey (see Exhibit II.5). The fall teacher survey collected information on the teachers' teaching background and experience, perceptions, use of the math curriculum, and teaching practices. The spring teacher survey collected information about use of the math curriculum and teachers' experiences with PL. Each survey was administered via a web-based platform and took approximately 30 minutes to complete.[7]

We administered the fall student survey to 1,908 students in Districts 1 and 4 and the spring student survey to 2,941 students in all four districts. The study team did not administer fall student surveys in Districts 2 and 3. District 3 schools were delayed until January 2022 in providing the student roster information needed to select the student sample. This would have meant administering the "fall" survey in February and March 2022 and then administering the spring survey in April 2022, which we felt would create too big of a burden on schools. As a condition of its continued participation, District 2 would not allow the study team to conduct student surveys in the fall because the district needed to plan and prepare for in-person student learning for SY 2021–2022. We had a 70 percent response rate to the fall survey and a 50 percent response rate to the spring survey (Exhibit II.5).

Exhibit II.5. Samples, completions, and response rates for fall and spring teacher and student surveys

	District 1			District 2			District 3			District 4			Total		
	Eligible sample	Completes	Response rate	Eligible sample	Completes	Response rate	Eligible sample	Completes	Response rate	Eligible sample	Completes	Response rate	Eligible sample	Completes	Response rate
Fall student survey	731	501	69%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,177	830	71%	1,908	1,331	70%
Spring student survey	731	306	42%	461	166	36%	522	163	31%	1,227	821	67%	2,941	1,456	50%
Fall teacher survey	21	14	67%	66	30	45%	48	27	56%	72	55	76%	207	126	61%
Spring teacher survey	21	12	57%	66	20	30%	48	15	31%	72	40	56%	207	87	42%

Source: AMS Fall 2021 and Spring 2022 Teacher and Student Surveys.

n.a. = not applicable.

[6] We also selected a set of classrooms for a deeper dive—more in-depth data collection activities such as classroom observations, teacher interviews, and student focus groups. For these more in-depth activities, we sought schools from within our larger sample described above that had demonstrated a willingness to make this additional investment. Our goal was to identify three schools in each of the four districts, and within those three schools to identify one math teacher in each of the three middle school grades. These nine classrooms and teachers per district (or 36 teachers across the four districts) became our "deep dive" sample. The rich data collected in these deep-dive classrooms will be including in subsequent reporting.

[77] The fall teacher survey also included the Math Knowledge for Teaching (MKT) instrument, which covers a sampling of middle school subject matter and pedagogical content knowledge. However, we do not use the MKT data for this reporting.

The student survey included questions related to student beliefs (growth mindset, achievement identity, math persistence, math self-efficacy, and math enjoyment), student engagement, and student interest and persistence in math. Both fall and spring administrations used the same instrument. The student survey took approximately 10 minutes to complete. Schools were offered the option of administering the survey by web or hard copy, with the majority of schools selecting hardcopy.

We analyzed teacher and student surveys using descriptive statistics, calculating frequencies, percentages, and means across all survey items. We disaggregated and explored survey results by gender, race and ethnicity, grade level, district, curriculum used and whether the curriculum used was rated green or non-green. We also disaggregated survey results by three teacher subgroups (Exhibit II.6). For the student surveys, we disaggregated results by gender, race and ethnicity, grade level, district, curriculum, and whether the student was in a school that used a green or non-green curriculum. We conducted t-tests and chi-squared tests to detect significant differences in response patterns between curricula and subgroups. We do not present findings in this report for all of these subgroups, however; we instead present subgroups selectively where we think they provide important additional insight into our research questions.

Exhibit II.6. Teacher subgroup construction

Subgroup	Inquiry area(s)	Subgroup construction
Teachers using ambitious pedagogy	3	Teachers with a mean score of 2 or above on the ambitious instruction scale (question 22b, c, d, f, g, i, j, and l on the spring teacher survey) and a mean score of 2 or above on the frequency of ambitious instruction (question 23a–h on the spring teacher survey). Teachers who rated their practice below this threshold were grouped as “teachers using procedural pedagogy.”
Frequent adapters	3, 4	Teachers who responded 4 or above on spring teacher survey question 24 (indicating that they adapt about half of their lessons or more). Teachers who rated their practice below this threshold were grouped as “infrequent adapters.”
CRMT teachers	3, 4	Teachers with a mean score of 2 or above on the culturally responsive teaching scale (question 27a–g on the spring teacher survey). Teachers who rated their practice below this threshold were grouped as “non-CRMT teachers.”

III. Preliminary Findings by Inquiry Area

We present preliminary findings to address the research questions in inquiry areas 2–4 laid out in the introduction to this report. We do not delve into inquiry area 1 in this report; these findings will be shared in a spring 2023 report. We also do not delve into inquiry area 5 in this report, which is about planned and unplanned instructional adaptations and will require examination of classroom observation and teacher interview data. We will examine inquiry area 5 as part of our December 2022 report. In addition, the research questions in each inquiry area examine complex, nuanced behaviors and, in some cases, the relationships between behaviors, investments, and student outcomes. This report is just the start of the investigation and shares descriptive data that do not yet explore these relationships in more sophisticated ways. Future reports will move in this direction.

For each inquiry area that follows, we note its relationship to our hypotheses, the data sources we draw on for this preliminary exploration, and which subgroups we explore, and briefly summarize our findings before presenting the more detailed analysis.

A. Inquiry area 2: Curriculum characteristics that influence instructional enactment

What curriculum characteristics support or hinder high-quality instructional delivery? How does each curriculum support or challenge culturally responsive math teaching?

IF	THEN
Teachers use high-quality math curricula that are embedded in coherent instructional contexts, and if Teachers receive high-quality PL support that aligns with intended curricula and develops their mathematical knowledge for teaching and culturally responsive math teaching	Teachers will plan curricula that align with standards, are cognitively demanding, are culturally responsive, and support students' math language development and language diversity Teachers will enact curricula with integrity and make productive adaptations Teachers' beliefs and instructional capacity will improve, and then Students who are Black, Latino, multilingual learners, or experiencing poverty will have a better classroom experience in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset

Our study hypothesizes that when teachers use high-quality middle school math curricula—curricula that are *aligned with standards*, *cognitively demanding*, and *culturally responsive*—they will have the tools to implement curriculum with *integrity*, make *productive adaptations*, and, consequently, deliver higher quality math instruction. As a result, students will have a *better classroom experience* in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset. Additionally, we hypothesize that green curricula are higher quality than non-green.

To understand whether the study curricula are *aligned with standards* and *cognitively demanding*, we first compared their SEC ratings. The SEC evaluates the extent to which curricula are aligned with the CCSS in both content coverage and cognitive demand. To understand whether teachers perceive that the study curricula *support or hinder high-quality instructional delivery*, we analyzed teacher survey data to explore whether they believe the curricula are sufficient as designed and, thus, can be enacted with *integrity*; or believe that curricula require substantive adaptation (or modification) to be more *productive* or appropriate for their students' needs. To understand how each curriculum supports or challenges *culturally responsive math teaching*, we compared CRMT curriculum review ratings for each curriculum.

To understand whether the study curricula help teachers provide a *better classroom experience for students*, we analyzed student survey data to determine whether students using green curricula report enjoying math class more than students using non-green curricula. In addition to comparing the study curricula to each other, we compared green curricula to non-green curricula to test the hypothesis that green curricula are higher quality than non-green.

Overall, we found that:

- On average, *green curricula are more aligned* with the CCSS than non-green curricula. Among the green curricula, Eureka Math is the most aligned with state standards.
- Both green and non-green curricula *meet or exceed CCSS content coverage standards*, with the exception of basic algebra and statistics. On average, green curricula place more emphasis on measurement, geometric concepts, and data displays while non-green curricula place more emphasis on number sense and operations.
- Two of the green curricula—Illustrative Math and Eureka Math—are *more cognitively demanding* than the non-green curricula; however, all the study curricula are less cognitively demanding than the CCSS recommends.
- Teachers using green curricula are significantly more likely to believe that their curricula are *too cognitively demanding* for their students and that they have insufficient time to reasonably cover the content during the school year.
- None of the study curricula meet the CRMT tool's standards for *cultural responsiveness*. Green curricula score slightly higher than non-green curricula, with the exception of Eureka Math, which scores the lowest of all six study curricula.
- Teachers using green curricula are significantly less likely to adapt their instructional materials to make them *more culturally responsive* or *more appropriate for multilingual learners*.
- Students in classrooms using green curricula are significantly more likely to report they *enjoy learning new things about math*.

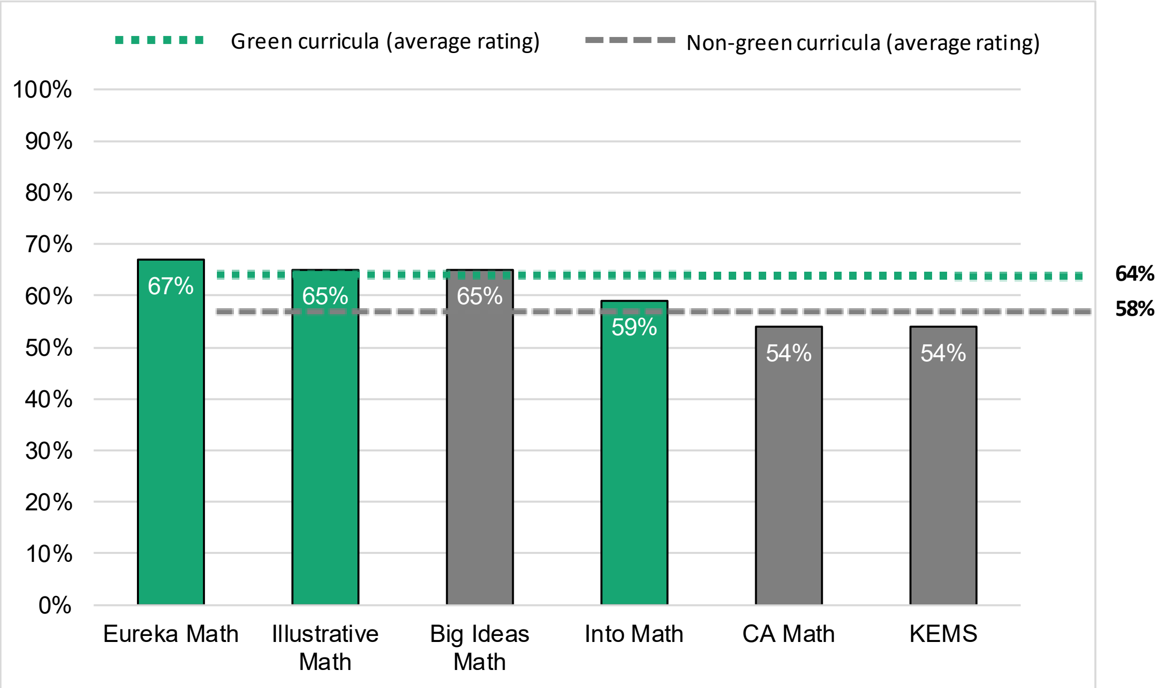
1. On average, green curricula are more aligned with the CCSS than non-green curricula. Eureka Math (green) is the most aligned and KEMS (non-green) is the least aligned of the study curricula.

An analysis of the comparative breadth and depth of each study curriculum (measured by topic coverage and student performance expectations) relative to the CCSS indicated that, on average, green curricula align with the CCSS more than non-green curricula (green = 64 percent of content and performance expectations align with the CCSS; non-green = 58 percent of content and performance expectations align). When disaggregated by curriculum (Exhibit III.1), Eureka Math (67 percent of content and performance expectations) is most aligned and KEMS is least aligned (54 percent of content and performance expectations).

The SEC rates curriculum on:

1. **Topic coverage**: How the content covered within math domains (such as number sense, operations, measurement) differs from CCSS
2. **Student performance expectations**: The proportion of instructional tasks outlined by a curriculum that are low cognitive (memorization or recall, procedural) and high cognitive (demonstrating understanding, conjecture, generalize or proving, and solving non-routine problems or making connections) compared to CCSS

Exhibit III.1. SEC analysis of the percentage of study curricula content and student performance expectations that align with the CCSS for grade 6



Source: SEC ratings of the six study curricula.

Note: Green curricula are denoted by green bars and non-green curricula are denoted by grey bars.

2. Most of the study curricula meet or exceed grade 6 content coverage standards with the exception of two topic areas: basic algebra and statistics.

As illustrated in Exhibit III.2, most of the study curricula meet or exceed the grade 6 content coverage standards for each SEC topic area, except for basic algebra and statistics. The topic focus of California Math (non-green curricula) is the least aligned of the study curricula. It places less emphasis on measurement, basic algebra, geometric concepts, and statistics than state standards do. Eureka (green), KEMS (non-green), and Big Ideas (non-green) are the most aligned with the coverage standards. They each place more or similar emphasis on number sense, operations, measurement, geometric concepts, data displays, probability, and special topics compared to the CCSS.

Exhibit III.2. Study curricula alignment with the CCSS for grade 6, by SEC topic area

↑	More emphasis than CCSS for grade 6	=	Similar emphasis to CCSS for grade 6	↓	Less emphasis than CCSS for grade 6

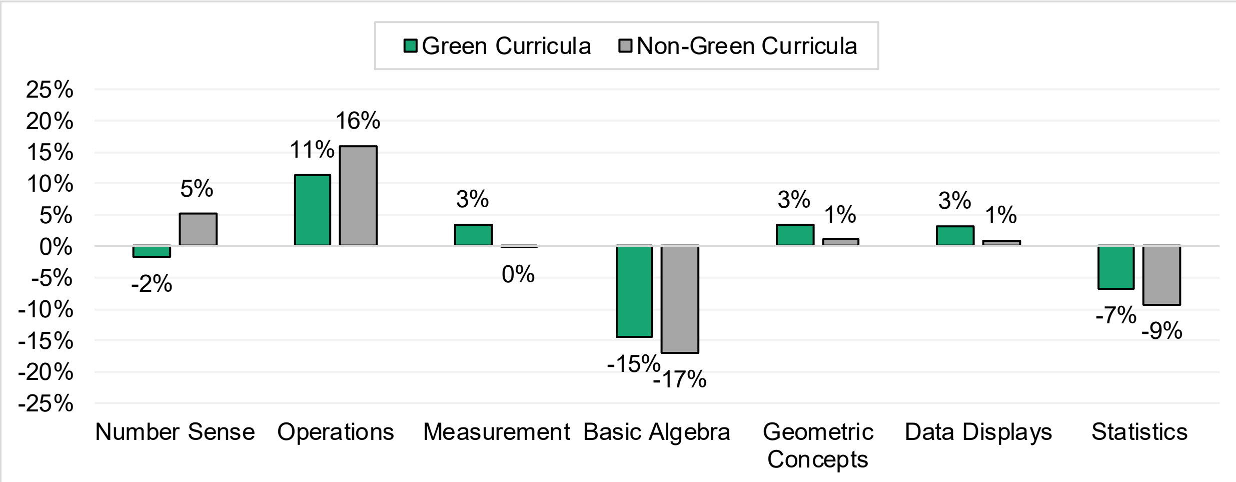
	Green curricula			Non-green curricula		
SEC topic area	Illustrative Math	Eureka	Into Math	KEMS	Big Ideas	CA Math
Number sense	↓	↑	↓	↑	↑	↑
Operations	↑	↑	↑	↑	↑	↑
Measurement	↑	↑	=	↑	=	↓
Basic algebra	↓	↓	↓	↓	↓	↓
Geometric concepts	↑	↑	↑	↑	↑	↓
Data displays	↑	↑	↑	=	↑	=
Statistics	↓	↓	↓	↓	↓	↓
Probability	=	=	↑	↑	=	=
Special topics	=	=	=	↑	=	=

Source: SEC ratings of the six study curricula.

3. On average, green curricula place more emphasis on measurement, geometric concepts, and data displays than non-green curricula.

Exhibit III.3 depicts the percentage point difference between the specific amount of content (rather than just whether there is more or less emphasis) that the green and non-green study curricula cover in each topic area relative to the amount of content the grade 6 standards cover. A zero-percentage point difference indicates that the curricula and the CCSS include a similar emphasis on the topic; a positive difference quantifies how much more emphasis the curricula include than the CCSS; and a negative difference quantifies how much less emphasis the curricula include than the CCSS. On average, green curricula place more emphasis on measurement (green = 3 percent; non-green = 0 percent), geometric concepts (green = 3 percent; non-green = 1 percent), and data displays (green = 3 percent; non-green = 1 percent) than non-green curricula. Non-green curricula place more emphasis on number sense and operations than green curricula. Overall, both green (11 percent) and non-green (16 percent) curricula place considerably *more* emphasis on operations than state standards and *less* emphasis on basic algebra (green = -15 percent; non-green = -17 percent) and statistics (green = -7 percent; non-green = -9 percent).

Exhibit III.3. Percentage point difference between the topic focus of the study curricula and the CCSS for grade 6



Source: SEC ratings of the six study curricula.

4. Two of the green curricula—Illustrative Math and Eureka Math—are more cognitively demanding than the non-green curricula; however, neither green nor non-green study curricula meet the level of cognitive demand recommended by state standards.

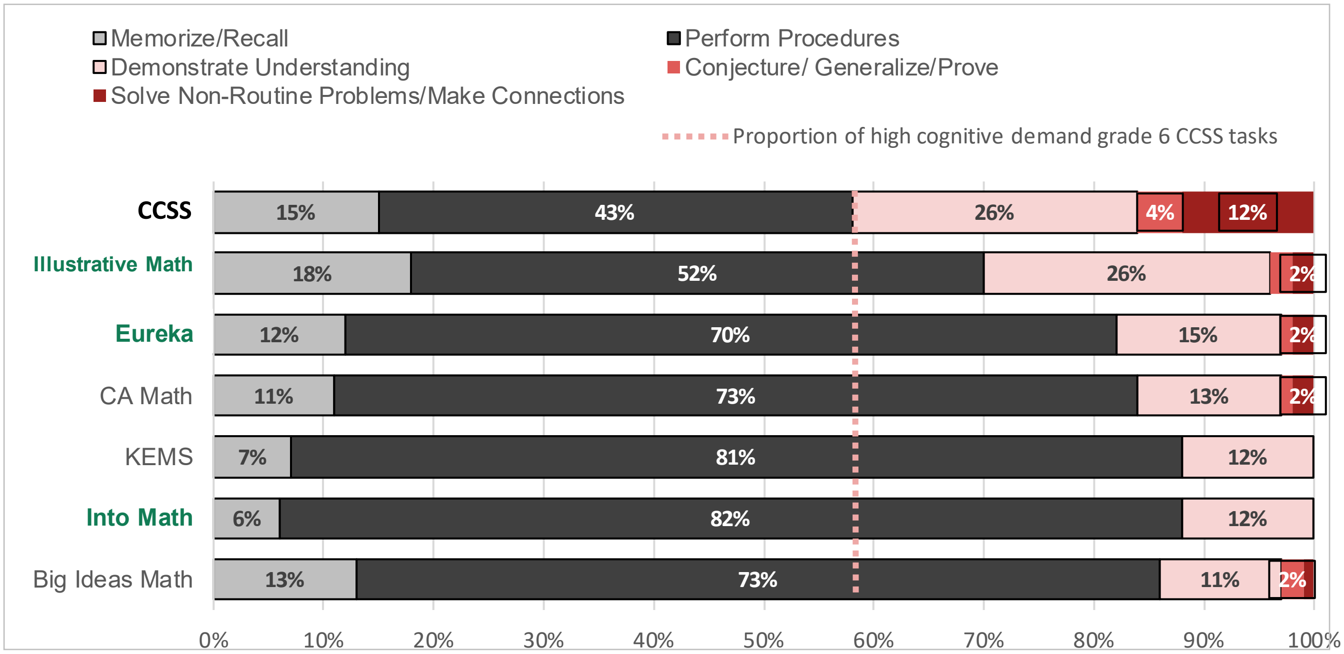
The SEC classifies the student performance expectations (or cognitive demand) of instructional tasks embedded in each curriculum into five categories:

- Memorization and recall and performing procedures are considered *less cognitively demanding*, with memorization and recall being the least demanding.
- Demonstrating understanding; conjecturing, generalizing, or proving; and solving nonroutine problems and making connections are considered *more cognitively demanding*, with solving nonroutine problems and making connections being the most demanding.

According to the CCSS for grade 6, approximately 42 percent of instructional tasks should be cognitively demanding, with 26 percent of student performance tasks allocated to demonstrating understanding; 4 percent to making conjectures, generalizing, or proving; and 12 percent to solving nonroutine problems and making connections (Exhibit III.4).

Neither green nor non-green curricula meet the level of cognitive demand recommended by the CCSS. Performance expectations beyond "demonstrating understanding" are rare among all study curricula. High expectations—making conjectures and solving nonroutine problems—are entirely absent from Into Math (green) and KEMS (non-green). Only Illustrative Math nears the cognitive demand standards, with 26 percent of performance tasks devoted to demonstrating understanding; 2 percent to making conjectures, generalizing, or proving; and 2 percent to solving nonroutine problems and making connections.

Exhibit III.4. Cognitive demand of study curricula instructional tasks compared to the CCSS for grade 6



Source: SEC ratings of the six study curricula.

5. **Teachers using green curricula are significantly more likely to believe that their curricula are too cognitively demanding for their students and that they have insufficient time to reasonably cover curriculum content during the school year.**

Recognizing that teacher perceptions of and satisfaction with a curriculum influence the degree to which they enact it with integrity (Carroll et al. 2007), we asked participating teachers to rate their primary math curriculum in four areas: normative authority, institutional authority, curriculum specificity, and curriculum consistency (Exhibit III.5).

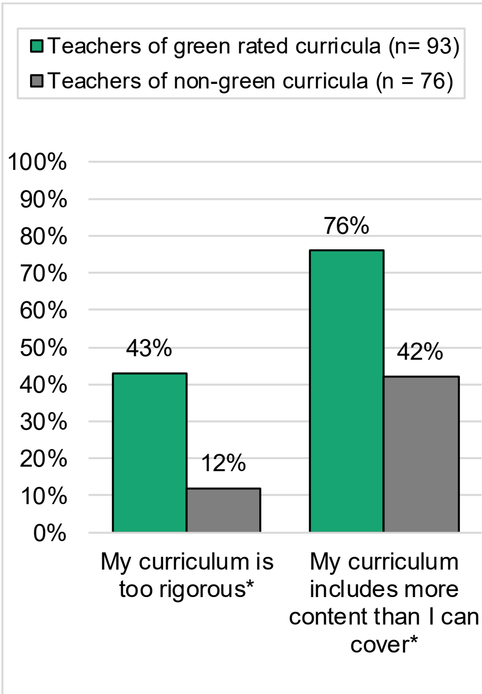
- **Normative authority** is the extent to which teachers perceive a curriculum to be appropriate for their students' learning needs (Edgerton and Desimone 2018). Compared to teachers using non-green curricula, teachers using green curricula are significantly more likely ($p = 0.00$) to perceive their curriculum as:
  - *Too rigorous* for most of their students (43 percent compared to 12 percent of non-green teachers)
  - Containing *more content than can be reasonably covered* in a school year (76 percent compared to 42 percent of non-green teachers); as noted earlier, although SEC ratings indicate that two of the green curricula are more rigorous than the non-green curricula, none of the study curricula (neither green nor non-green) are as rigorous as the CCSS
- **Institutional authority** is the extent to which teachers perceive they have the time, training, and resources needed to implement a curriculum (Edgerton and Desimone 2018). Compared to teachers using non-green curricula, teachers using green curricula are:
  - *No more likely* to believe that they have adequate time, training, and resources to implement their curriculum

  - *Significantly more likely* ($p = 0.00$) to report that their *school* leadership (78 percent compared to 27 percent of non-green teachers) and *district* leadership (80 percent compared to 21 percent of non-green teachers) have made adopting their curriculum a major priority

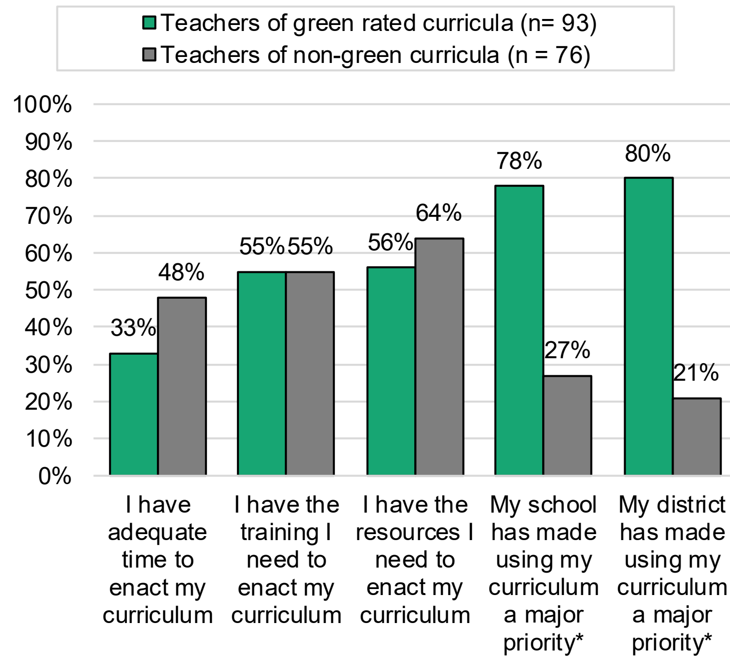
- **Curriculum specificity** refers to the level and clarity of detail a curriculum developer provides teachers on a curriculum's instructional protocols, content, tasks, and assessments to support high-quality enactment (Desimone 2009; Desimone and Garet 2015; Edgerton and Desimone 2018). Compared to teachers using non-green curricula, teachers using green curricula are:
  - *Significantly less likely* to strongly agree or agree that their curriculum *clearly outlines the math content teachers should deliver* (85 percent compared to 98 percent of non-green teachers)
  - *Significantly more likely* to report that math content is *appropriately sequenced* in their curriculum (89 percent compared with 72 percent of non-green teachers)

- **Curriculum consistency** is the extent to which teachers perceive a curriculum is coherent with their district and school's vision for high-quality math instruction, such how well it aligns with state standards and is supported by instructional leaders (Edgerton and Desimone 2018). Compared to teachers using non-green curricula, teachers using green curricula are:
  - *No more likely* to believe that their curriculum aligns with state standards and assessments
  - *Significantly more likely* to believe that their district and school leadership explicitly support or encourage their curriculum

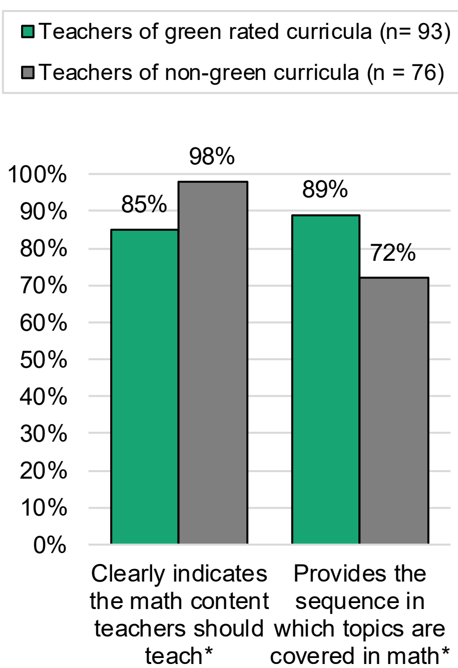
Exhibit III.5. Teachers' perceptions of their curriculum (percentage of teachers who strongly agree or agree)



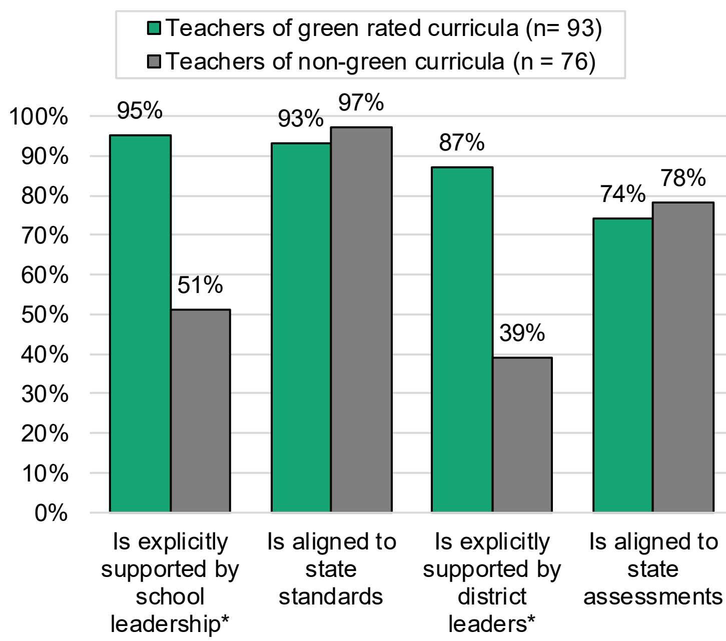
Source: Fall 2021 Teacher Survey; *p=0.00



Source: Spring 2022 Teacher Survey; *p=0.00



Source: Fall 2021 Teacher Survey; *p < .05

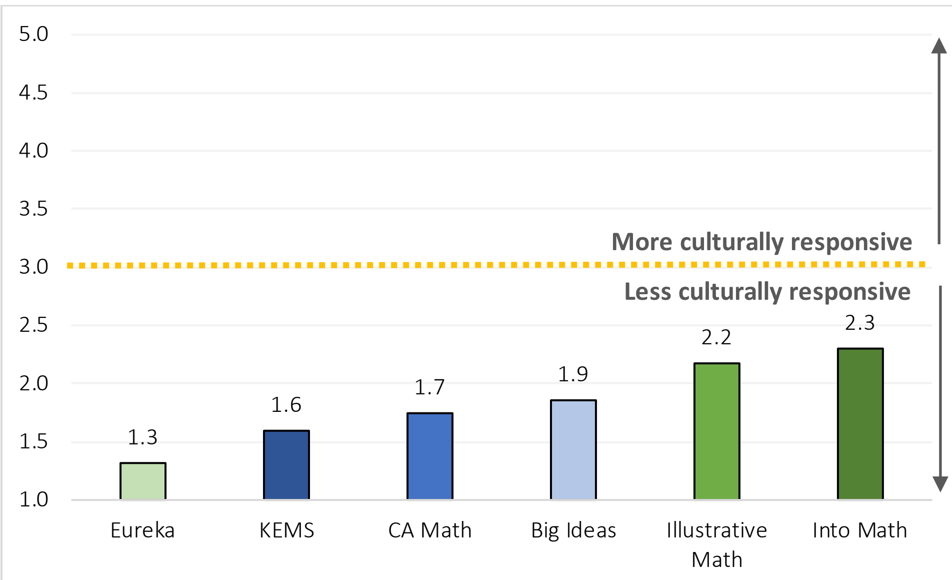


Source: Fall 2021 Teacher Survey; *p=0.00

6. **None of the study curricula meet the CRMT curriculum review tool's threshold for cultural responsiveness. Green curricula score slightly higher than non-green curricula, with the exception of Eureka Math, which scores the lowest of all six study curricula.**

Our review of the cultural responsiveness of the study curricula found that, on average, green curricula rate slightly higher than non-green curricula overall across all domains measured (1.8 and 1.5, respectively, based on a 5-point scale where 1 indicates no evidence of cultural responsiveness and 5 indicates ample evidence of cultural responsiveness). Among the green curricula, two—Into Math and Illustrative Math—score the highest among the study curricula (2.3 and 2.2, respectively; Exhibit III.6). The third green curricula, Eureka Math, scores the lowest of the study curricula (1.3). Importantly, the CRMT tool sets a minimum threshold score of 3 to consider a curriculum culturally responsive. None of the curricula included in the study meet this threshold.

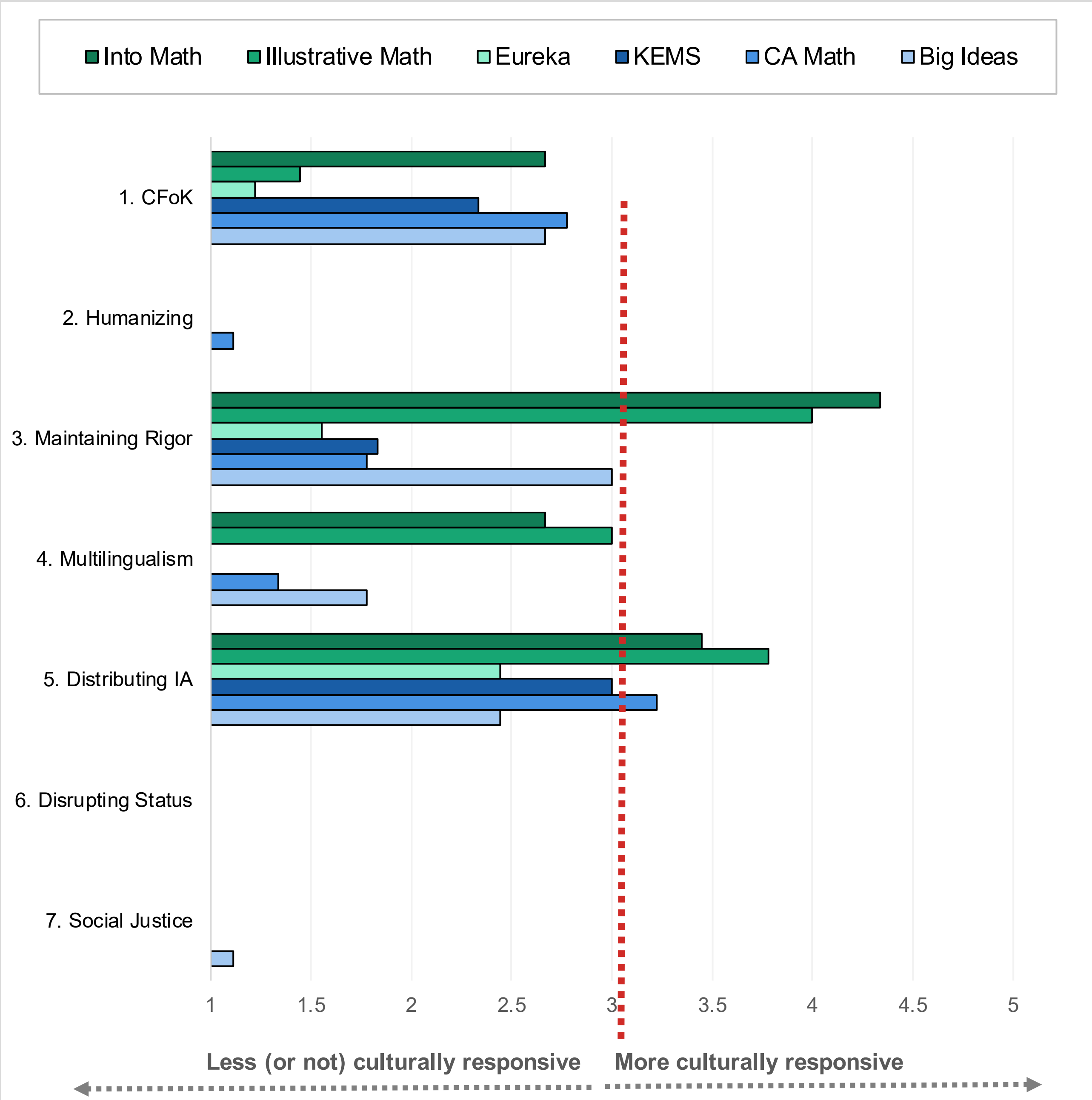
Exhibit III.6. Average CRMT curriculum review rating by curriculum



Source: CRMT ratings of the six study curricula.

Though none exceed the threshold overall, two of the green curricula, Illustrative Math and Into Math, exceed this threshold in two domains: *maintaining rigor* and *distributing intellectual authority* (Exhibit III.7). None of the curricula meet the threshold in the remaining domains. All curricula score particularly low in the *humanizing*, *disrupting status*, and *social justice* domains, suggesting that without considerable adaptation, these curricula may not foster an engaging and enjoyable learning environment for all students.

Exhibit III.7. Average curriculum rating by CRMT domain

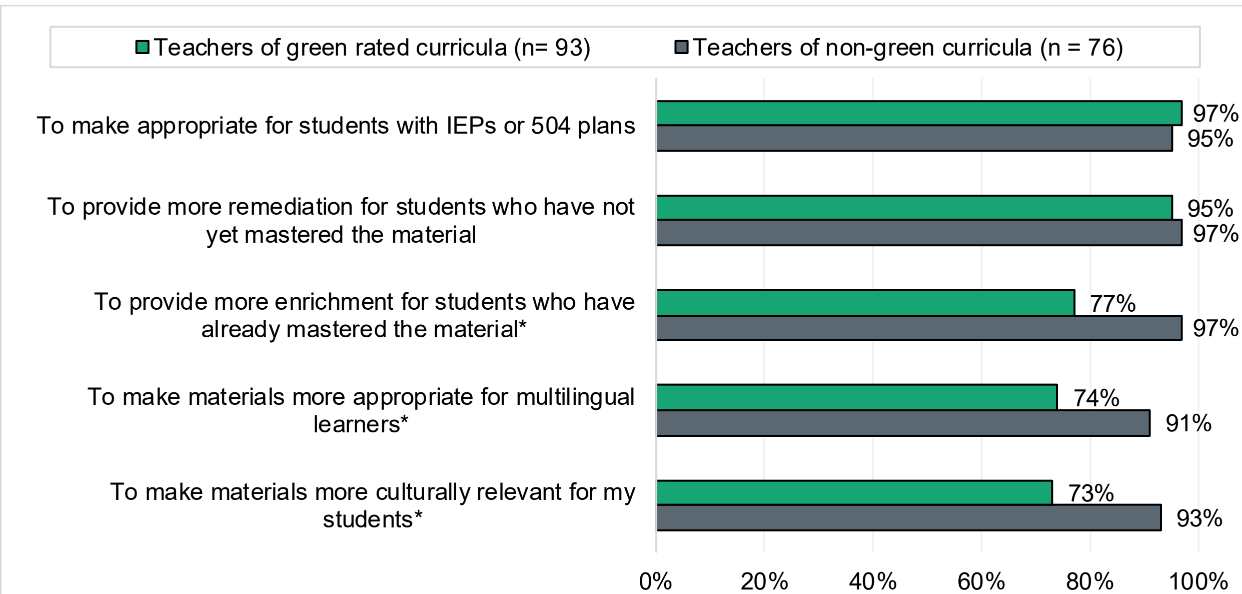


Source: CRMT ratings of the six study curricula.

7. **Teachers using non-green curricula are significantly more likely to adapt their instructional materials to make them more culturally responsive or more appropriate for multilingual learners.**

Although the majority of teachers using both green (73 percent) and non-green (93 percent) curricula report adapting (or modifying) curricula to make them more culturally responsive for their students, teachers using non-green curricula are significantly *more likely* ($p < 0.05$) to do so. Teachers of non-green curricula (91 percent compared to 74 percent of non-green) are also significantly more likely ($p < 0.05$) to modify their materials to make them *more appropriate for multilingual learners* (Exhibit III.8). Given that two of the green curricula rate higher than the three non-green curricula in our analysis of their cultural responsiveness, it may be that those green curricula require less adaptation to meet diverse student needs.

Exhibit III.8. Teachers' reasons for modifying curricula

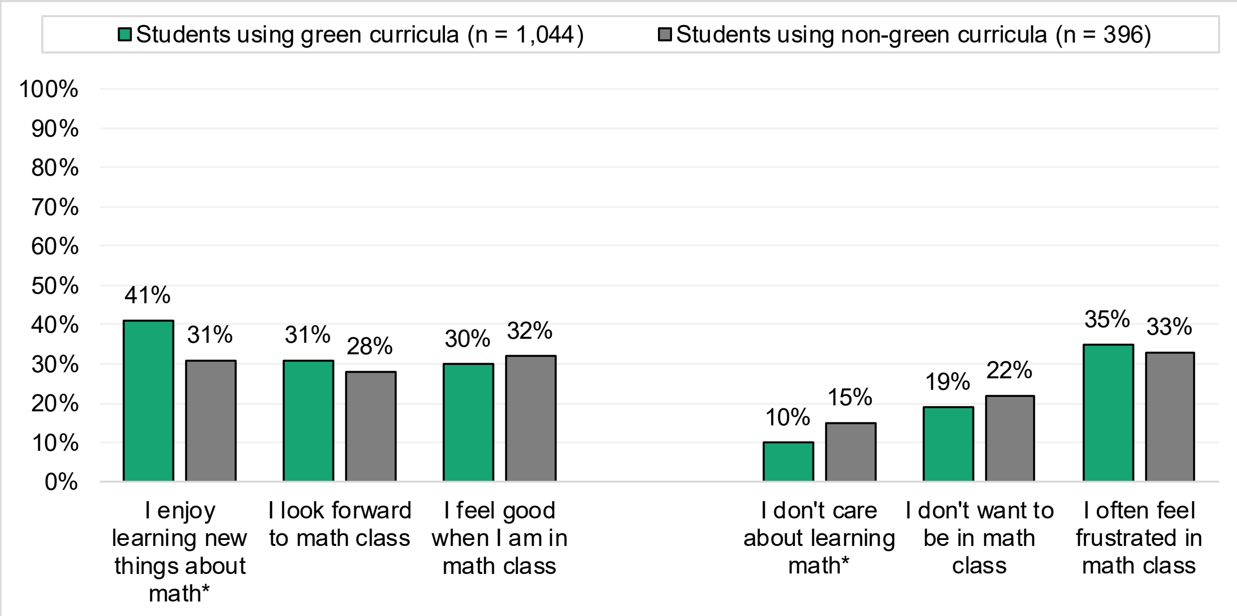


Source: AMS Fall Teacher Survey, question 15; * $p < 0.05$.

8. **Students in classrooms using green curricula are significantly more likely to report that they enjoy learning new things about math.**

As illustrated in Exhibit III.9, students in classrooms where teachers use a green curriculum are significantly *more likely* ($p = .001$) than their peers in non-green classrooms to strongly agree or agree that they *enjoy learning new things about math* and significantly *less likely* to ($p = 0.01$) to indicate that they *don't care about learning math*. Interestingly, students in green classrooms (35 percent) are just as likely as students in non-green classrooms (33 percent) to express feelings of *frustration in math class*. At this point in our analysis, these survey data are blunt measures for a complex relationship. We do not know whether these findings are due to the curriculum, teacher, school climate, or other individual or school-level factors.

Exhibit III.9. Students' math enjoyment by green and non-green curricula



Source: AMS Fall 2021 Student Survey, question A5; * $p < 0.05$.

B. Inquiry area 3: Characteristics of effective PL

What PL supports help teachers productively adapt and enact culturally responsive and ambitious pedagogies within the context of the curriculum?

IF	THEN
Teachers use high-quality math curricula that are embedded in coherent instructional contexts, and if **Teachers receive high-quality PL support that aligns with intended curricula and develops their mathematical knowledge for teaching and culturally responsive math teaching**	Teachers will plan curricula that align with standards, are cognitively demanding, are culturally responsive, and support students' math language development and language diversity **Teachers will enact curricula with integrity and make productive adaptations** **Teachers' beliefs and instructional capacity will improve, and then** Students who are Black, Latino, multilingual learners, or experiencing poverty will have a better classroom experience in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset

Our study hypothesizes that when teachers participate in high-quality PL that is aligned with their curriculum, their beliefs about their own *efficacy as a teacher*, their *expectations for their students*, and their ability to *productively adapt their curriculum* to their students' needs will improve. We consider PL to be "high quality" when it:

- Engages teachers in *reflective practice* to identify and address their individual learning needs and implicit biases (Civitillo et al. 2019; Hozebin 2018; Monet and Etkina 2008; Weber et al. 2018)

- Advances teachers' *mathematical knowledge for teaching*, capacity to employ *CRMT practices*, and understanding of *how students learn* (Aguirre and del Rosario Zavala 2013; Desimone 2009; Desimone and Garet 2015; Hill et al. 2008)
- Provides ample opportunity for teachers to engage in *active learning* through such interactive activities as discussion and analyzing student data, student work, student inquiry, instructional materials, and lessons (Akiba et al. 2019; Desimone 2009; Desimone and Garet 2015; Murata et al. 2012)
- Is *aligned with their curriculum*, *state or district standards*, and their district and school's vision and goals for teaching and learning in math (Desimone 2009; Desimone and Garet 2015)
- Is offered on an ongoing basis throughout the school year with at least 20 hours of contact time (Desimone 2009; Desimone and Garet 2015)
- Is *differentiated* in response to teachers' individual learning needs (Desimone 2009; Desimone and Garet 2015)
- Is *championed by district and school leaders* who encourage teachers to apply knowledge and skills in their classrooms (Desimone 2009; Desimone and Garet 2015)

To understand whether the PL teachers receive is high quality, we analyzed teacher survey data on each of these features. We first characterized the dosage and range of PL supports teachers receive, as well as teachers' perceptions of those supports. Second, we compared how the types of PL and teachers' perceptions of PL differed by teachers who report routinely:

1. *Adapting* their curriculum
2. Adopting *culturally responsive* practices
3. Employing pedagogically *ambitious* practices

While not causal, these relationships can help us understand what PL supports may prepare teachers to deliver more engaging and high quality math instruction.

Overall, we found that:

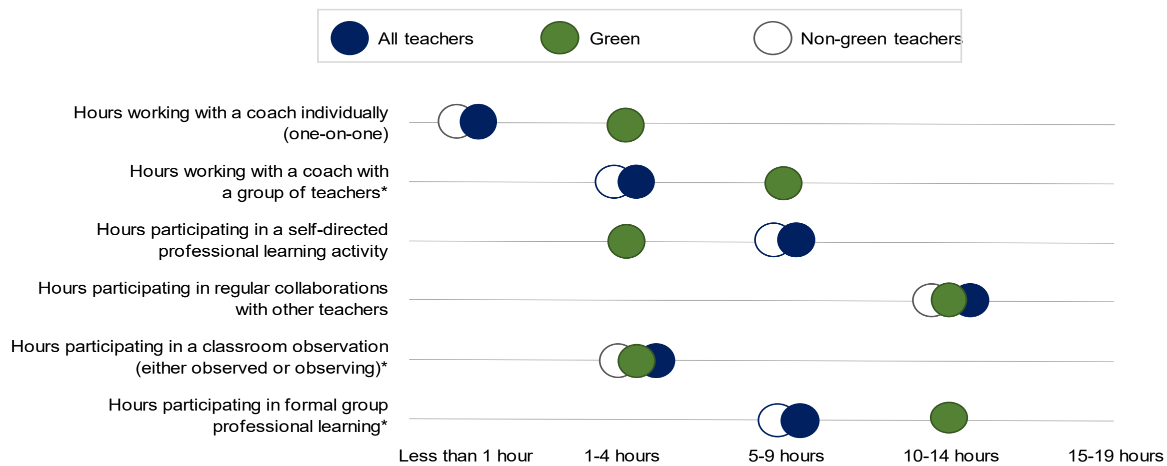
1. Teachers implementing green curricula spend significantly more time working with a coach, participating in a classroom observation, or participating in formal group PL.
2. The majority of teachers report participating in activities that align with the core features of high-quality PL. Teachers are most likely to receive PL on culturally responsive practices and analyzing student work or assessment data.
3. Teachers are most likely to perceive PL activities as valuable to their math instruction, their understanding of *how students learn math*, their responsiveness to *student backgrounds*, *cultures*, *and points of view*, their mindset and biases about students and *setting higher expectations for all students*, and their strategies to improve their math instruction.
4. Although the majority of teachers report that their PL is aligned with their school's instructional goals and district policies, less than half of the teachers believe that their PL is differentiated for their individual professional growth needs.
5. Teachers who frequently adapt their curriculum and use culturally responsive and ambitious practices report higher dosages of PL, more PL activities in key areas that may support these practices, and PL activities that help them across a broad range of areas. These differences are most pronounced

between CRMT and non-CRMT teachers, and teachers of ambitious pedagogy versus teachers of procedural pedagogy.

1. Teachers implementing green curricula spend significantly more time working with a coach, participating in a classroom observation, or participating in formal group PL.

Teachers report participating in a range of PL activities in SY 2021–2022. Overall, teachers report spending the most time collaborating with other teachers (five to nine hours, on average) and the least amount of time working one-on-one with a coach (less than one hour, on average). Teachers implementing green curricula report a higher dosage of PL in most areas than teachers using non-green curricula, with significant differences in the amount of time spent working with a coach as a group of teachers, participating in a classroom observation, and participating in formal group learning opportunities (Exhibit III.10).

Exhibit III.10. PL dosage (total hours in SY 2021–2022) by curricula and activity type



Source: AMS Spring Teacher Survey, question 1; * $p < 0.05$.

2. The majority of teachers report participating in activities that align with the core features of high-quality PL. Teachers are most likely to receive PL on culturally responsive practices and analyzing student work or assessment data.

The majority of teachers report participating in activities that align with the core features of high-quality PL (Exhibit III.11). The most commonly reported topical focuses of PL activities include CRMT (96 percent of teachers), analyzing student work or assessment data (92 percent), math standards (89 percent), developing instructional activities or lessons (89 percent), and reflective practice to address biases (89 percent). Teachers are least likely to report that the PL supports focus on classroom management (60 percent) or teaching in a virtual setting (41 percent) (not shown). There are virtually no significant differences in how teachers report topic areas covered in PL between teachers using a green versus a non-green curriculum.[8]

[8] The only exception was that 100 percent of teachers using a green curriculum report that PL supports specifically focus on their use of their particular curriculum, and only 50 percent of teachers using a non-green curriculum report this ($p < .05$).

Exhibit III.11. Teachers' participation in high-quality PL activities

Core features of high-quality PL	Percentage of teachers who reported engaging in a PL activity
1. Reflective practice	• 89 percent reported engaging in structured self-reflection
2. Mathematical knowledge for teaching	• 88 percent reported receiving PL on general math content
3. CRMT practices	• 96 percent reported receiving PL on CRMT practices
4. How students learn	• 87 percent reported receiving PL on how students learn math
5. Active learning	• 92 percent reported analyzing student work or assessment data • 89 percent reported developing instructional activities or lessons • 76 percent reported participating in lesson study (collaborative lesson development, enactment, evaluation, and reflection)
6. Aligned with curriculum and standards	• 89 percent reported receiving PL on math standards • 82 percent reported receiving PL on their specific curriculum • 76 percent reported receiving PL on how to adapt their curriculum to address unfinished learning related to COVID-19

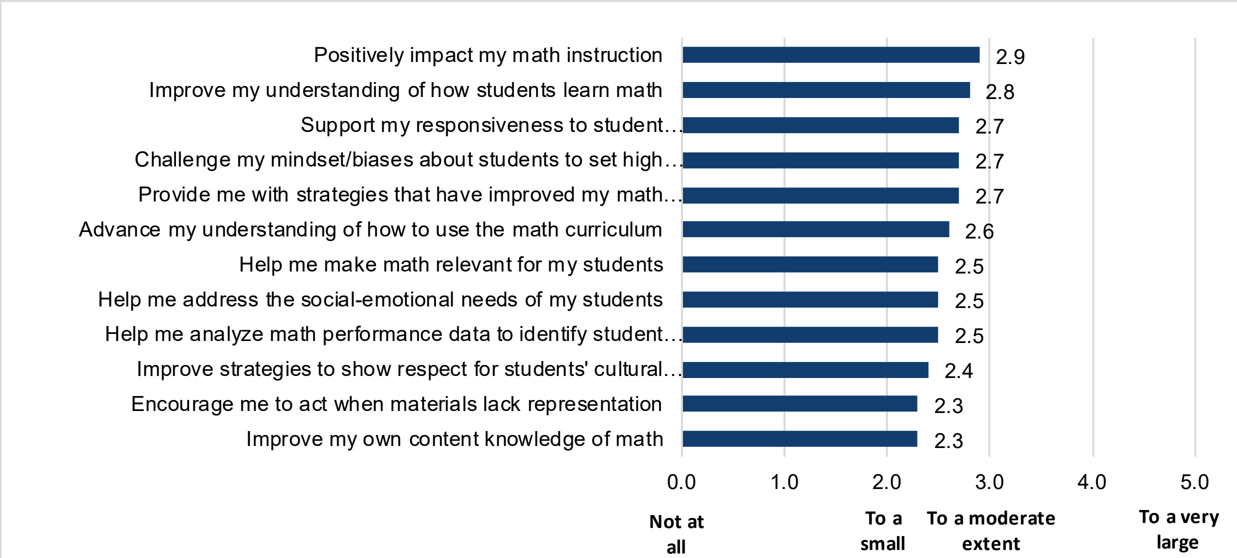
Source: AMS Spring Teacher Survey, question 2.

Additionally, the majority of teachers report receiving at least some PL support on differentiating learning. Eighty-eight percent or more of all teachers said that at least some of their PL supports include ideas and strategies for teaching students performing at and below grade level, students who have an Individualized Education Plan (IEP), are designated as English learners, or who are from low-income families (not shown).

3. Teachers are most likely to perceive PL activities as valuable to their math instruction, their understanding of how students learn math, their responsiveness to student backgrounds, culture, and points of view, their mindset and biases about students and setting higher expectations for all students, and their strategies to improve their math instruction

Teachers were asked to indicate the extent to which their PL activities over the course of the year assist them in a variety of areas, using a 6-point scale (0 = Not at all, 5 = To a very large extent). Teachers indicate that the PL activities are most likely to positively impact their math instruction, improve their understanding of *how students learn math*, support their responsiveness to *student backgrounds, cultures, and points of view*, challenge their mindset and biases about students to *set higher expectations for all students*, and provide strategies that have improved their math instruction (Exhibit III.12). There is a significant difference between those using a green (95 percent) and non-green (74 percent) curriculum only in the case of *advancing understanding of how to use the math curriculum*. However, this difference is expected because teachers using green curricula were offered curriculum-specific PL for the AMS study.

Exhibit III.12. Extent to which PL assists teachers (average score)



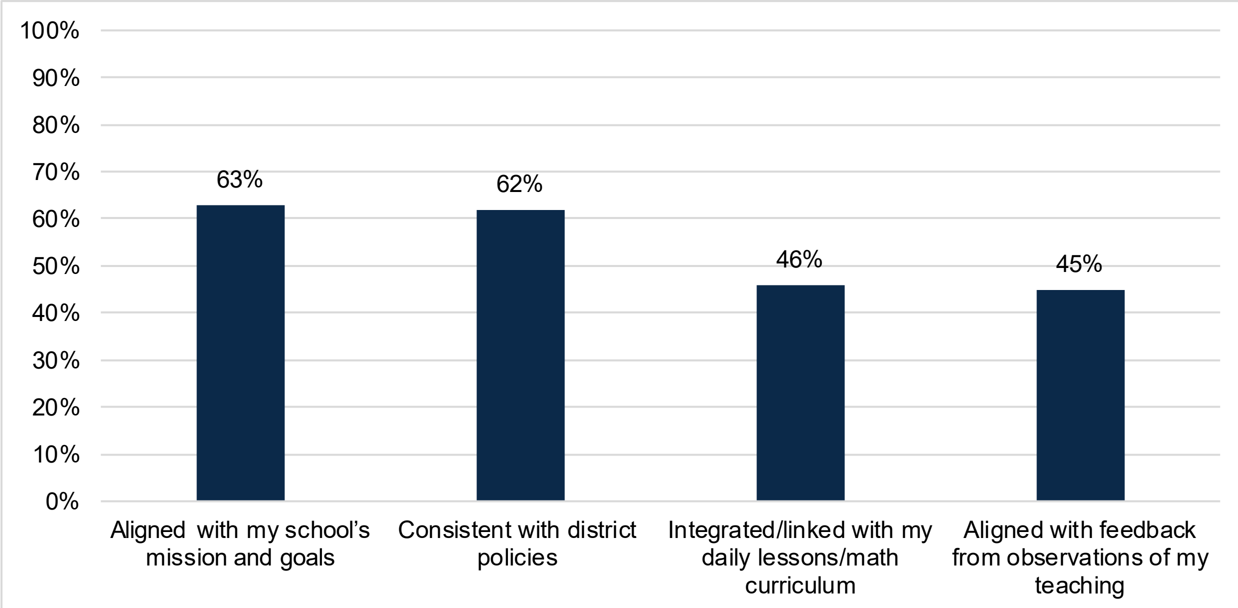
Source: AMS Spring 2022 Teacher Survey, question 3.

One important lens to bring to this, however, is that these ratings are in the middle on the scale teachers were provided. The "2.9" in Exhibit III.12, for example, indicates that on average teachers feel that the PL activities positively impact their math instruction somewhere between only a small extent (2) and a moderate extent (3), while they were provided the opportunity to indicate that these activities positively impact math instruction to a large (4) or very large (5) extent. However, this may suggest there is still a fair amount of room for the PL activities to do more to help teachers with various pedagogical practices.

4. **Although the majority of teachers report that their PL is aligned with their school's instructional goals and district policies, less than half of the teachers believe that their PL is differentiated for their individual PL needs.**

Teachers were also asked questions about the coherence of their PL activities—the extent to which the PL they receive is aligned with their curriculum, state or district standards, and their district and school's vision and goals (Exhibit III.13). Although the majority of teachers report that their PL is aligned with their school's instructional goals (63 percent) and district instructional and accountability policies (62 percent), less than half of the teachers strongly agree or agree that their PL is aligned with individual professional growth needs. Only 45 percent of teachers report that their PL activities are aligned with feedback from observations of their teaching and only 46 percent of teachers report that their PL opportunities are connected to their daily lessons. There are no significant differences between teachers using green curricula and those using non-green curricula.

Exhibit III.13. Teachers' perceptions of the coherence of their PL



Source: AMS Spring 2022 Teacher Survey, question 4.

To understand more about the specific relationship between the various PL activities and actual teacher practices, we look at teachers' engagement in and perceptions of PL supports by their self-reported practices. This involved creating three groups of teachers, defined and constructed as follows in Exhibit III.14:[9]

Exhibit III.14. Subgroups of teachers by constructs that define high-quality instruction

Construct	Definition	Sample counts
Teachers who reported making productive adaptations in their instruction (referred to as *adapters* in the text)	Teachers who report making adaptions to about half of their lessons or more (question 24 in the spring teacher survey) to address the learning needs of their students	Adapters: 46; non-adapters: 40
Teachers who reported the use of culturally responsive practices in their instruction (referred to as *CRMT teachers* in the text)	Teachers with a mean score of 2 or above on the culturally responsive teaching scale (question 27a–g on the spring teacher survey)	CRMT teachers: 31; non-CRMT teachers: 55
Teachers who reported the use of ambitious pedagogy in their instruction (referred to as *teachers of ambitious pedagogy* in the text)	Teachers with a means score of 2 or above on the ambitious instruction scale (question 22b,c,d,f,g,i,j, and l on the spring teacher survey) and a mean score of 2 or above on the frequency of ambitious instruction (question 23a–h on the spring teacher survey)	Teachers of ambitious pedagogy: 25; teachers of non-ambitious pedagogy: 61

For each of these three groups we again looked at the areas we examined above: *dosage* of engagement in different PL activities, *topics covered* in these activities, and *perceptions* of the PL supports. Our investigation here could shed light on whether teachers who report making more frequent productive adaptations, using culturally responsive practices, or using ambitious pedagogy also report significantly

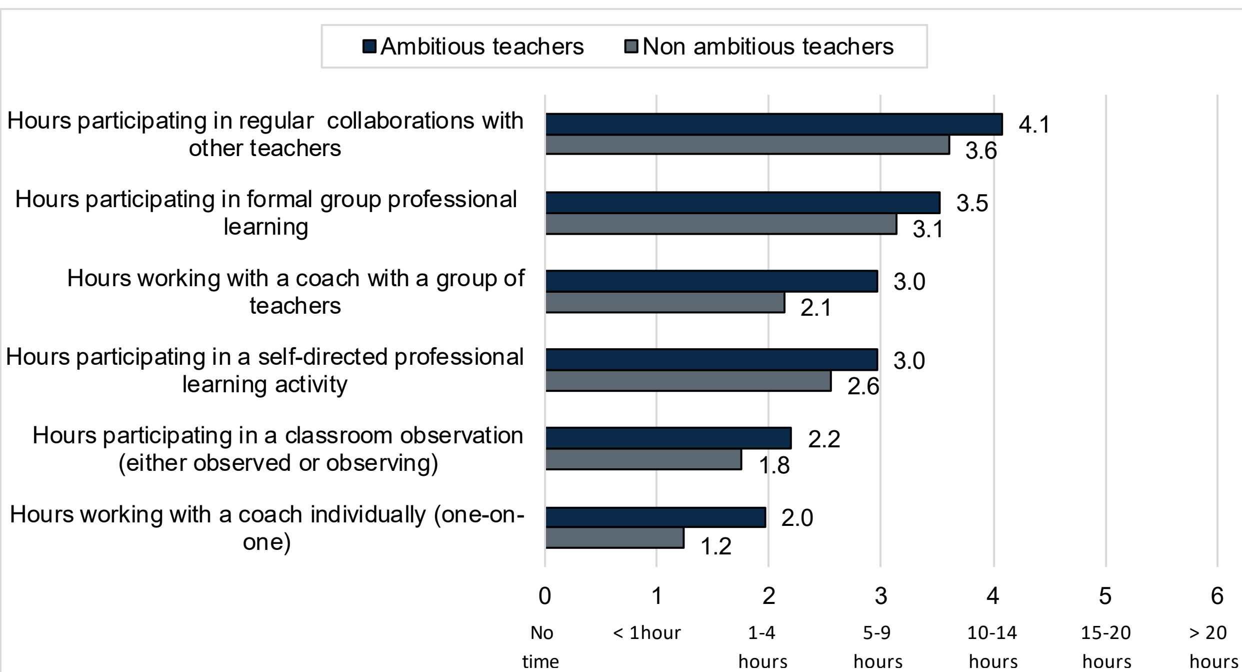
[9] These groups are not mutually exclusive.

different dosage, topic coverage, or perceptions about the value of these supports compared to their counterparts—teachers who do not report making frequent productive adaptations, using culturally responsive practices, or using ambitious pedagogy.

5. **Teachers who frequently adapt their curriculum and use culturally responsive and ambitious practices report higher dosages of PL, more PL activities in key areas that may support these important pedagogical distinctions, and PL activities that help them across a broad range of areas. These differences are most pronounced between CRMT and non-CRMT teachers, and teachers of ambitious pedagogy and teachers of procedural pedagogy.**

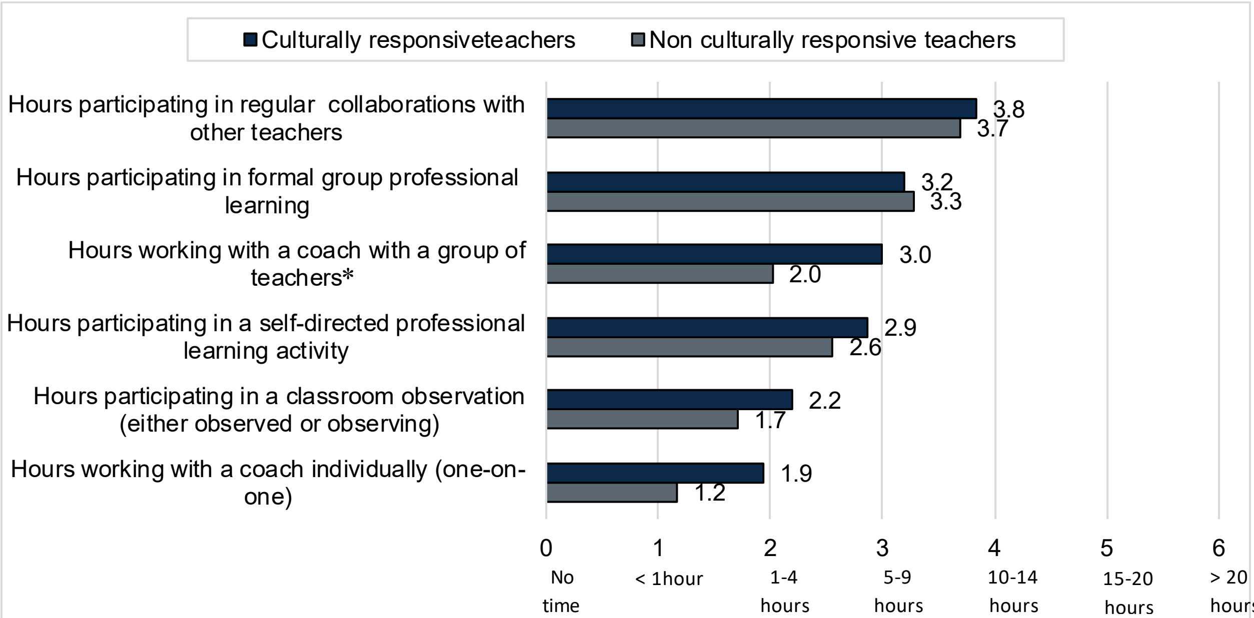
There is higher dosage of PL activities for teachers who report frequently adapting and using culturally responsive and ambitious practices across almost all types of PL support; however, these differences are not significant. In all but two cases in Exhibits III.15–III.17, teachers who indicate the preferred practices also report a higher dosage of engagement with PL. Though the differences are not significant (potentially due to small sample sizes), they are at least suggestive of a relationship between how much PL support teachers get and the practices that they report using (Exhibits III.15–III.17). We emphasize that this is only suggestive since we have not yet accounted for factors such as PL availability or requirements, or teachers' motivation. This more nuanced relationship will be part of our further investigation going forward.

Exhibit III.15. PL dosage (total hours in SY 2021–2022) by activity type between teachers of ambitious and procedural pedagogy



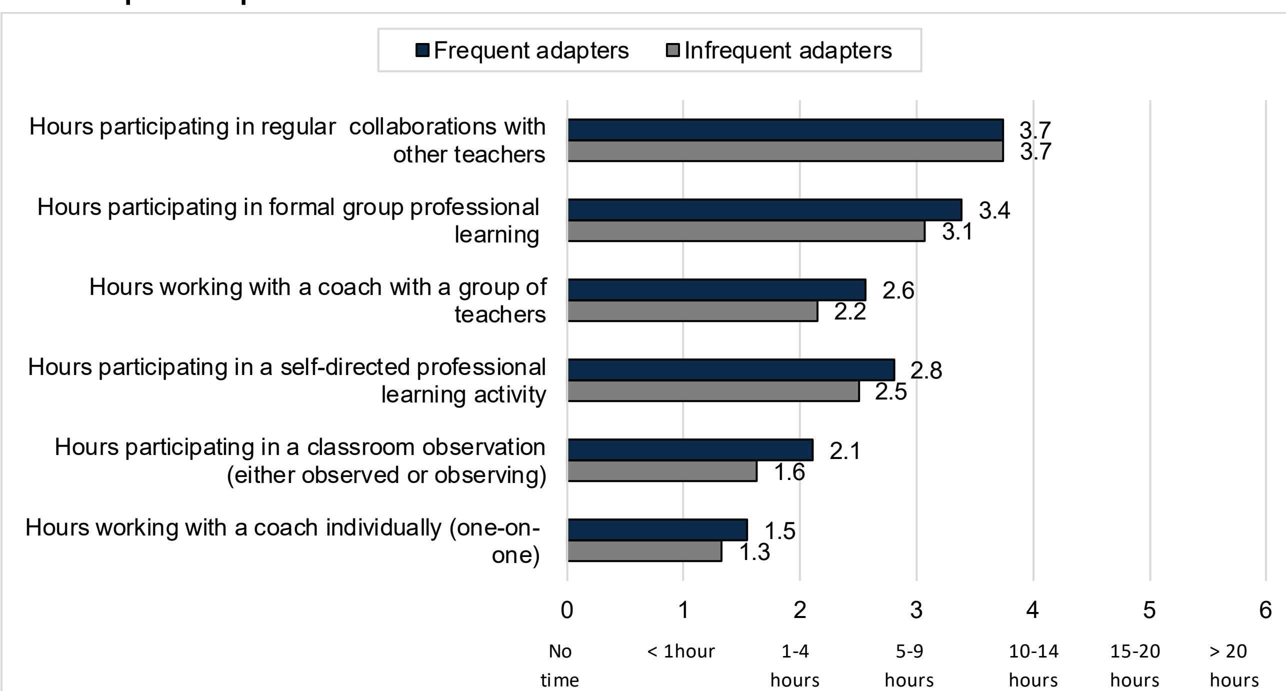
Source: AMS Spring 2022 Teacher Survey, question 1.

Exhibit III.16. PL dosage (total hours in SY 2021–2022) by activity type between CRMT and non-CRMT teachers



Source: AMS Spring 2022 Teacher Survey, question 1; * $p < 0.05$.

Exhibit III.17. PL dosage (total hours in SY 2021–2022) by activity type between frequent adapters and infrequent adapters



Source: AMS Spring 2022 Teacher Survey, question 1.

Teachers who report frequently adapting their curriculum and using culturally responsive and ambitious practices report PL activities focused in key areas that may support these important pedagogical distinctions. There are a number of significant differences in the focus of PL topics between those in each of our three groups of teachers, particularly between teachers of ambitious pedagogy versus teachers of procedural pedagogy and CRMT teachers versus non-CRMT teachers (Exhibit III.18). For example, CRMT teachers are significantly more likely to report participating in PL on *culturally responsive teaching* and *engaging in structured reflection on how your perspectives may create biases* compared to those who are less likely to report using culturally responsive practices. And teachers of ambitious pedagogy are significantly more likely to report participating in PL on *analyzing student work or assessment data* and *how students learn math* compared to these who report using more procedural practices.

Frequent adapters are also significantly more likely to report participating in PL in several areas; however, differences between frequent adapters and infrequent adapters are not as common as the differences between our other two groups.

These differences are compelling and suggest that there is a relationship between PL supports and teacher practice in our sample. It is unclear, however, whether the differences represent some other confounding variable, such as teacher motivation. For example, teachers who are already engaging in CRMT practices might also be more inclined to seek PL that focuses on CRMT-related topics. As noted above, this more nuanced relationship will be part of our investigation going forward.

Exhibit III.18. Differences between PL topic areas between frequent adapters and infrequent adapters, CRMT teachers and non-CRMT teachers, and teachers of ambitious pedagogy and teachers of procedural pedagogy

Compared to teachers of non-ambitious pedagogy, ***teachers of ambitious pedagogy*** were more likely to report participating in PL that focused on…	Compared to non-CRMT teachers, ***CRMT teachers*** were more likely to report participating in PL that focused on…	Compared to non-adapters, ***adapters*** were more likely to report participating in PL that focused on…
• Analyzing student work or assessment data • Lesson study-collaboratively create, participate in, evaluate, and reflect on lesson • How students learn math (e.g. learning progressions) • General math content • Teaching math in a virtual setting • How to adapt the curriculum to address unfinished learning from COVID-19 • Engaging in structured reflection on how your perspectives may create biases • National, state, or local math standards • Classroom management • General instructional strategies	• Analyzing student work or assessment data • Lesson study-collaboratively create, participate in, evaluate, and reflect on lesson • How students learn math (e.g. learning progressions) • General math content • Developing instructional activities or lessons • How to adapt the curriculum to address unfinished learning from COVID-19 • Engaging in structured reflection on how your perspectives may create biases • Culturally responsitve teaching • National, state, or local math standards • Classroom management • Math-related PL specifically focused on my curriculum • Other math-related PL, but not specific to my curriculum	• Culturally responsive teaching • Classroom management • Other math-related PL, but not specific to my curriculum

Source: AMS Spring 2022 teacher survey, question 2.

Teachers who report using culturally responsive and ambitious practices are significantly more likely to say that PL activities have helped them across a broad range of areas. There are notable, extensive differences in teachers' perceptions of their PL supports between CRMT teachers versus non-CRMT teachers and teachers of ambitious versus procedural pedagogy. CRMT teachers and teachers of ambitious pedagogy are significantly more likely to say that PL activities have helped them across a broad range of areas, including:

- Improving my own content knowledge of math
- Improving my understanding of how students learn math
- Advancing my understanding of how to use my curriculum in my classroom
- Providing me with teaching strategies that have improved my math instruction
- Helping me analyze student performance data in math to identify student needs
- Having a positive impact on my instruction in math
- Improving my strategies that show respect for cultural backgrounds of students
- Challenging mindsets and biases about students to show high expectations for all

- Supporting me being responsive to students' backgrounds, cultures, and points of view
- Encouraging me to take action when materials are lacking in representation
- Helping me address the social-emotional needs of my students
- Helping me make math relevant for my students

There are no significant differences between frequent adapters and infrequent adapters in their perceptions of PL supports.

C. Inquiry area 4: Adaptations in instructional enactment

How and to what extent do math teachers' adaptations of curricula promote culturally responsive math instruction? How and to what extent do math teachers' adaptations of curricula promote equitable engagement and minimize status issues in the classroom?

IF	THEN
Teachers use high-quality math curricula that are embedded in coherent instructional contexts, and if Teachers receive high-quality PL support that aligns with intended curricula and develops their mathematical knowledge for teaching and culturally responsive math teaching	Teachers will plan curricula that align with standards, are cognitively demanding, are culturally responsive, and support students' math language development and language diversity **Teachers will enact curricula with integrity and make productive adaptations** Teachers' beliefs and instructional capacity will improve, and then Students who are Black, Latino, multilingual learners, or experiencing poverty will have a better classroom experience in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset

Our study hypothesizes that when teachers *productively* adapt curricula they can positively influence the classroom experience of Black and Latino students, multilingual learners, and students experiencing poverty, in terms of their math enjoyment, achievement identity, performance, persistence, self-efficacy, and growth mindset. We define *adaptations* as significant planned or unplanned changes to a lesson plan, as opposed to accommodations made for individual students.

To understand whether and how teachers make adaptations—and whether reported adaptations are productive—we identified the various ways in which teachers report adapting their curriculum and their reasons for doing so. We characterized adaptations as productive when teachers modify lessons to promote:

- **Equitable engagement,** which we define as instructional protocols, tasks, or content that differentiate the learning experience for specific subgroups of students, such as multilingual learners.
- **Cultural responsiveness,** which we define as math instruction that (1) engages students in authentic, real-world inquiry; (2) allows them to express multiple ways of knowing and doing math; (3) engages students in rigorous mathematical discourse; (4) provides appropriate academic literacy support and scaffolding for multilingual learners; (5) leverages students' funds of knowledge for individual and collective learning; (6) draws connections between math and other content areas; or (7) allows students to pose questions about societal challenges of importance to them.

Among teachers who report they adapt their curricula to promote cultural responsiveness, we explored the extent to which they employ one of the seven strategies above. Overall, we found:

1. Most teachers report adapting lessons at least a few times a week, most commonly by augmenting curriculum content or instructional materials. Teachers who adapt their curriculum frequently (about half or more of all lessons) are significantly more likely than teachers who infrequently or never adapt their curriculum to *change the way content is delivered* or *change the sequence* in which it is delivered.
2. The majority of teachers indicate that they make productive adaptations to their curricula. Teachers report modifying lessons to ensure a more equitable experience for their students. This includes differentiating instruction not only for students performing below grade level and multilingual learners, but also for students performing above grade level.
3. Of the teachers who modify their curriculum to promote CRMT, only a small percentage report employing strategies that are explicitly intended to leverage students' cultural and community knowledge as an asset for learning.

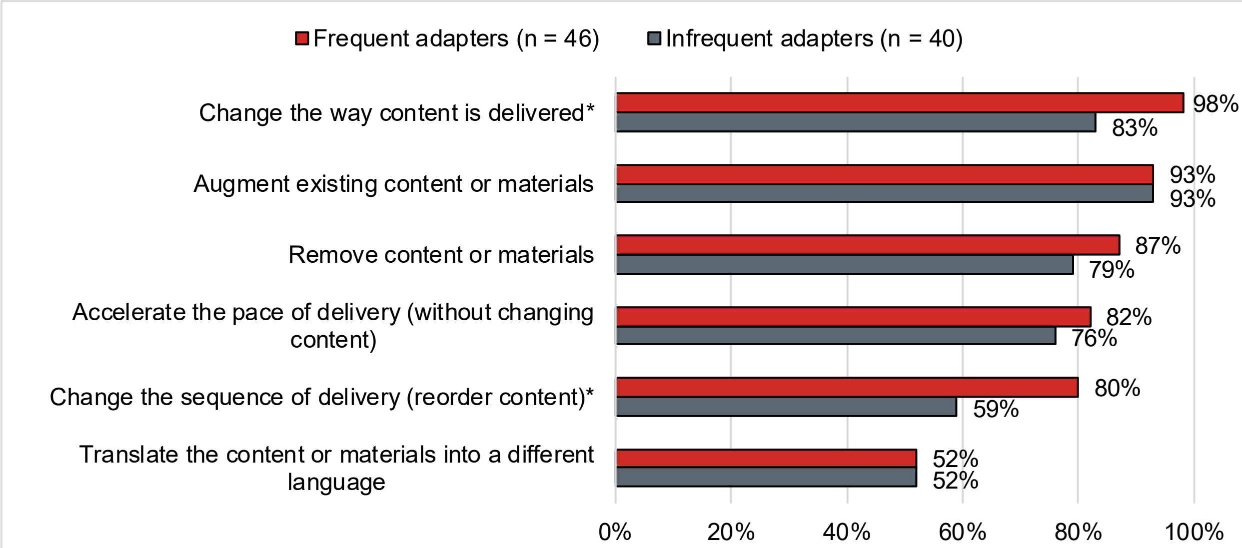
1. Most teachers report adapting lessons at least a few times a week, most commonly by augmenting curriculum content or instructional materials. Teachers who are frequent adapters (about half or more of all lessons) are significantly more likely than infrequent adapters to *change the way content is delivered* or *change the sequence* in which it is delivered.

First, we explored *how much* adaptation is going on. The majority of teachers (87 percent) indicate they adapt their curriculum, and 53 percent of teachers (n = 46) indicate that they adapt their curriculum frequently (about half or more of all lessons). Per week:

- 36 percent (n = 31) adapt *more than half* of their lessons
- 17 percent (n = 15) adapt *about half* of their lessons
- 34 percent (n = 29) adapt *a few lessons*
- 13 percent (n = 11) *do not adapt* their curriculum due to their preference to follow it consistently or because their school or district does not permit adaptations

We then turned to understanding *how* teachers are adapting their curricula. Overall, teachers are most likely to report changing how content is delivered or augmenting their instructional materials (93 percent). Those who frequently adapt their curriculum are significantly more likely than infrequent adapters to *change the way content is delivered*—such as the instructional tasks recommended by a curriculum ($p < .05$)—or *change the sequence* in which content is recommended to be delivered ($p < .05$) (Exhibit III.19).

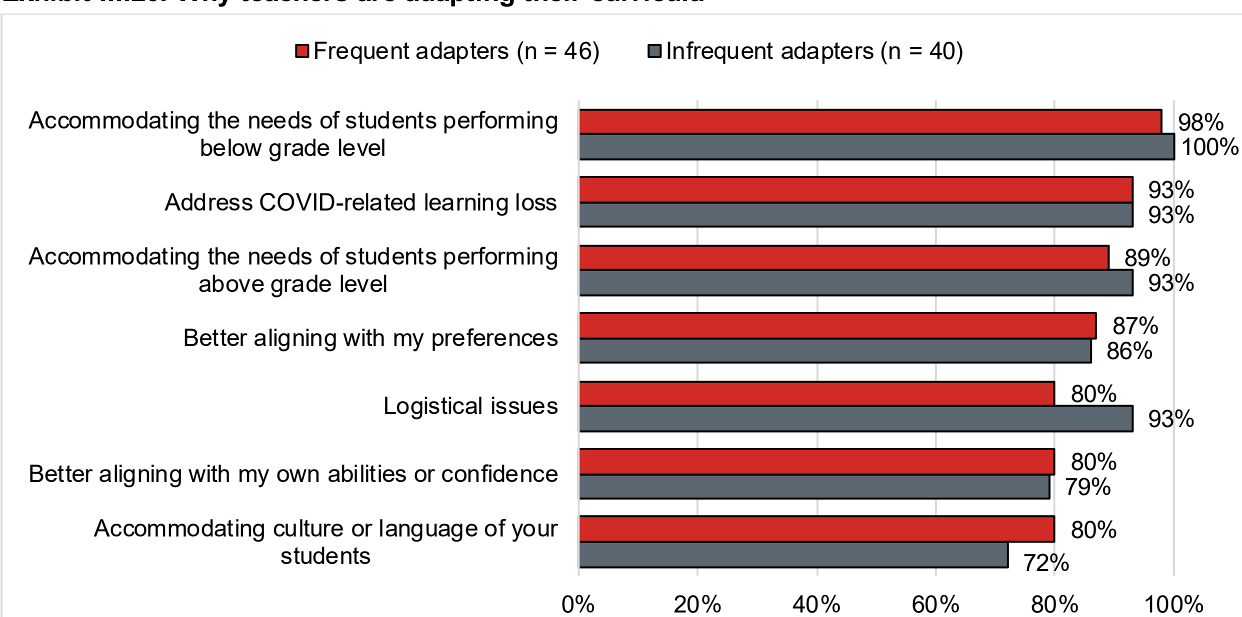
Exhibit III.19. How teachers are adapting their curricula



Source: AMS Spring 2022 Teacher Survey, question 25, * $p < 0.05$.

In order to dig into whether adaptations are likely to be productive, we looked at *why* teachers make adaptations. Although 85 percent of teachers overall report adapting their curriculum for logistical reasons (such as bell schedule or facility constraints), the majority also say they adapt their curriculum to ensure a more equitable experience for their students. Accommodating the needs of *students performing below grade level* and addressing *COVID-19-related learning loss* are the most common reasons for adapting the curriculum (99 percent of teachers). In contrast with the differences in *how* groups of teachers adapt curricula, there are no significant differences in *why* they do; frequent and infrequent adapters report the same reasons. (Exhibit III.20).

Exhibit III.20. Why teachers are adapting their curricula



Source: AMS Spring 2022 Teacher Survey, question 26.

2. **Of the teachers who engage in activities to promote CRMT, only a small percentage report employing strategies that are explicitly intended to leverage students' cultural and community knowledge as an asset for learning.**

To understand the extent to which teachers are engaging in activities that promote culturally responsive teaching, we asked teachers about the frequency with which they employ specific culturally responsive practices.[10] As shown in Exhibit III.21, 77 percent report they typically create opportunities for students to *discuss math in meaningful and rigorous ways* in half or more of their lessons. Seventy-one percent report they typically create opportunities for students to *discuss and explore multiple representations of mathematical concepts and problem-solution paths* in half or more of their lessons. Although these practices are commonly associated with both high-quality math instruction and CRMT, instruction must leverage students' cultural and community knowledge to be truly responsive.

However, of the modifications that are explicitly intended to draw on students' cultural and community knowledge as an asset for teaching and learning, only:

- 44 percent report creating opportunities for students to draw on their lived experience, local community context, and cultural and linguistic heritage in half or more of their lessons
- 31 percent report creating opportunities for students to pose questions about societal challenges of relevance to them in half or more of their lessons

Exhibit III.21. Frequency of engaging in activities to promote CRMT in a typical week

	Never or a few lessons	Half or more lessons
Create opportunities for students to discuss mathematics in meaningful and rigorous ways (e.g., debate mathematics ideas/solution strategies, use mathematics terminology, develop explanations, communicate reasoning, make generalizations)	23%	77%
Create opportunities for students to discuss and explore multiple representations of mathematical concepts and problem-solution paths	29%	71%
Support and scaffold the oral and written academic language development of multilingual students (e.g., gesturing, use of objects, use of cognates, revoicing, graphic organizers and manipulatives)	35%	65%
Create opportunities for students to pose authentic questions and/or investigate real-world problems using math	41%	59%
Create opportunities for students to draw connections between math and other content areas	44%	56%
Create opportunities for students to draw on their lived experience, local community context, and/or cultural and linguistic heritage as resources for individual and collective learning	56%	44%
Create opportunities for students to pose questions about societal challenges of relevance to them and/or instructional tasks that explore, critique, and test solutions to those issues	69%	31%

Source: AMS Spring 2022 Teacher Survey, question 27.

[10] This analysis of modifications is different from our analysis of CRMT teachers versus non-CRMT teachers as presented earlier under inquiry area 3. This analysis examines the practices of all teachers, looking at what portion of their lessons in a typical week they engage in various activities.

IV. Implications, Limitations, and Next Steps

This first report is largely focused on the three critical levers to how students experience math: an intended curriculum produced by a publisher, a set of PL supports to help the classroom teacher make best use of those materials, and the instructional practice that each teacher brings to their daily lessons. In this report we pay limited attention to how students are experiencing math in our participating classrooms—the key outcome of interest, but one that we plan to explore in future reports. This report is principally about understanding these three levers and how they operate in relation to one another. We summarize here what our initial findings suggest.

A. Implications

Curriculum is an important lever in middle school math instructional delivery. While curricula inevitably transform once in the hands of teachers, our findings make clear that the curriculum itself plays an important role in influencing what does—and does not—get taught in the classroom.

There are differences between curricula, but measures used to assess aspects of their quality differ. Curricula differ in topic coverage, cognitive demand of student tasks, and attention to culturally responsive teaching approaches. Assessment of curricula quality, however, depends on measurement but the education field lacks consensus about such measures. For example, while both the SEC and EdReports assess a curriculum's alignment with the CCSS, the reports differ in their assessment of the extent of topic coverage or cognitive demand of student tasks. Further, neither the SEC nor EdReports include measures of a curriculum's cultural responsiveness. Without better agreement on what matters for quality and the corresponding measures to assess the strengths and weaknesses of curricula on these features, districts risk making critical strategic decisions with insufficient information.

Curriculum developers need to focus on supporting culturally responsive math teaching practices. The six curricula promote culturally responsive teaching practices to a limited extent. This is an area where curriculum developers need to focus, if indeed this is a priority. Based on their responses to questions about culturally responsive practices, teachers in our participating districts appear to feel CRMT is important in their instruction, but the curricula do little to support it.

PL is an important lever in instructional delivery, but it too often falls short of meeting teachers' needs. There is a clear pattern of engagement with PL that differs for teachers exhibiting different practices. But the current menu of PL supports has some distance to go in adequately supporting all teachers. If curricula are written to encourage more rigorous student engagement with math concepts, then PL needs to directly support teachers' understanding of these materials and their ability to deliver them within the time provided and to the students in their classes. Similarly, if teachers are attempting to adapt curricula with more culturally responsive practices, then PL needs to address the gap between the curricula and teachers' instructional aspirations. Teachers too often are reporting that PL supports help them in only modest ways, leaving room for supports to be stronger. Finally, in addition to issues of quality, PL supports are not providing sufficient individual differentiation or directly connecting to actual classroom practice—characteristics that help teachers' pedagogy.

To compensate, many teachers are making adaptations in their instructional delivery. While they desire to implement culturally responsive practices—which teachers report as a reason for adaptation—many teachers unfortunately do not report using strategies that support CRMT. Similarly, many teachers report removing content as a way that they adapt their curriculum. Whether because the content is too rigorous or for some other reason, removal of content is nonetheless a red flag for potentially compromising rigor. After one year, we do not know the extent to which these adaptations are related to limitations of the intended curricula, limitations of the PL supports, or something else. We also do not know the extent to which these adaptations are productive or not. Nonetheless, the more teachers' desires to deliver instruction in ways unmet by either curricula or PL, the more they are likely to rely on their own adaptations.

Overall, our findings suggest the potential of the core inputs needed to support effective instruction—the intended curriculum and PL—but also the shortcomings that invite adaptation. Shortcomings that force adaptations invite more variability in the quality of instruction and also likely demand more teacher time—a resource in critically short supply. Unless these adaptations are productive (teachers modify lessons to promote equitable engagement and cultural responsiveness), they risk undermining critical goals for instructional delivery around student equity, identity, enjoyment, perseverance, growth mindset, and self-efficacy.

B. Limitations

It is important to acknowledge that this study's limitations impact the interpretation of our findings. First, curricula are not randomly assigned to schools, so schools that are implementing a green curriculum might differ from schools that are implementing a non-green curriculum in meaningful ways. For example, in District 4, schools using Big Ideas (a non-green curriculum) are notably higher achieving relative to schools using the green Illustrative Math. As is true here and likely the case in all districts, reported differences between green and non-green curricula may be confounded with both observed and unobserved differences between the schools using these curricula.

We analyze our survey data using between-group comparisons, rather than more complicated analysis techniques like correlation analysis or multiple regression. While we believe the analysis in this report is a useful starting point for describing and understanding relationships between curricula, PL, and instructional practice, we were not able to control for important confounding variables such as teacher experience, school demographics, and district characteristics. We will explore more sophisticated analytic techniques in future work, assuming that our data can support these models. Additionally, this report relies on teachers' self-reported survey data to capture instructional practices, which may not accurately capture what is actually delivered to students in math classrooms. While self-reports are useful for understanding patterns of responses, we will triangulate these data using more objective measures (for example, classroom observations) as part of our ongoing work.

C. Next steps

We have rich qualitative data that can help us look more closely at adaptations and whether they are productive or not, and—as we delve into inquiry area 5—whether they are planned or unplanned. We will also turn to inquiry area 1 and investigate curriculum efficacy in the context of District 1 and the two green curricula in use in that district.

We will undertake complex analyses to disentangle different factors contributing to the relationships we have begun to see. In these analyses, we will introduce student outcomes—how do curriculum characteristics, instructional practices, and potentially broader context relate to priority students' math classroom experiences? In terms of context, we know from qualitative and anecdotal data collected in the first study year that there was variation between schools and districts in how they coped with the pandemic, in requirements for participation in PL, and in expectations and accountability related to instruction. As a result, we also want to explore the role that a coherent system of supports plays in all of these levers and in our core outcome of interest—priority students' enjoyment of math.

Finally, we will dig deeper into analyses in areas that have special interest to the foundation. There are many quantitative and qualitative data for investigation, and so we will target resources toward such questions.

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Appendix A.

Findings from the Grade 6 Textbook Analysis Using the Surveys of Enacted Curriculum

This appendix provides supplemental analyses that give more detailed information on the SEC analysis. The SEC rates curriculum in both topic emphasis (content coverage) and student performance expectations (cognitive demand). Exhibit A.1 shows the full list of topics and their components that are used to evaluate content coverage.

Exhibit A.1. Topics and sub-topics in SEC

Number sense, properties, and relationships	Operations	Measurement
Place value	Add, subtract whole numbers, integers	Use of measuring instruments
Whole numbers, integers	Multiplication whole numbers, integers	Theory (arbitrary, standard units, unit size)
Operations	Division whole numbers, integers	Conversions
Fractions	Combinations of add, subtract, multiply, divide by whole numbers or integers	Metric (SI) system
Decimals	Equivalent and non-equivalent fractions	Length, perimeter
Percentages	Add, subtract fractions	Area, volume
Ratio, proportion	Multiply fractions	Surface area
Patterns	Divide fractions	Direction, location, navigation
Real and rational numbers	Combinations of add, subtract, multiply, divide fractions	Angles
Exponents, scientific notation	Ratio, proportion	Circles (e.g., pi, radius, area)
Factors, multiples, divisibility	Representations of fractions	Mass (weight)
Odds, evens, primes, composites, square numbers	Equivalence of decimals, fractions, percentages	Time, temperature
Estimation	Add, subtract decimals	Money
Number comparisons	Multiply decimals	Derived measures (e.g., rate and speed)
Order of operations	Divide decimals	Calendar
Computational algorithms	Combinations of add, subtract, multiply, divide decimals	Accuracy, precision
Relationships between operations	Computing with precents	Volume
Number theory (e.g., base-ten, non-base-ten systems)	Computing with exponents, radicals	Distance
Mathematical properties (e.g., distributive property)	Writing expressions and equations	
Basic algebra	**Advanced algebra**	**Geometric concepts**
Absolute value	Quadratic equations	Basic terminology
Use of variables	Systems of equations	Points, lines, rays, segments, vectors
Evaluation of formulas, expressions, equations	Systems of inequalities	Patterns
One-step equations	Compound inequalities	Congruence
Coordinate plane	Matrices, determinants	Similarity
Patterns	Conic sections	Parallels

Basic algebra	Advanced algebra	Geometric concepts
Multi-step equations	Rational, negative exponents, radicals	Triangles
Inequalities	Rules for exponents	Quadrilaterals
Linear, non-linear relations	Complex numbers	Circles
Rate of change, slope, line	Binomial theorem	Angles
Operations on polynomials	Factor and remainder theorem	Polygons
Factoring	Field properties of real number system	Polyhedra
Square roots and radicals	Multiple representations	Models
Operations on radicals	Logarithmic properties	3D relationships
Rational expressions	Rational equations	Symmetry
Multiple representations		Transformations (e.g., flips, turns)
Coordinate plane graphs		Pythagorean theorem
Writing expressions and equations		

Advanced geometry	Data displays	Statistics
Logic, reasoning, proof	Summarize data in a table or graph	Mean, median, mode
Loci	Bar graph, histogram	Variability, standard deviation, range
Spheres, cones, cylinders	Pie charts, circle graphs	Line of best fit
Coordinate geometry	Pictographs	Quartiles, percentiles
Vectors	Line graphs	Bivariate distribution
Analytic geometry	Stem and leaf plots	Confidence intervals
Non-Euclidean geometry	Scatter plots	Correlation
Topology	Box plots	Hypothesis testing
Geometric properties	Line plots	Chi square
Geometric constructions	Classification, Venn diagrams	Data transformation
	Tree diagrams	Central limit theorem
	Tally charts	Sample size
	Frequency table	Statistical questions (e.g., validity and reliability)

Probability	Analysis	Trigonometry
Simple probability	Sequences and series	Basic ratios
Compound probability	Limits	Radian measure
Conditional probability	Continuity	Right triangle trigonometry
Empirical probability	Rates of change	Law of sines, cosines
Sampling, sample spaces	Maxima, minima, range	Identities
Independent and dependent events	Differentiation	Trigonometric equations
Expected value	Integration	Polar coordinates
Binomial distribution	Kinematics	Periodicity
Normal curve		Amplitude
Randomness		

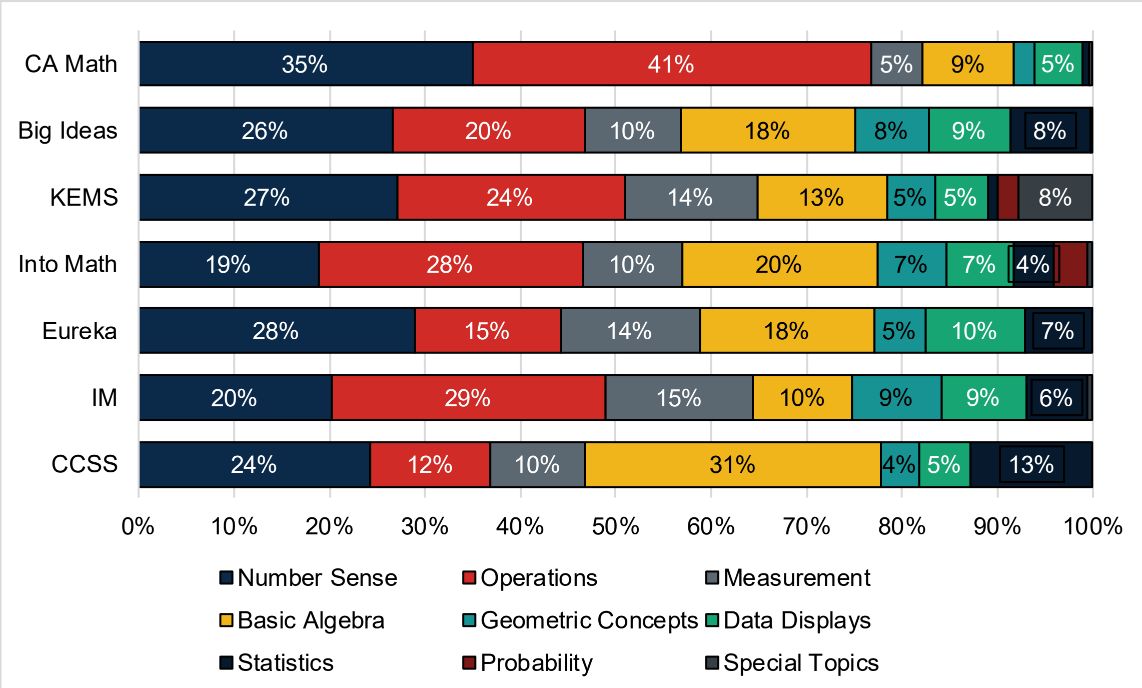
Functions	Special topics
Notation	Sets
Relations	Logic
Linear	Mathematical induction
Quadratic	Linear programming
Polynomial	Networks
Rational	Iteration, recursion
Logarithmic	Permutations, combinations
Exponential	Simulations
Trigonometric, circular	Fractals
Inverse	Problem-solving strategies
Composition	
Definition	
Piece-wise functions	
Transformations	

Relative emphasis across topics

Exhibit A.2 shows for each topic for which there was more than 1 percent coverage how much coverage each curriculum has on that topic. In addition to the overarching findings described in the main report, select curriculum specific findings are as follows:

- **CA Math** places more emphasis on number sense than the other curricula (35 percent of the materials), as well as on operations (41 percent of the materials); emphasis in these topics well exceed CCSS coverage.
- **Into Math** places more emphasis on basic algebra than do other curricula, and comparatively less on number sense.
- **KEMS** devotes a relatively substantial amount of emphasis (8 percent) to the special topic of problem-solving strategies, whereas the other curricula spend no or very little time on this.

Exhibit A.2. Curriculum document topic emphasis, grade 6



Performance expectations

Exhibit A.3 illustrates the coverage each curriculum has on different performance expectations.

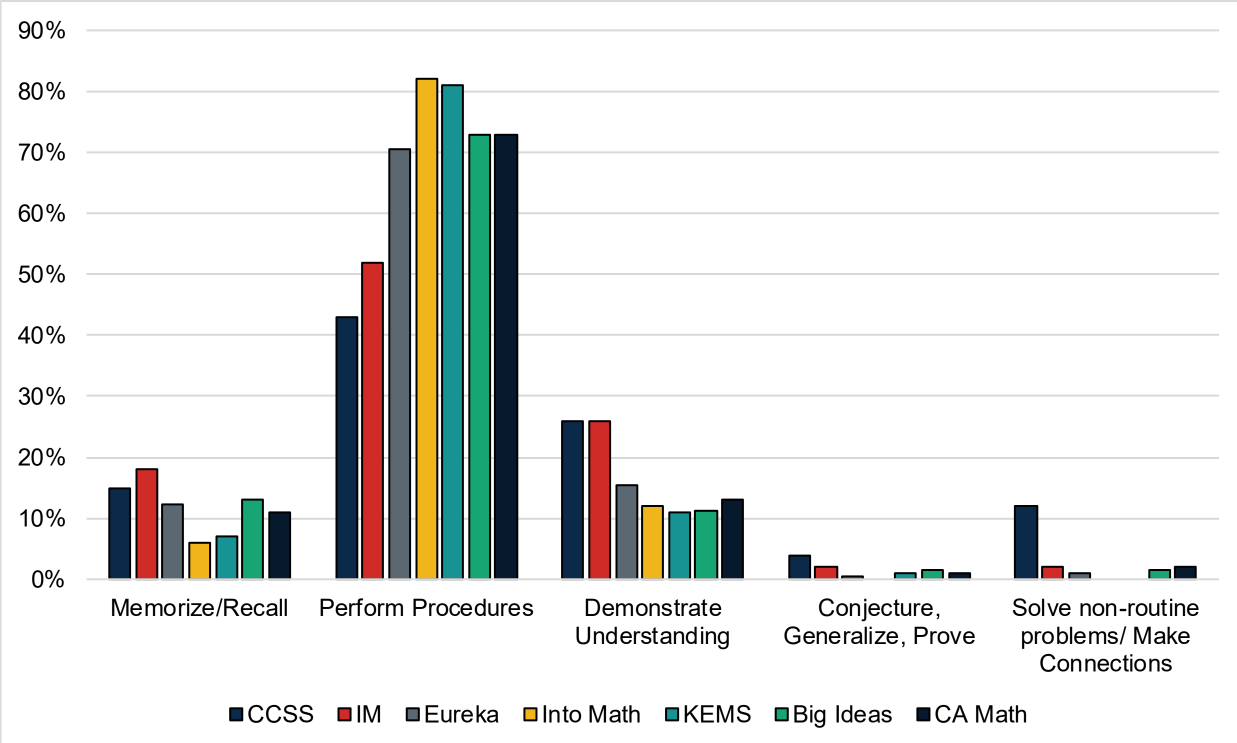
Select overarching findings

- **The majority of every curriculum (52–82 percent) focus on performing procedures.** This compares with 43 percent of the CCSS for grade 6 that focuses on performing procedures.
- **The expectation of solving non-routine problems and making connections is largely absent (<2 percent) from every curriculum.** However, this performance expectation is found in 12 percent of the CCSS for grade 6.

Select curriculum-specific findings

- Memorizing and recalling expectations is most pronounced in Illustrative Math (18 percent) and least pronounced in Into Math (6 percent) and KEMS (7 percent).
- Illustrative Math has the most expectations of demonstrating understanding at 26 percent, compared to 11–15 percent for all other analyzed curricula.

Exhibit A.3. Performance expectations across curriculum materials, grade 6



Content maps

Exhibit A.4 shows what are termed "topographical" content maps. These maps combine the topic coverage and performance expectations to allow us to examine how such performance expectations are addressed across each topic. If covered in the documents, a particular topic at a particular performance expectation typically ranges from 1 percent of the written materials (shown as the large, dotted yellow "valleys") to 10 percent of the materials (shown as blue "hilltops"). The y-axis includes rows for each topic area within grade 6 math and the x-axis includes columns for the five performance expectation levels: (1) memorize/recall, (2) perform procedures, (3) demonstrate understanding, (4) conjecture/generalize/prove, and (5) solve non-routine problems/make connections.

The intersections of the column and row lines describe how much content is addressed at the level of performance expectations for that particular topic area. For example, looking at the topographical content map for KEMS, the top-left most intersection describes how much content within the KEMS curricula is memorizing or recalling within the number sense topic area. The intersection is located in a tan-colored area that indicates 2 percent of written materials are memorizing or recalling number sense mathematical tasks. The CCSS topographical map describes how much content is recommended by standards at each intersection. For instance, standards suggest 3 percent of content include solving non-routine problems or making connections within measurement. Referring back to the KEMS, topographical map, 0 percent of their content include solving non-routine problems or making connections within measurement.

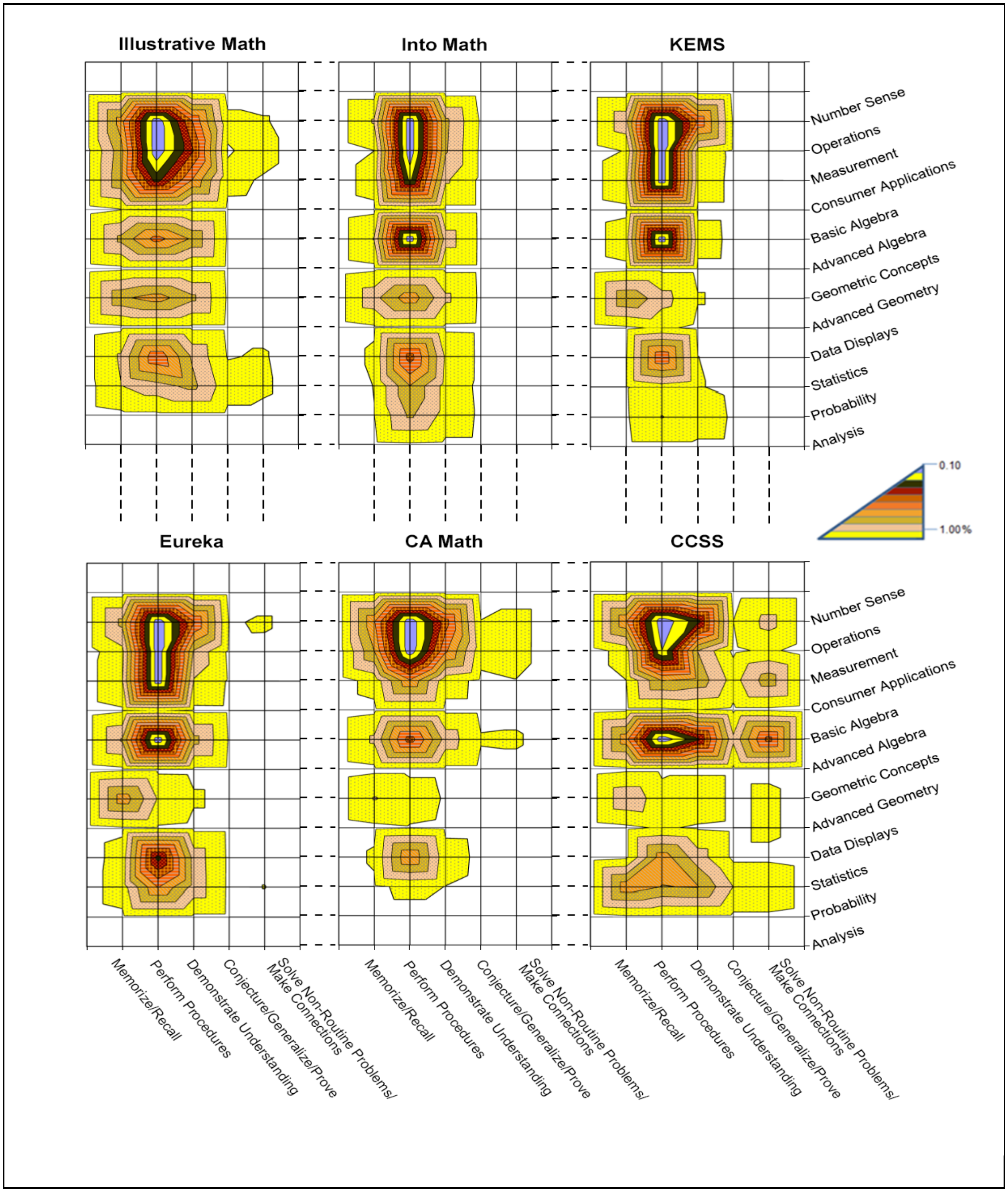
Select overarching findings

- Across all curricula, there is consistent, extensive coverage (≥10 percent of the materials) on performing procedures involving number sense and operations.
- All included curricula have less focus on solving non-routine problems or making connections compared to the CCSS for grade 6.

Select curriculum-specific findings

- While all documents also have extensive coverage on performing procedures regarding basic algebra, this is most apparent (≥10 percent of the materials) with Into Math, KEMS, and Eureka.
- Performance expectations beyond demonstrating mastery are rare across all curriculum documents. Such higher expectations (conjecture/generalize/prove and solve non-routine problems/make connections) are entirely absent from Into Math and KEMS.

Exhibit A.4. Content maps of curriculum documents, grade 6

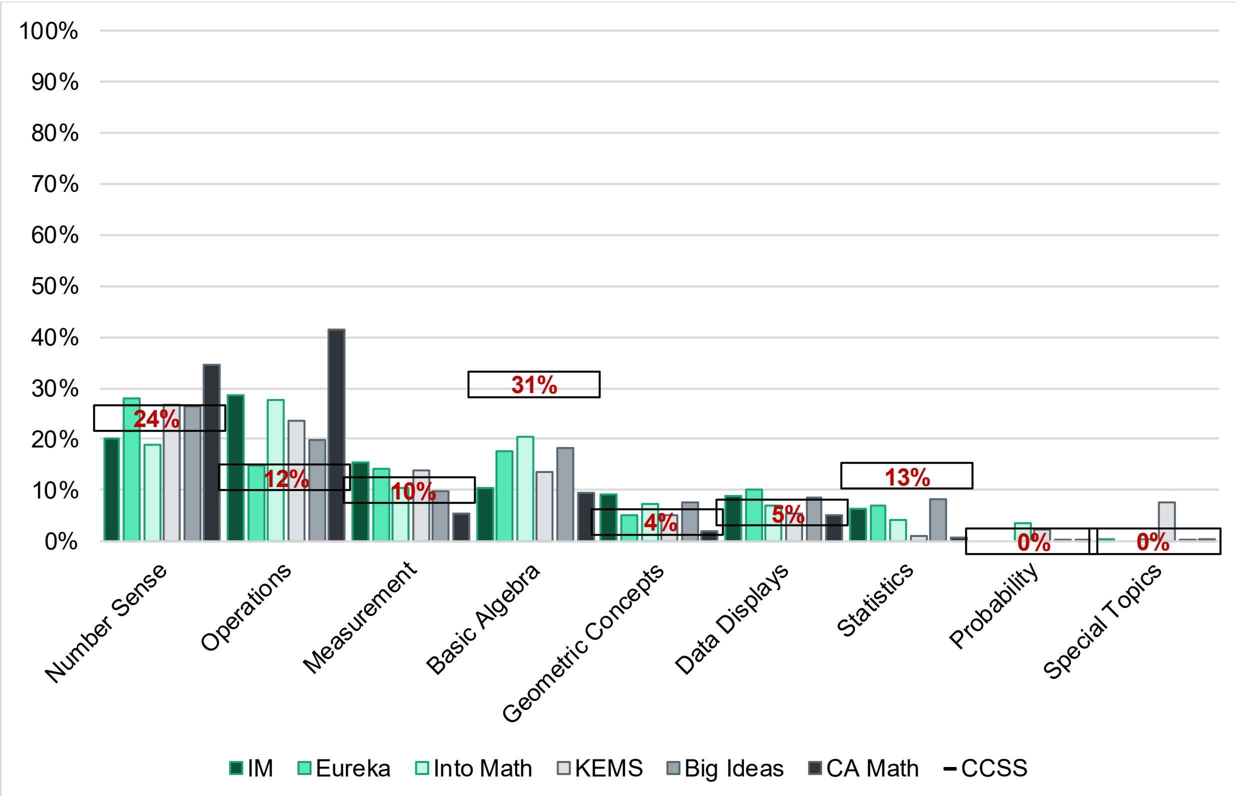


Appendix B.

Supplementary Exhibits for Inquiry Areas

Inquiry area 2

Exhibit B.1. Percentage of study curricula content aligned with the CCSS for grade 6, by SEC content area



Source: SEC ratings of the six study curricula.

Note: Exhibit shows the percentage of study curricula content for each topic SEC assess (represented by the green and grey bars, denoting green and non-green curricula, respectively), compared to the percentage of topic coverage recommended in each area by the CCSS for grade 6 (represented by percentage in the text boxes). All study curricula placed more emphasis on Operations, and less emphasis on Basic Algebra and Statistics, compared to the percentage of topic coverage recommended in each area by the CCSS for grade 6.

Inquiry area 3

Exhibit B.2. Topical focus of activities

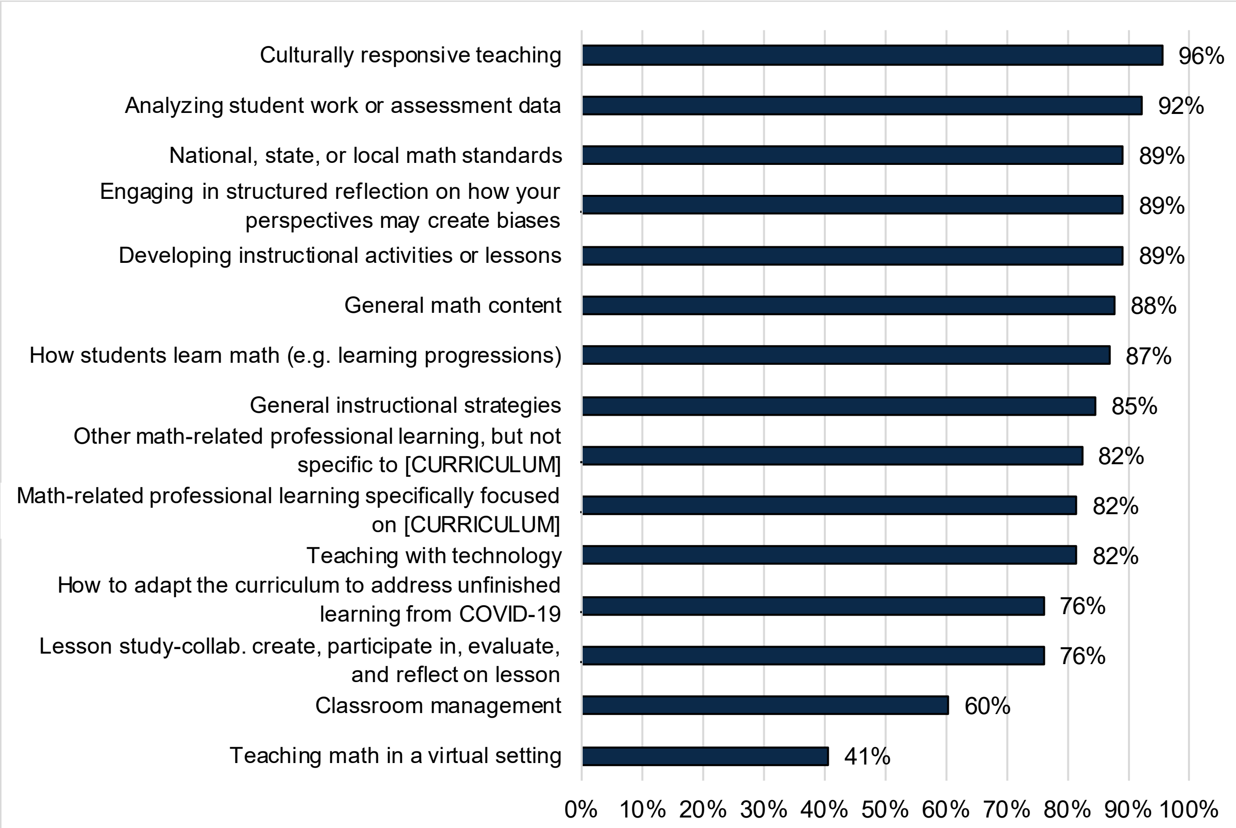


Exhibit B.3. Differences between PL topic areas between frequent adapters and infrequent adapters, CRMT teachers and non-CRMT teachers, and teachers of ambitious pedagogy and teachers of procedural pedagogy

	Teachers of ambitious instruction	Teachers of non-ambitious instruction	Adapters	Non-adapters	CRMT teachers	Non-CRMT teachers
Analyzing student work or assessment data	**2.250**	**1.689**	1.778	1.925	**2.333**	**1.582**
Lesson study-collaboratively create, participate in, evaluate, and reflect on lesson	**1.800**	**1.000**	1.283	1.175	**1.581**	**1.036**
How students learn math (e.g., learning progressions)	**2.160**	**1.344**	1.565	1.600	**2.000**	**1.345**
General math content	**2.333**	**1.500**	1.659	1.825	**2.267**	**1.444**
Developing instructional activities or lessons	2.080	1.721	1.913	1.725	**2.129**	**1.655**
Teaching math in a virtual setting	**1.000**	**0.492**	0.667	0.600	0.867	0.509
How to adapt the curriculum to address unfinished learning from COVID-19	**1.760**	**1.180**	1.261	1.450	**1.742**	**1.127**
Engaging in structured reflection on how your perspectives may create biases	**2.080**	**1.459**	1.696	1.575	**2.065**	**1.400**
Culturally responsive teaching	1.880	1.836	**2.022**	**1.650**	**2.194**	**1.655**
Teaching with technology	1.920	1.525	1.696	1.575	1.742	1.582
National, state, or local math standards	**2.320**	**1.607**	1.935	1.675	**2.290**	**1.545**
Classroom management	**1.400**	**0.867**	**1.244**	**0.775**	**1.355**	**0.833**
General instructional strategies	**2.083**	**1.475**	1.739	1.538	1.933	1.491
Math-related PL specifically focused on [CURRICULUM]	2.080	1.607	1.761	1.725	**2.161**	**1.509**
Other math-related PL, but not specific to [CURRICULUM]	1.440	1.183	**1.457**	**1.026**	**1.613**	**1.056**
N (Teachers)	25	61	46	40	31	55

Source: AMS Spring 2022 teacher survey, question 2.

Note: Bolded values represent significant differences between groups.

Exhibit B.4. Differences between PL topic areas between frequent adapters and infrequent adapters, CRMT teachers and non-CRMT teachers, and teachers of ambitious pedagogy and teachers of procedural pedagogy

	Teachers of ambitious instruction	Teachers of non-ambitious instruction	Adapters	Non-adapters	CRMT teachers	Non-CRMT teachers
Improving my own content knowledge of math	3.160	1.984	2.391	2.250	3.032	1.927
Improving my understanding of how students learn math	3.520	2.508	2.783	2.825	3.452	2.436
Advancing my understanding of how to use [CURRICULUM] in my classroom	**3.360**	**2.197**	2.370	2.725	3.032	2.255
Providing me with teaching strategies that have improved my math instruction	3.520	2.393	2.848	2.575	3.290	2.400
Helping me analyze student performance data in math to identify student needs	3.400	2.180	2.522	2.550	3.258	2.127
Having a positive impact on my instruction in math	3.600	2.623	2.935	2.875	3.419	2.618
Improving my strategies that show respect for cultural backgrounds of students	3.200	2.098	2.587	2.225	3.258	1.945
Challenging mindsets/biases about students to show high expectations for all	3.400	2.443	2.848	2.575	3.355	2.364
Supporting me being responsive to student backgrounds/cultures/points of view	3.280	2.483	2.889	2.525	3.452	2.296
Encouraging me to take action when materials are lacking in representation	3.250	1.902	2.435	2.103	**3.097**	**1.815**
Helping me address the social-emotional needs of my students	3.400	2.200	2.630	2.462	3.258	2.148
Helping me make math relevant for my students	3.480	2.098	2.652	2.325	3.387	2.000
N (Teachers)	25	61	46	40	31	55

Source: AMS Spring 2022 Teacher Survey, question 3.

Note: Bolded values represent significant differences between groups.

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