PRINCETON PUBLIC SCHOOLS

MATHEMATICS PROGRAM EVALUATION REPORT

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ADL
Meaningful Teaching & Learning

Angela Di Michele Lalor Consulting
angela@adlalorconsulting.com
www.adlalorconsulting.com

Sub-Reports

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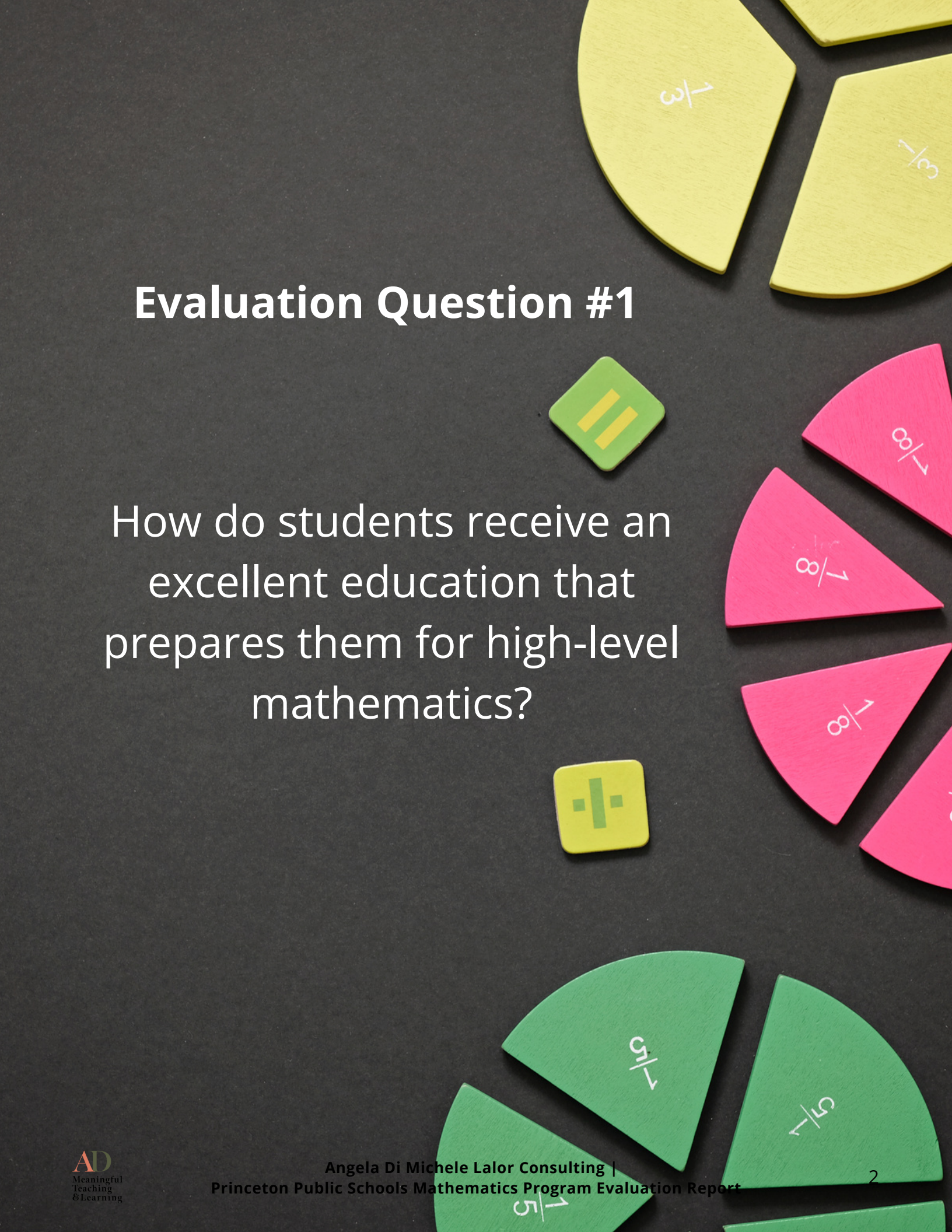
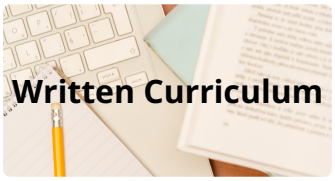
Evaluation Question #1

How do students receive an excellent education that prepares them for high-level mathematics?



Excellent Education



The written curriculum refers to the documents created by the district to guide instruction and are housed in Rubicon Atlas, a web-based curriculum management system. The written curriculum was reviewed and analyzed because it communicates information that teachers can use to make informed decisions about classroom practice. Additionally, district curricula are available to the public and serve as communication tools, informing caregivers about what students will learn and when.

Notably, 70% of teachers do not consult the curriculum housed in Rubicon Atlas. So, while the following findings are important, the Rubicon Atlas curricula need to be integrated into the systems and structures of the district for routine use to impact teaching and learning.

Each grade level has a district curriculum available to the public. The district curricula were updated during the 2022-23 school year. Additional curriculum maps are labeled by school but have not been updated. Only district curricula were reviewed as they are the most current. District curricula were previously analyzed for the degree of alignment with the standards. This review focuses on how the written curricula address the underlying principles of the New Jersey State Learning Standards, incorporate the attributes of a quality curriculum (Lalor, 2016), and prepare students for high-level mathematics.

Underlying principles of the New Jersey State Standards in Mathematics:

- Clearly communicate the critical areas for instruction at each grade level.
- Ensure strong alignment with domains, clusters, and individual standards.
- Delineate the relative importance of various content clusters, such as major clusters, supporting clusters, and additional clusters.
- Foster mathematical rigor by implementing a balanced approach that builds conceptual understanding, procedural fluency, and practical application.
- Leverage the mathematical progressions to build upon prior knowledge and advance student learning systematically.
- Ensure that the standards for mathematical practices are consistently woven into the curriculum

Elementary Curricula: A review of written curriculum documents curricula for grades 3, 4, and 5 indicated the following:

1. New Jersey State Standards for Mathematics are identified in each unit. However, math standards are listed after English Language Arts standards and occasionally with other discipline-specific standards.
2. Every unit includes all Standards for Mathematical Practice, negating their importance within the unit.
3. Grade-level critical areas for instruction are difficult to find. They are listed on the 3rd and 5th grade unit calendars but not on the 4th grade unit calendars. Information regarding the focus of each unit is listed under content, academic vocabulary, and skills.
4. Math standards have not been coded to indicate which belong to major, supporting, and additional clusters.
5. Opportunities to develop conceptual understanding, procedural fluency, and apply mathematics exist but are not explicitly identified or distinguished from other information. Valuable information regarding mathematical rigor is included in the *Math Prerequisite Standards and Learning Objectives* document attached to the unit.
6. Assessment lists vary by grade level and sometimes by units within the same grade level. No assessments are listed for 3rd grade. The link provided for K - 5 does not work. 4th grade includes the same list in all units as formative assessments. There is no connection made to the LinkIt system or iReady assessment system. 5th grade varies by unit.
7. Learning activities are included in different ways. 3rd and 5th grade curricula provide standard codes and topics with links to specific activities. Each unit also includes additional resources, but they are the same links regardless of the unit. 4th grade provides learning objectives, but they are not coded to standards or linked to specific resources.
8. Important information useful in differentiating instruction is included in units. All include *Ready Mathematics Background Models, Progressions, and Teaching Tips* as attachments. Information regarding differentiation and tiered support is duplicated from one unit to the next, thus decreasing its importance and usefulness to the teacher In addition, the 3rd grade includes unit-specific math concept support and enrichment information. The 4th and 5th grade district curricula explain the *Ready Mathematics Background Models, Progressions, and Teaching Tips* attachment.
9. While including the *Ready Mathematics Background Models, Progressions, and Teaching Tips* document is helpful in determining starting points for instruction, it does not make connections to the content students will learn in subsequent grade levels that would help prepare them for the advanced coursework at the middle school.
10. No information is available that explains how to develop students' algebraic thinking at the elementary school.

Middle School Curricula: The district maps for the following courses for middle school math were reviewed: Pre-Algebra Accelerated, Algebra I Part 1, Algebra I Part 2, and Algebra 1 Accelerated.

Pre-Algebra Accelerated and Algebra I Part 2 are the most comprehensive maps of the middle school curricula. Both of these maps could serve as models for other courses. The listed assessments include important information for teachers: topic, standards assessed, purpose (formative or summative), and link. The same is true for the learning activities, which are organized by standard and include the learning objective, a description of the task, and a link to the resource. Similar information is contained in the Algebra I Part 1 curriculum document. Still, connections to learning objectives and activities need to be more explicit, and links to assessments need to be included. As with the elementary school curricula, essential questions, big ideas and content, academic vocabulary, and skills contain a great deal of information and do not highlight the most important conceptual understandings for the unit. Learning activities also need to communicate if they are intended to develop students' conceptual understanding, procedural fluency, or application of knowledge.

There is a significant concern about the curriculum organization for the Pre-Algebra Accelerated, Algebra I Part 1, and Algebra I Part 2 courses. The following graphs illustrate the number of standards targeted in Pre-Algebra Accelerated, Algebra I Part 1, Algebra I Part 2, and the culminating assessment for the course.

Pre-Algebra Accelerated

Targeted Standards		Total Number of Standards Targeted	NJSLA-M
55/55 6th grade standards	30/51 7th grade standards	85 standards	6th grade

Algebra I Part 1

Targeted Standards			Total Number of Standards Targeted	NJSLA-M
51/51 7th grade standards	11/44 8th grade standards	18 HS standards	80 standards	7th grade

Algebra I Part 2

Targeted Standards			Total Number of Standards Targeted	NJSLA-M
33/44 8th grade standards	24/42 HS Algebra standards	29 additional high school standards	86 standards	Algebra

All standards for 6, 7, 8, and Algebra 1 are addressed in a 3-year time frame. To do so requires the strategic organization of standards by domain, clear communication of the conceptual understanding, and explicit articulation of the progressions. Units in Rubicon Atlas were reorganized in 2023 to include some of this information.

The titles of courses at the middle school are confusing. Pre-algebra is a foundational level of mathematics that bridges arithmetic (basic calculations involving numbers) and more advanced algebraic concepts. It covers essential mathematical topics and skills necessary for understanding and solving equations and working with variables. Typically, the following topics are taught in pre-algebra:

- Basic operations: Addition, subtraction, multiplication, and division of numbers and terms.
- Exponents: Understanding and working with powers and exponents.
- Factors and multiples: Identifying factors, common factors, and multiples of numbers.
- Number systems: Understanding properties of integers, fractions, decimals, and percentages.
- Equations and inequalities: Solving simple linear equations and inequalities.
- Order of operations: Rules for correctly evaluating mathematical expressions.
- Variables and expressions: Introduction to using letters or symbols to represent unknown quantities.
- Basic geometry: Working with shapes, angles, and area
- Integers and rational numbers: Operating with positive and negative numbers.
- Ratios and proportions: Understanding proportional relationships between quantities.

These topics are addressed in both the 6th grade Pre-Algebra Accelerated course and the 7th grade Algebra I Part 1 courses.

The names of the courses, Pre-Algebra Accelerated, Algebra I Part 1, and Algebra I Part 2, are confusing because they do not adequately describe what students will learn and how they will be assessed. The term “accelerated” is widely used to describe mathematics courses at the middle school. The term “accelerated” is misleading in the context of the Pre-Algebra course. “Accelerated” is also unnecessary in describing the content of Algebra I. All students will complete the same Algebra I course before leaving middle school. Similarly, if the Algebra II and Geometry courses follow the same curriculum at the high school, the term “accelerated” is not necessary.

Two other courses available at the middle school are Algebra I Accelerated and Algebra II Accelerated. These courses align with high school standards. Algebra I Accelerated at the middle school and Algebra I at the high school follow the same scope and sequence. Both courses result in students taking the Algebra 1 assessment. Algebra II is structured differently at the middle and high school, though they address the same standards and result in the same state assessment. Courses that are available to students at middle school and high school (Algebra I, Algebra II, and now Geometry) should have the same curriculum.

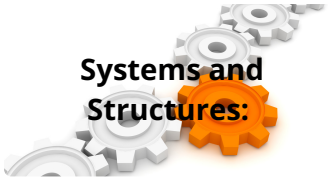
High School Curricula: The following courses were reviewed at the high school since they are courses most commonly taken to fulfill high school graduation requirements. These included Algebra II, Geometry, and Pre-Calculus. The written curriculum for Algebra II and Geometry are structured similarly to the middle school curricula, making it easy for teachers to see the connection between learning goals, resources, assessments, and standards. It should be noted that the high school maps highlight information in red that indicates standards in supporting clusters that can help teachers use the information provided to make instructional decisions. Assessments are identified but not linked.

Course curricula for Algebra II and Geometry are the same for regular, plus, and accelerated courses. Curricula for accelerated courses at the high school identify additional standards to those that are major or supporting standards, and therefore, appropriately labeled. Additional standards are distinguished in red in individual unit documents. Two different maps are available for Pre-Calculus: regular and accelerated. There are differences in the units taught in those courses.

Summary of Findings

Principles of the New Jersey Learning Standards	Elementary Curricula	Middle School Curricula	High School Curricula
Communication of grade-level critical areas	PE	PE	PE
Alignment to grade-level standards	E	PE	E
Communication of emphasis	X	X	PE
Development of mathematical rigor	PE	PE	PE
Leveraging progressions	PE	PE	X
Standards for mathematical practices	PE	PE	PE
Preparation for advanced coursework	X	PE	E

E- Evident
PE - Partially evident
X - Not evident



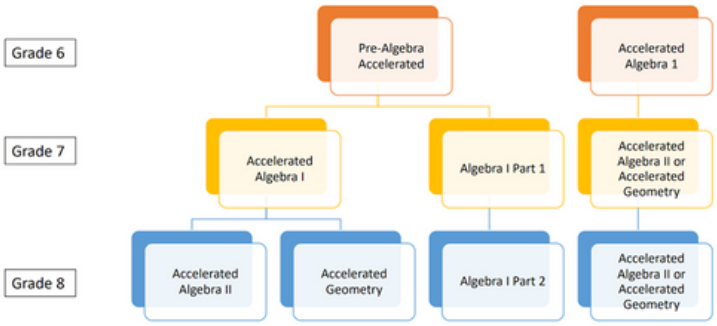
Systems and Structures:

Course Placement Process: Middle school courses encompass many standards, so students complete Algebra I by 8th grade. Additionally, students are allowed to further advance through two, and in some cases, three levels of mathematics to complete Algebra II or Geometry during this time. The opportunity for enrollment in these courses is highly competitive. For accurate placement that ensures all students have access to appropriate, high-level mathematics, this review analyzed the validity and reliability of the assessments used for placement purposes.

Course placement occurs during these grade-level transitions:

- 5th to 6th grade into Pre-Algebra Accelerated or Algebra I Accelerated
- 6th to 7th grade into Algebra I Part 1 or Algebra I Accelerated
- 7th to 8th grade from Algebra I Accelerated to Algebra II Accelerated or Geometry (2023-24 School Year)
- 8th to 9th grade from Algebra I Part 2 to Geometry or Geometry Accelerated

Math Courses at PMS for 2023-2024



During these transitions, the following information is collected and scored using a math placement rubric specific to the course offerings. The placement rubric allocates points based on the following measures:

- Link-It Form C: Assessment aligned to grade-level standards (0 - 4 points)
- Readiness Assessment (0 - 4 points): Assessment aligned to grade level and subsequent grade level standards
- NJ Markers for Success: Rubric completed by the student's teacher to report on student's level of mastery of grade-level skills (0 - 4 points)
- Additional Assessment:
  - Algebra Readiness Assessment (5th graders entering 6th grade)
  - Average of 4 Open-Ended Response Questions (6th graders entering 7th grade)
  - Unit Assessment (7th and 8th graders entering 8th grade or high school)

Diversified and Balanced:

- Three of the four measures are on-demand assessments.
- The student's teacher completes the Markers for Success Rubric. The sample Markers for Success Rubric, accessible through a link in the district's Placement Presentation, was created by the New Jersey Department of Education as part of the Student Growth Objective Process. It was designed as a source to gauge student preparedness for instruction. Although districts are encouraged to modify the rubric, the original rubric was designed to gather teacher input on work habits and included dimensions on participation, independence, and attendance. These are not included in the district's adaptation, which focuses on skills.

Validity and reliability: The assessments used in the placement process and the standards to which they align are as follows:

- The LinkIt Form C is aligned to the grade level standards the students have completed, e.g. 5th-grade students complete a LinkIt Form C Assessment aligned to 5th-grade standards.
- The Readiness Assessment is also a LinkIt Form C assessment aligned with the following standards:
  - Pre-Algebra Readiness Assessment aligns to 5th, 6th, and 7th grade standards
  - Algebra Readiness Assessment aligns to 8th grade standards
  - Algebra ll Readiness Assessment aligns with high school domains
- The Markers for Success Rubric solicits teacher input on student consistency in meeting expectations for grade-level skills.
- Additional assessments: not reviewed

The validity of an assessment depends on its ability to measure its intended outcome accurately. The following charts illustrate the alignment between

- standards and course
- standards and the LinkIt Form C assessment
- standards and readiness assessments

5th-grade students entering 6th grade:

	5th Grade Standards	6th Grade Standards	7th Grade Standards	8th Grade Standards	HS Standards
5th grade course	✓				
Link-It Form C Assessment	✓				
Pre-Algebra Readiness Assessment	✓	✓	✓		
Algebra I Readiness Assessment				✓	

6th grade entering 7th grade:

	6th Grade Standards	7th Grade Standards	8th Grade Standards	HS Standards
6th Grade Course	✓	✓		
Link-It Form C Assessment	✓			
Algebra Readiness Assessment			✓	

The LinkIt Form C Test Blueprint does not show alignment with the Standards for Mathematical Practice. The LinkIt Form C Test Blueprint includes the level of rigor for each question by identifying the DOK level as illustrated in the following chart:

LinkIt Form C	DOK level 1	DOK level 2	DOK level 3
5th (entering 6th grade)	90%	10%	
6th (entering 7th grade)	66%	34%	
7th (entering 8th grade)	28%	43%	29%
8th (entering 9th grade)	45%	33%	22%

Placement Assessment Findings

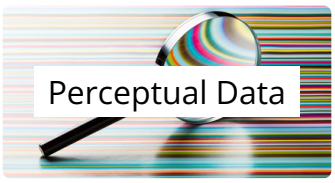
- 5th Grade: According to the district's test blueprint, the 5th grade LinkIt Form C is a valid measure of grade level standards, making it an appropriate assessment of students' mathematical understanding for students who have completed a course aligned with 5th-grade state standards. The Pre-Algebra readiness test blueprint aligns with 5th, 6th, and 7th grade standards and, therefore, aligns with the purpose of the assessment, to determine readiness for coursework that will be taught in middle school. Eligible students are then assessed on 8th grade standards to determine entry into Algebra l Accelerated, also making it a valid form of assessment.

- 6th grade: The LinkIt Form C Assessment for 6th grade aligns with those standards and, therefore, is valid in its design. 6th graders who are enrolled in Pre-Algebra Accelerated are taught some 6th and 7th-grade standards. They are placed into either Algebra l Part 1 or Algebra l Accelerated in 7th grade. Students are assessed on 8th grade standards on the Algebra Readiness assessment. This is appropriate for determining readiness for Algebra, although additional standards from Algebra would provide greater detail on the extent to which students are prepared.

- The LinkIt Form C Test Blueprint does not show alignment with the Standards for Mathematical Practice. This is necessary for determining students' ability to think mathematically as they transcend specific mathematical content and focus on students' habits of mind and practices.

- The LinkIt Form C Test Blueprint includes the level of rigor for each question by identifying the DOK level. When compared to the 5th and 6th grade LinkIt Form C Assessment, the 7th and 8th grade assessments indicate the use of more strategic thinking and reasoning. The Readiness assessments also identify DOK Level, with the predominant number of questions falling into DOK Level 2.

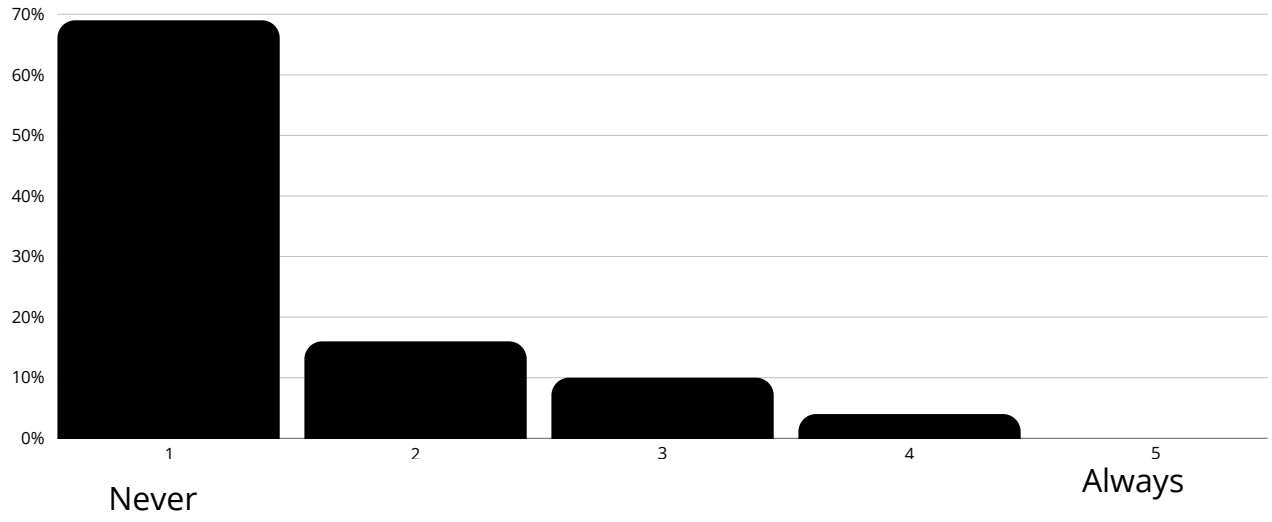
- The Markers for Success Rubric solicits teacher input on student consistency in meeting expectations for grade-level skills. Skills listed in the Rubicon Atlas are lengthy. The accuracy of the information reported on the rubric depends on teachers' understanding of these grade-level skills. In middle school, these skills should span multiple grade levels.



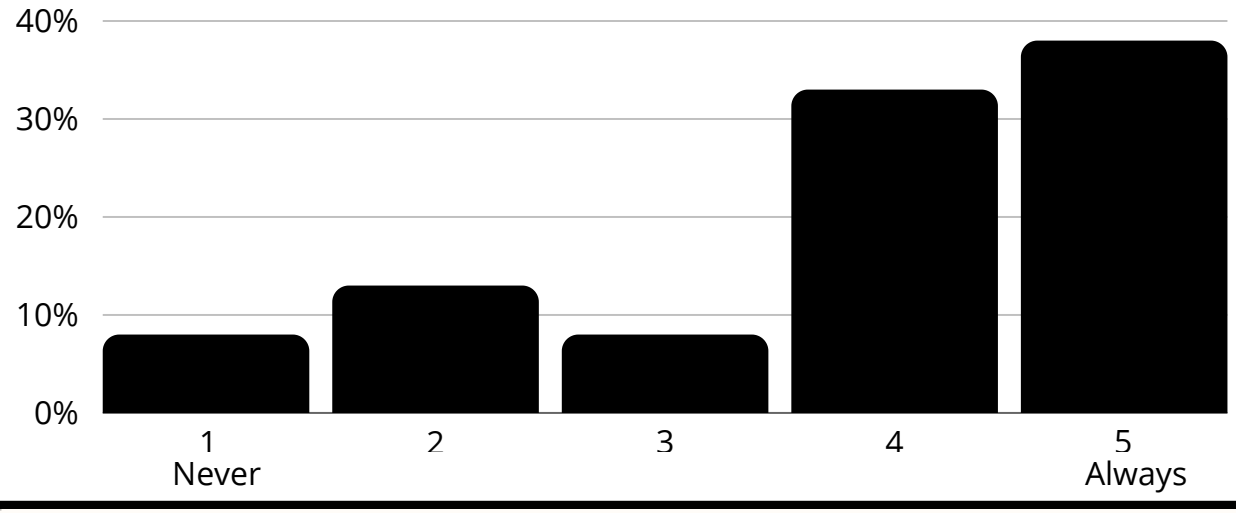
Teacher Surveys and Focus Groups

Surveys and Focus Group Interviews were used to gather perceptual data related to curricula and the placement process. Teachers were asked questions about their use of curriculum and resources, the placement and assessment systems.

How frequently do you consult the mathematics written curriculum housed in Rubicon Atlas to make instructional decisions?



How frequently do you use the mathematics resource (R*eadyMath or SAVVAS EnVision*) to make instructional decisions?



New Jersey Learning Standards and Supporting Principles:

To what degree are you familiar with the New Jersey State Learning Standards and supporting principles? The following chart summarizes teachers' responses.

	Not familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Very familiar
Grade level critical areas for instruction		3 (6%)	4 (8%)	25 (51%)	26 (53%)
Grade level standards		2 (4%)	1 (2%)	15 (31%)	30 (61%)
Levels of Focus	1 (2%)	7 (14%)	8 (16%)	23 (47%)	9 (18%)
Coherence	1 (2%)	5 (10%)	10 (20%)	13 (27%)	19 (39%)
Mathematical rigor		3 (6%)	3 (6%)	26 (53%)	16 (33%)
Standards for mathematical practice		2 (4%)	5 (10%)	18 (37%)	23 (47%)

Placement Process:

What factors should be considered for students to be eligible for accelerated courses in middle school?

The following are teachers' responses:

- Multiple Measures (95.8%)
- Teacher recommendation or input from previous teachers (89.6%)
- Student demonstration (83.3%)
- Student motivation and interest (79.2%)
- Review of student's math grades (72.9%)
- Standardized testing (58.3%)
- Parental support (31.3%)

Teachers' opinions regarding assessment practices and beliefs were also reviewed to determine how they correspond with the assessment used for the placement process.

Which assessments do you use and find most valuable in determining students' understanding of mathematics?	Which assessments do you use for grading and reporting purposes?
• Formative assessments (85.7%) • Performance tasks (83.7%) • Teacher observations (79.6%) • Multiple-choice tests (55.1%) • Projects (42.9%) • LinkIt assessments (42.9%) • Student reflections or journals (34.7%) • New Jersey State Learning Assessments (30.6%) • Math portfolios (12.2%)	• Formative assessments (89.8%) • Multiple-choice tests (75.5%) • Performance tasks (71.4%) • LinkIt assessments (51.1%) • Projects (36.7%) • Student reflections or journals (34.7%) • Math portfolios (14.3%)

Teacher Survey Findings

Use of Curriculum and Resources:

- Most teachers are using their resources or supplementary materials to make instructional decisions. 70% of teachers reported that they frequently/always use *Ready Mathematics* or *SAVVAS EnVision*. At the elementary school, 91% of teachers reported relying on *Ready Mathematics* to guide instruction, and 50% use district technology resources (Desmos, GeoGebra, Canvas, DeltaMath). The reliance on the resource as the curriculum was reinforced by teacher responses to the open-ended question, "what parts of the mathematics program do you feel are most effective?" Teachers' responses indicated that they interpreted "program" to mean the curriculum resource as 82% of the teachers identified some aspect of either *Ready Mathematics* or its corresponding assessment system, *iReady*.
- None of the five teachers who completed the middle school survey use *SAVVAS EnVision*, but all reported using outside resources and district technology resources (Desmos, GeoGebra, Canvas, Delta Math). Their open-ended responses indicated that they felt the teachers were the most vital aspect of the program and could be relied upon to teach the necessary math.

Teacher Survey Findings

Use of Curriculum and Resources:

- At the high school, 78% of teachers reported relying on outside resources. All of the high school teachers reported using technology (Desmos, GeoGebra, Canvas, Delta Math) as resources to support instruction.

New Jersey Learning Standards and Supporting Principles:

- Teachers identified that they are most familiar with the standards for their specific grade level (61%). This area of strength can be developed so that teachers can deepen their understanding of grade-level critical areas (53%) and levels of focus (18%), which will assist them in making decisions about where to spend instructional time.
- Coherence, also referred to as progressions, is another underlying principle of the New Jersey Learning Standards for Mathematics. Only 39% of teachers were familiar with pre-requisite skills and concepts for grade-level standards.

Placement Process:

- Teachers' responses indicate that the majority believe multiple measures (96%) should be considered for students to be eligible for accelerated courses in middle school. The use of multiple measures is also evidenced by the large number of teachers who identified teacher recommendations or input from previous teachers (90%), student demonstration (83), student motivation and interest (79%), and review of student's math grades (73%) as significant factors.
- Standardized testing was less emphasized as a factor that should be considered for placement.

Assessment, Grading and Reporting:

- Formative assessments (86%) and performance tasks (84%) emerged as the most favored and valued assessment methods for determining students' understanding of mathematics.
- Although widely used, multiple-choice tests received a lower percentage of support, with 55% of respondents finding them valuable.
- Teachers value formative assessments and use them for grading and reporting purposes. In most cases, this type of alignment would be favorable. However, formative assessments are intended for providing students with feedback and not grading and reporting purposes.

Assessment, Grading and Reporting:

- Although teachers do not view multiple-choice tests favorably for determining student understanding (55%), a significant proportion (76%) use these tests for grading and reporting purposes. In contrast, teachers value performance tasks as assessments and often use them for grading and reporting.
- Teachers also appreciate projects for their effectiveness in assessing students' comprehension and application of knowledge.

Caregiver Surveys and Focus Groups:

The questions on the survey were designed to ascertain caregivers' insights into their children's learning and achievement, the vehicles in which information is shared with caregivers, and children's access to advanced coursework.

In addition, caregivers were also asked to share their opinions about the mathematics program through open-ended questions:

- What aspects of the mathematics program do you feel have been most effective for your child(ren)?
- What improvements would better support your child(ren)'s mathematics learning?
- Is there anything else you would like to share about your child(ren)'s experience(s) related to learning mathematics at their school?

Caregiver Survey Findings

Student Achievement: Caregivers believe their children excel or are good at mathematics (79%). When asked how they explain to their children that math is important to learn, all respondents indicated that they communicate to their children that math is important because it helps solve problems in everyday life. Parents have high expectations for their children, with 82% wanting their child to take Calculus and above and AP Courses in high school. It is apparent that caregivers believe in their children's capabilities, and the importance of mathematics drives their pursuit of an excellent mathematics program in the Princeton Public Schools.

Curriculum: 43% of caregivers agreed or strongly agreed that their children had access to a high-quality curriculum. Examination of the open-ended responses revealed only 1% of caregivers felt the curriculum was the most effective aspect of the mathematics program for their child. 18% indicated that the curriculum needed improvement, particularly in rigor. Caregivers felt the courses did not allow for depth of understanding, their children were not challenged in their math courses, or they did not receive enough homework.

Accelerated Courses: When caregivers were asked what was most effective, a small percentage of caregivers (13%) identified acceleration as an effective component of the Princeton Mathematics Program. The importance of acceleration was communicated through the 20% of caregivers who either expressed concern that the current accelerated courses would either be reduced or eliminated or expressed a desire for more offerings or different entry points into accelerated courses. Similar points about acceleration were shared when caregivers (19%) were invited to share additional thoughts about the mathematics program.

When asked if they believe it is likely that their child(ren) will have the opportunity to take a high-level mathematics course, 53% responded that they felt their child would advance to the high level they identified, 15% felt their children would not, and 33% were unsure. The common factor, 42% of all respondents, indicated that their children's ability to attain advanced courses was dependent on the school district. This includes whether the school district continued to offer the courses, if the placement process was fair, and if the quality of instruction improved.

Caregiver responses:

- "*I do not believe he will have the chance for a few reasons: there is no differentiated teaching (sorry, but LinkIt doesn't substitute for an actual teacher), there is very little encouragement to grow and be challenged at school, and recently, artificial barriers were created by PPS administration at the middle school and high school to slow kids down. For example, by allowing the child to skip ahead just once in their high school career (why limit a capable child?), or through assessment tests that allow only the top of the top students to pass, even if they scored an A.*"

- *"Yes, but not because of the district (unless things change for the better). Assuming my child continues to be interested in mathematics, if the district continues to fail to provide opportunities (and continues to put up roadblocks) to learn advanced mathematics, I will do whatever it takes (personal tutoring, outside classes, etc.) to make that possible."*

- *"Not sure. Given the way the math curriculum is changing in PMS and from Feedback I've heard from out-of-district families at PHS, it doesn't seem like PPS has a good route set for children who are interested in Math to pursue higher-level courses. Elementary school Math curriculum is not meeting my child's need for challenges either."*

It is important to note that throughout their responses, caregivers recognized the impact of acceleration on teaching and learning, as illustrated in the following comments:

- "*Because the Princeton curriculum is taught at a high level, starting in 6th grade with Pre-Algebra, it forces parents to seek outside help tutoring in elementary school to make sure that they are prepared for the 6th-grade math curriculum.*"

- *"The accelerated classes move so quickly that the teachers admit that they cannot teach the material."*

- *"There is a huge gap between 6th-grade math and 7th-grade accelerated math, where important concepts were just skipped."*

It is also important to note that throughout their responses, caregivers recognized the impact of acceleration on teaching and learning, as illustrated in the following comments:

- "*Children need access to math classes that are suited to their own pace of learning. Not everyone is an accelerated math student. The current HS freshmen and MS students have a gaping hole in their understanding of fundamental algebra -- due not only to the pandemic but also to the fact that all students were put in an accelerated class. Many, many students were overwhelmed by the pace of the class and missed out on the basics of algebra. They now struggle with math and have lost the chance to gain a basic understanding that will drag them further and further behind as the curriculum progresses.*"

- *"There is tremendous pressure for intelligent kids to take high-level math courses. However, there is not adequate teaching to support them in these classes, and they struggle and hate math."*

- *"This sounds very trivial, but hear me out. Much of the uproar over math placement really comes down to branding. Math classes are either "advanced/accelerated" or "regular." No one in Princeton thinks their kid is "regular," hence the push for placement in advanced classes. It would be as simple as calling "regular" math "college preparatory" math instead. People love the idea that their kids are being prepared for college. And this thinking starts long before high school -- 6th-grade algebra is where it all begins."*

- *"There has been too much emphasis on getting too many kids into the PU classes, when that should be for exceptional learners, as an *exception*. There has been too little emphasis on applying math to real life, to build solid foundations, and to appreciating the role that math has played in human development."*

Placement Process: While caregivers were not asked directly about the assessments used for placement purposes, they shared their thinking through open-ended responses to the question, "do you believe it is likely that your child(ren) will have the opportunity to take a high-level mathematics course?" The following comments are representative of several factors that caregivers feel impede student placement:

Communication of the placement process:

- *"We need a fully transparent and fair placement system that is flexible and easy to understand for both old and new students' families."*
- *"I was very frustrated because the placement test/policy was not made clear to students. I wish that my child and myself were aware of the possibilities of advancing a math course. My child was quite bored in her math class throughout middle school. It would be nice if she was able to advance one level to be challenged. I hope that all kids at different levels can be provided with the opportunity to reach their full potential."*
- *"Parents should be provided with a full overview of the math pathways early on so they understand that their children will get to a very high level - and should understand that PPS provides more advanced math opportunities than almost all other public and private schools."*
- *"The issues with teaching math for a population with different backgrounds and skill sets is challenging. However, communication is lacking about how to prepare and in some cases, what the exam is even for. For example, my child took an exam prior to grade 6 to see if she was ready for grade 7 math. At the time, no one could tell us that this was what the exam was for. Only that it was optional. Moreover, since there was no information about this exam, there was no way to prepare, and since it was optional, did it matter? So many kids skipped it since it was during the summer break. Why would you even have that exam available without having the grade 5 teachers involved or at least informed?"*

Pathways:

- *"Some kids mature later. Some children start out slow and may fall behind. However, they may get to the point where they are ready to learn and excel. Hopefully, there is a way for those kids to have a strong basic foundation in math and then have a clear path and support to catch up and excel."*

- *"There is no way she could switch out now at the end of 7th grade because the class content for Accelerated Algebra I has advanced way too much to be caught up. This is the biggest flaw of the tracking program as there is only 1 chance to enter the accelerated track, and extremely unfair to highly able students who did not enter the Princeton district at the 'triage' point."*

Multiple Measures:

- *"Opportunities for all students to take accelerated classes if they are ready. It should never come done to one person's individual assessment or lack of resources or teachers."*

Assessment System: Directly related to the placement process is the assessment system. The assessment system provides caregivers with information about student achievement and often impacts caregivers' expectations for student placement. Caregivers indicated that they use the following assessment methods to understand their children's progress in mathematics:

- Tests 67%
- Homework 57%
- Quizzes 53%
- Classwork 27%
- State assessments 26%
- Projects 9%
- LinkIt assessments 7%
- Performance assessments 7%
- Portfolios 4%
- Teacher feedback 2%

The combination of tests, quizzes, and homework is the highest combination of communication sources. Additionally, caregivers indicated that they use report card grades to monitor progress or that they did not feel that they received adequate information. Two other noticings by caregivers that are critical to understanding the relationship among the overall assessment system, the grading and reporting system, and the placement process are communicated through the following caregiver's comments:

- "*The teachers need to be more creative with assessments and how they evaluate whether a child is learning. A child that gets an F with one teacher and an A with another for the same material is telling. Both teachers say my child gets the concepts. So what differs is what is being utilized as 'performance'".*

- *"I would like to have access to more feedback about her work in math. I feel like in HS, there are not any opportunities to hear about how your child is doing beyond grades and the one-line comment on the report card (that some teachers don't even use). I would love another mechanism for teacher feedback."*

- *"Comprehensive curriculum so that when testing of children is conducted, it is on a curriculum that they have learned."*

- *"I hear from many of the kids/parents, and I've seen from my child, that there is frustration with what is taught vs. what is assessed. There seems to be a widespread disconnect in many of the math courses between the class lessons and what shows up on tests and quizzes."*

- *'I fear that my child has holes in his learning and has not covered the essential topics for Accelerated Algebra I. My son was tutoring another child in Algebra I Part One and saw a topic that he had not learned yet, and my son is in accelerated. This should not be. I truly do not trust the mathematics curriculum at PPS."*

Student Surveys and Focus Groups: The questions on the survey were designed to determine students' mathematical identity, feelings about middle school mathematics, and methods used by students to monitor their learning.

Student Mathematical Identity: Students have mixed feelings about mathematics:

- 3rd and 4th graders: 20% feel okay at math, 36% feel good at math, 28% feel advanced in math
- 5th graders: 28% feel okay at math, 39% feel good at math, 21% feel advanced in math
- Middle school students: 15% excelled at math, 36% felt they were good at math, and 27% of students felt they were average.
- High school: 13% felt that they excelled in mathematics. 41% of students indicated they are good at math, and 2% indicated they are average at math.

Placement process and middle school mathematics: 5th grade students

How do you feel about taking math when you start middle school?	N 172	%
I am excited to take math in middle school	45	26%
I am a little nervous about taking math in middle school	65	38%
I am not looking forward to taking math in middle school	20	12%
I am unsure of how I feel about taking math in middle school	30	17%
Other:	34	20%

Grading and Reporting:

Which of these help you understand what you've learned in math? Check up to 3	Elementary 391		Middle School 586		High School 737		Totals 1714	
	N	%	N	%	N	%	N	%
Quizzes	193	49%	228	39	303	41%	724	42%
Tests	225	58%	194	33%	206	28%	625	37%
LinkIt assessments	45	12%	57	10%	24	3%	126	7%
Classwork	218	56%	436	74%	548	74%	1202	70%
Homework	186	48%	383	65%	513	70%	1082	63%
Projects	144	37%	195	33%	238	32%	577	34%
Portfolios	6	2%	26	4%	12	2%	44	3%
Performance tasks	37	9%	69	12%	68	9%	174	10%
Other: 10 students identified Delta Math	36	9%	38	6%	30	4%	104	6%

Student Survey Findings:

- Students have varying levels of confidence in their mathematical ability. Confidence declined as students moved into middle and high school. In 3rd and 4th grade, 20% of students felt good at math, and 28% felt advanced in math. In 5th grade, 28% felt okay at math, and 21% felt advanced in math. In middle school, 27% of students felt they were average, and 15% felt they excelled at math. This was similar to high school, where 26% indicated they were average at math, and 13% felt they excelled in mathematics.
- When students were asked why mathematics was important to learn, the primary responses varied slightly at the different levels, with the responses of the importance of mathematics in everyday life and getting into a good college appearing on all lists as the most important. Students' reasons for the importance of mathematics were reinforced with their responses to the open-ended question posed at the middle school, What courses do you want to take in high school? Why? Getting into a good college and application to everyday life topped student lists (22%).
- 38% of students were nervous about taking math in middle school.
- Students found classwork (70%) and homework (63%) most helpful in determining what they learned in mathematics.

Conclusions and Recommendations

Elementary Curricula: The information in the elementary school written curriculum highly depends on the resource *Ready Mathematics*. The elementary school curricula do not include important information that would address principles of the New Jersey State Standards in Mathematics. They are also missing information highlighting content to build algebraic thinking at the elementary level in anticipation of the acceleration in middle school.

Recommendations: Improve the written curriculum at the elementary school level so it communicates essential underlying principles of the New Jersey State Learning Standards in Mathematics:

- While opportunities for interdisciplinary connections are appreciated, important math information should be emphasized upon first reading the unit. Connections to other disciplines and standards areas should appear at the end of the document.
- Communicate the critical areas for instruction at each grade level so that teachers know how to best focus instruction.
- Delineate standards that belong to major clusters, supporting clusters, and additional clusters to assist teachers in using time, focusing instruction, and differentiating instruction.
- Identify domains, clusters, standards, and learning activities that develop algebraic thinking to bring them to the teacher's attention.
- Integrate the standards for mathematical practices by specifying which standards for mathematical practice will be emphasized in the unit and how students will utilize them in their learning.
- Foster mathematical rigor by including performance tasks that require students to solve authentic problems. Information regarding mathematical rigor is included in the New Jersey Math Prerequisite Standards and Learning Objectives document and should be incorporated into the curriculum document.
- Utilize learning progressions to include strategies and resources for differentiated instruction for each unit.
- Develop a uniform format for including information teachers can use for classroom instruction. Information should include the learning target (from the New Jersey Math Prerequisite Standards and Learning Objectives document), the corresponding standards, the lesson purpose (build conceptual knowledge, procedural fluency, apply knowledge), and a link to the resource.

Elementary school curriculum also needs to develop student's algebraic thinking. According to the NCTM's *Research Brief on Algebraic Thinking*, three of the main ideas of algebraic thinking are "thinking relationally about equality, thinking rulewise in pattern generalization, and thinking representationally about the relations in problem situations (Kiernan, 2014)." When teachers are made aware of opportunities to develop this thinking and provided with appropriate materials and resources to do so, they can support students in fostering algebraic thinking within the context of arithmetic.

Middle School Curriculum and Course Structures:
Middle school courses align with many standards from multiple grade levels. To illustrate, Pre-Algebra Accelerated targets 85 standards, while 6th grade courses in New Jersey typically target 55 standards. The abundance of standards may lead teachers to either move through content too quickly or eliminate content from the taught curriculum, accounting for a drop in the percentage of students who express a positive mathematical identity at the middle school level. In addition, students may not have developed the deep conceptual understanding necessary for future success in mathematics.

The names of the Pre-Algebra Accelerated and Algebra I Part 1 and Algebra I Part 2 do not accurately reflect the standards identified in the courses, nor the intention of the course. Students learn material from multiple grade levels and are then assessed on the grade level New Jersey State Learning Standards Assessments in Mathematics for that course. For example, 7th grade students learn material designated for 7th and 8th grade and Algebra and then are assessed on the 7th grade New Jersey State Learning Standards Assessment for Mathematics. The number of standards in the course, the responsibility of adequately preparing students for a state assessment, and the lack of a written curriculum may unintentionally impact teacher's instructional decisions. Students may be underprepared for the state assessments or prepared for the state exams but not fully prepared with the conceptual understanding necessary for the next course.

In addition, the titles of courses at the middle school are confusing. Pre-algebra is a foundational level of mathematics that bridges arithmetic (basic calculations involving numbers) and more advanced algebraic concepts. It covers essential mathematical topics and skills necessary for understanding and solving equations and working with variables. Both the 6th grade Pre-Algebra course and the 7th grade Algebra I Part 1 courses could be described as Pre-Algebra courses. In addition, these courses result in grade-level assessments so alternative names would be more appropriate.

"Accelerated" is overused at the middle school. The entire program at the middle school is designed to cover multiple grade level standards, so the term accelerated is not an appropriate designation for the Pre-Algebra Accelerated course. In addition, while students in middle school take Algebra I and Algebra II earlier than their peers, the term "accelerated" is not a necessary designation. Students in these courses are already on a pathway to advanced courses in high school, which will be indicated on their school transcripts.

The inability of course names to accurately describe content contributes to the confusion and concerns shared by parents and students in both surveys and focus groups. These include misunderstanding about what is taught, the pace and rigor in which it is taught, and the assessment used to measure and report on student achievement.

Recommendations: Courses at the middle school need to be re-examined to ensure they strategically address all standards for grades 6th, 7th, and 8th grade in a way that is not overloaded with an unreasonable number of standards and fosters conceptual understanding for students. This requires organizing standards by domain, clearly communicating the conceptual understanding, and explicitly articulating progressions. The New Jersey Math Prerequisite Standards and Learning Objectives document can provide guidance on how to appropriately address standards from multiple grade levels at the same time.

A revised Pre-Algebra class should mainly focus on 6th grade standards and essential 7th grade standards, culminating in the New Jersey State Learning Assessment in 6th grade. The course currently known as Algebra I Part 1 should focus mainly on 7th grade standards and priority 8th grade standards, concluding with the 7th grade New Jersey Learning Standards Assessment. The course names should be changed to minimize confusion and describe course content and assessment more accurately. The Algebra l Part 2 would be replaced with the Algebra l course. “Accelerated” should be removed from the Pre-Algebra course.

Grade Level	Current Course Title	Standards				Culminating Assessment
		6th Grade	7th Grade	8th Grade	High School	
6th Grade	Pre-Algebra Accelerated	✓	✓			6th Grade NJLSA-M
7th Grade	Algebra l Part 1		✓	✓		7th Grade NJLSA-M
8th grade	Algebra l Part 2 (replace with Algebra l)				✓	Algebra NJLSA-M

Middle School and High School Course Curricula:
Algebra ll is structured differently at the middle and high school, though they address the same standards and result in the same state assessment. Courses that are available to students at middle school and high school (Algebra l, Algebra ll, and Geometry) should have the same curriculum.

Recommendation: Teachers responsible for the same courses must meet regularly to ensure students have access to the same high expectations and that courses are not modified at either level. Together, educators can develop strategies that assist students at all levels in developing deep conceptual understandings, strategies, and dispositions to engage in the productive struggle necessary for pursuing high-level mathematics.

Use of Curriculum and Resources: Most teachers are using their resources or supplementary materials to make instructional decisions.

70% of teachers reported that they do not consult Rubicon Atlas to make instructional decisions. Teachers rely mostly on their textbooks, *Ready Mathematics* and *SAVAAS EnVisions*, which EdReport has highly rated. In addition, many are supplementing the textbook with additional materials and resources. This is problematic for the following reasons:

- Textbooks need guiding documents, such as a written curriculum, to ensure grade-level critical areas, areas of focus, and, in the case of advanced coursework, algebraic thinking, are emphasized during instruction.
- The level of rigor may vary from classroom to classroom because so many teachers are using supplemental materials and resources without a written curriculum to guide them.
- Teacher's instruction may vary in quality without a guiding document that identifies high-quality instructional practices.
- Assessments may vary in quality and reliability if they do not strongly align with established standards.
- Reliance on textbooks may reduce understanding of the underlying principle of the standards that could be used to further enhance and support student learning.

Teachers identified that they are most familiar with the standards for their specific grade level (61%). This area of strength can be developed so that teachers can deepen their understanding of grade-level critical areas (53%) and levels of focus (32%), which will assist them in making decisions about where to spend instructional time. Without this understanding, all content and standards are given equal weight and approached as a checklist of skills to be covered. Understanding critical areas for instruction and standards emphasis is particularly important at the middle school, where courses include standards from multiple grade levels, and teachers indicated that they had limited to insufficient time to address the curriculum, address the needs of all students, and prepare students for advanced coursework.

Coherence, also referred to as progressions is another underlying principle of the New Jersey Learning Standards for Mathematics. Only 39 % of teachers were familiar with pre-requisite skills and concepts for grade-level standards. Deepening understanding of the progression would help teachers to differentiate instruction. It would be beneficial at the middle school, where teachers address multiple grade-level standards simultaneously.

As important as the content are the standards for mathematical practice. NCTM's Research Brief, *Continuing the Journey: Mathematics Learning 2021 and Beyond*, emphasizes, "The processes and practices must be viewed as co-equal partners with the specific content priorities for each grade or course. One cannot be fully realized without the other, and both are essential in helping students to reach the broader mathematical goals for student learning."

Often, the standards for mathematical practice are given equal weight in all units and not prioritized based on how they support student understanding of the content. When they are explicitly named and integrated into instruction, they can be leveraged as tools for learning across grade levels.

Recommendation: Curriculum design initiatives are high-leverage opportunities for teachers to work collaboratively to understand grade-level standards and learning progressions across grade-level domains, clusters, and standards and to share and develop effective instructional practices.

The NCTM *Research Brief on Curriculum* also highlights the necessity for adequate professional development to ensure teachers can effectively implement a high-quality curriculum. In Princeton Public Schools, where most teachers do not currently rely on the written curriculum for instructional decisions, it is crucial to provide time to develop the written curriculum as a collaborative professional learning experience and integrate it into all professional learning opportunities.

Course Placement Process: The assessments that make up the current placement system vary in quality. While the LinkIt Form C Assessments and the Readiness Assessment demonstrate alignment to standards, they do not include the standards for mathematical practice, which are critical for determining students' mathematical reasoning. In addition, the thinking demands of the questions vary, becoming more complex but not sufficiently complex for a placement process that advances students through 2-3 grade levels of standards and ensures they have the necessary conceptual understandings.

The Marker for Success Rubric is not a reliable form of assessment as it is based on individual teachers' understanding of grade level skills, and currently, teachers are not widely using the Rubicon Atlas curriculum as a common source for this information. The fourth assessment used for placement purposes was not readily available, nor was an assessment blueprint available for review.

Recommendations:
It is the expressed desire of the stakeholders of Princeton Public Schools to offer advanced courses at the middle school with all students completing Algebra l in 8th grade. It should be noted that research and position papers from professional math educators, including the National Council for Teachers of Mathematics and NCSM: Leadership in Mathematics Education, have explicitly called for a common course pathway through middle school. Although this is not the decision of Princeton Public Schools, information from this research should be used to ensure that the placement process does not undermine student success.

Foundational is a strong elementary program that builds student conceptual understanding to develop procedural fluency and develops a positive student mathematical identity and agency. Acceleration may be appropriate for some students in middle school. Guidance from NCTM suggests, “Appropriate acceleration must ensure that no critical concepts are rushed or skipped, and such decisions should not be based solely on traditional assessment instrument results (NCTM 2016).”

Revisions are needed to the course placement system to ensure students are appropriately placed in middle school courses. These changes can work with the existing current mathematics placement rubric. These revisions include:

- Ensuring the grade level LinkIt Assessments align with the critical areas and major clusters for the grade level and standards that indicate students' algebraic thinking. The grade level LinkIt assessments should also align with the standards for mathematical practice and cover a range of thinking levels as indicated by the Depth of Knowledge Levels.
- Readiness assessments should align with standards foundational to the content of the advanced course. These standards are determined by examining progressions documents. Readiness assessments should also align with the standards for mathematical practice and address a range of thinking levels.
- Revising the Markers for Success Rubric to include specific concepts, skills, and mathematical practices and dispositions the student should demonstrate. There should be a way for the student's teacher to share additional, relevant information that may impact student success in the advanced course.
- Replace or revise the additional assessment method to include performance tasks. Performance tasks are extended response tasks that allow multiple entry points that enable students to express their thinking. These performance tasks should be designed to align with critical areas for a grade level that is part of the progression for the advanced course.
- Add an option for educators, caregivers, or students to contribute additional information for consideration.

Assessments and Placement System: There are several discrepancies that exist among curriculum, assessment, and placement systems that may contribute to some of the misunderstandings expressed by caregivers regarding student achievement and the placement process at the middle school.

Formative assessments (86%) and performance tasks (84%) emerged as the most favored and valued assessment methods among teachers for determining students' understanding of mathematics. These methods provide insights into student progress and opportunities for teachers to adjust instruction. Open-ended assessments, such as performance tasks, are useful in evaluating student application of mathematics and the use of the standards for mathematical practices. Although widely used, multiple-choice tests received a lower percentage of support, with 55% of respondents finding them valuable. Multiple-choice tests offer efficient and standardized assessment methods. However, they may not fully capture students' depth of understanding as they are more suitable for assessing factual knowledge and may not adequately assess problem-solving skills or conceptual understanding. Teachers value formative assessments and use them for grading and reporting purposes. In most cases, this type of alignment would be favorable. Here, it indicates a misunderstanding of formative assessments. Dylan Wiliam, a prominent educational researcher, and expert in formative assessment, defines formative assessment as all those activities undertaken by teachers and their students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged. As soon as an assessment is graded, the formative assessment process has ended, and it becomes a summative assessment instead.

In contrast, teachers value performance tasks as assessments and often use them for grading and reporting. Performance tasks assess students' understanding of real-world contexts and their capacity to evaluate problem-solving skills and critical thinking. Similarly, teachers also appreciate projects for their effectiveness in assessing students' comprehension and application of knowledge. If implemented more widely and with clearer guidelines on how parents can interpret and utilize project-based assessments to monitor their children's progress, projects could become a viable and informative form of communicating student achievement and growth.

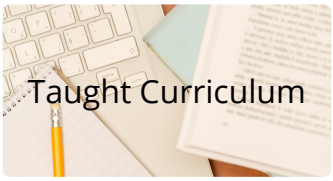
Recommendations: Revisions to the placement assessments need to correspond with the overall assessment, grading, and reporting system. The most effective way to align these systems is to ensure curricula, assessments, and all tools for communicating student progress and achievement are intentionally and explicitly aligned to the New Jersey Standards for Mathematics and the standards for mathematical practice. Creating assessment blueprints must become a routine practice to ensure the reliability and validity of the assessments used during the placement process, and all summative assessments used for grading and reporting purposes. It is also recommended that teachers work collaboratively to deepen their understanding of diagnostic and formative assessments as evidence used to drive instruction and in developing students as assessment-capable learners.

All educators would benefit from assessment literacy. By connecting New Jersey Learning Standards in Mathematics to classroom formative assessments and district progress-monitoring systems, educators can differentiate instruction for those still developing conceptual understandings and those ready for further application and knowledge. Widespread use of test blueprints would increase the validity and reliability of all assessments and improve communication of student progress and achievement. A diversified and balanced assessment system would provide all stakeholders with more detailed information about students' depth of understanding of key mathematical concepts, use of mathematical reasoning, and aptitude for applying mathematics to new and non-routine situations.

Evaluation Question #2

- What instructional practices and routines do teachers use to prepare students for high-level mathematics?
- How are teachers supported in designing and implementing curricula that leads to advanced courses?

Effective Teaching and Learning



Classroom Visits:

The purpose of the classroom visits was to gain insight into the implementation of mathematics teaching and learning in the Princeton Public Schools.
The classroom visits were conducted on May 23rd and 24th. Members of the Princeton Program Evaluation Team volunteered to be involved in this process. Some members of the team offered to host a classroom visit. Additional faculty members who were not on the Princeton Program Evaluation Team also volunteered to host visits to provide a broader sample of grade levels.
In total, 12 elementary, 10 middle school, and 2 high school classrooms were visited. Due to the small number of high school classrooms visited, this measure could not be used for the analysis of the high school instructional practices and routines.

The classroom visits involved trios or pairs of Program Evaluation Team members. Prior to classroom visits, the Program Evaluation Team members created the guidelines to follow as consistent norms:

- Visitors maintain a friendly and welcoming presence.
- Visitors spread out in the classroom and remain as inconspicuous as possible.
- Visitors to the classroom do not record any information during their visit.
- Visitors engage with students if circumstances allow but are mindful not to disrupt learning.
- Visitors debrief outside the classroom.

The trios or pairs pushed into classrooms for 10-15 minutes and captured insights related to 3 categories: Classroom Environment and Instructional Models, Rigor, and Engagement.
The team used Google Forms that were created to capture insights related to the Princeton mathematics department vision and teaching and learning practices defined in the research. Each trio or pair met to calibrate the process and assign the lens that an individual would prioritize. There was an opportunity to debrief and share insights before the Google Forms were submitted.

Classroom Environment & Instructional Materials:

The purpose of this lens was to gain insight into the learning environments. The characteristics listed include aspects that affect safety, accessibility, and classroom culture. The instructional materials displayed provide insight into how student learning is facilitated within the classroom environment.

The table below summarizes the insights collected related to classroom environment and instructional materials:

Characteristic	12 Elementary School Classrooms		10 Middle School Classrooms		Combined (22)	
	N	%	N	%	N	%
Furniture is arranged to ensure safety and accessibility and promote collaboration	10	83%	7	70%	17	77%
Use of precise mathematics language is encouraged and supported	10	83%	5	50%	15	68%
Appropriate mathematics resources are accessed	7	58%	6	60%	13	59%
Norms are clear and respected	7	58%	9	90%	16	73%
Mathematics anchor charts are displayed	5	42%	2	20%	7	32%
Goal for the lesson is clear	4	33%	6	60%	10	46%
Displays related to mathematical mindset and identity exist	2	17%	5	50%	7	32%
Student mathematics work is displayed	1	8%	1	10%	2	9%

Instructional Model(s) & Use of Time:

This lens provided insight into the lesson design. Characteristics include the grouping structures used and how the learning progression is paced. The actual learning activities and formative assessment practices may be included.

The table below summarizes the insights collected related to instructional models and use of time:

Characteristic	12 Elementary School Classrooms		10 Middle School Classrooms		Combined (22)	
	N	%	N	%	N	%
Individual practice	9	75%	5	50%	14	64%
Appropriate learning routines exist	9	75%	6	60%	15	68%
Small Groups	8	67%	3	30%	11	50%
Tasks are aligned to the goals of the lesson	8	67%	7	70%	15	68%
Use of space to maximize learning routines	7	58%	5	50%	12	55%
Centers or Stations	6	50%	2	20%	8	36%
Direct Instruction	5	23%	6	60%	11	50%
Guided Practice	5	23%	6	60%	11	50%
Conferencing	5	23%	4	40%	9	41%
Whole Group	4	33%	7	70%	11	50%
Checks for understanding are implemented	4	33%	7	70%	11	50%
Computers	4	33%	0	0%	4	18%
Mini-Lesson	3	25%	2	20%	5	23%
Responsive Pacing	3	25%	5	50%	8	36%
Do-Now	1	8%	1	10%	2	9%
Problem-Based or Inquiry-Based Model	1	8%	4	40%	5	23%

Student Engagement:

This category is intended to capture insight into how students are engaged in learning. It includes noticing physical features and listening to student voice to infer cognitive engagement.

The table below summarizes the insights collected related to student engagement:

Characteristic	12 Elementary School Classrooms		10 Middle School Classrooms		Combined (22)	
	N	%	N	%	N	%
Students worked with a partner	8	67%	3	30%	11	50%
Students worked in a small group	11	92%	1	10%	12	55%
Students worked independently	12	100%	10	100%	22	100%
Active participation	11	92%	8	80%	19	86%
Thoughtful reflection	9	75%	6	60%	15	68%
Visible reflection and metacognition	8	67%	4	40%	12	55%
Collaboration and discussion	8	67%	4	40%	12	55%
Application of knowledge	7	58%	3	30%	10	46%

	Elementary Data	Elementary AVERAGE	Middle School Data	Middle School AVERAGE
Overall Level of Engagement	5,5,5,5,5,5,4,4,4,3,3,2	**4.5**	4,4,4,4,3,3,2,2,2,1,1	**2.7**
Overall Level of Participation	5,5,5,5,4,4,4,4,4,3,3,2	**4.0**	4,4,2,2,2,1,1,1	**2.1**

Rigor:

The purpose of this lens is to gain insight into students' level of thinking as demonstrated through their interactions with the teacher and peers. It includes teacher and student questions that create response opportunities, discourse, and verbal feedback.

Costa's taxonomy provides common coding:
Level 1: Gathering
Level 2: Processing
Level 3: Applying

The table on the following page summarizes the insights collected related to student rigor:

Characteristic	12 Elementary School Classrooms		10 Middle School Classrooms		Combined (22)	
Types of Interaction	**N**	**%**	**N**	**%**	**N**	**%**
• Teacher to student	11	92%	10	100%	21	96%
• Student to teacher	10	83%	8	80%	18	82%
• Student to student	9	75%	5	50%	14	64%
Levels of thinking prompted through questions asked by the teacher:						
• Level 1: Gathering	9	75%	9	90%	18	82%
• Level 2: Processing	10	83%	7	70%	17	77%
• Level 3: Applying	5	42%	1	10%	6	27%
Levels of thinking demonstrated by student responses to teacher questions:						
• Level 1: Gathering	10	83%	9	90%	19	86%
• Level 2: Processing	11	92%	7	70%	18	82%
• Level 3: Applying	7	58%	1	10%	8	36%
Levels of student thinking implied by the questions students ask						
• Level 1: Gathering	4	33%	4	40%	8	36%
• Level 2: Processing	3	25%	1	10%	4	18%
• Level 3: Applying	1	8%	0	0	1	5%
Teacher and Student Feedback						
• Verbal feedback provided to students from teacher	10	83%	9	90%	19	86%
• Written feedback provided to students from teacher	1	8%	1	10%	2	9%
• Verbal feedback provided to students from other students	7	58%	3	30%	10	46%
• Written feedback provided to students from other students	1	8%	0	0%	1	5%
• Student use of feedback during class time	6	50%	3	30%	7	32%

Classroom Visit Findings:

Classroom Environment & Instructional Materials:

- Precise mathematics language is encouraged and supported, especially at the elementary level.
- Classroom norms were clear and respected in 90% of the middle school classrooms. This commitment to expectations within the classroom environment ensures that time is preserved for learning, not behavior management.
- Furniture arranged to ensure safety and accessibility and promote collaboration appears acceptable, but there may be an issue with the item because it contains multiple factors.
- Space restrictions and inflexible furniture arrangement may be a challenge to implementing small group work and centers or stations at the middle school.

Instructional Model(s) & Use of Time:

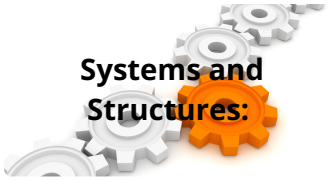
- Appropriate learning routines and tasks aligned to the goals of the lesson were relatively strong in both elementary and middle classrooms.
- Elementary classrooms use different small group structures, including centers or stations, while middle school routines are more often whole class.
- There was only 1 of the 12 elementary classrooms where an instructional model aligned with the concepts of problem-based or inquiry-based learning was being used.

Student Engagement:

- Students in all classrooms were able to work independently. This is a significant benefit as the adults in the classroom can provide guidance and support to small groups or individual students without the distraction of monitoring and addressing behavior.
- Elementary students demonstrated thoughtful reflection and meta-cognition in at least 2/3 of the classrooms. This higher-order thinking is extremely beneficial to establish at a young age so that learners can be confident critical thinkers as the mathematical concepts become more sophisticated.
- The overall level of engagement and participation at the middle school is below average. Collaborative structures, including working with a partner, working in a small group, and collaboration and discussion, were all low (each <50%).

Rigor:

- There were a limited number of student-to-student interactions at the middle school. This is connected to the lack of collaborative strategies previously noted.
- Levels of thinking demonstrated by student responses and questions posed seldom stretched into higher-order thinking in both elementary and middle school classrooms.



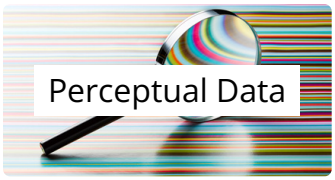
Systems and Structures: Professional Development

The Princeton Public School District Professional Development Plan for 2022-2023 contained the following three overarching professional learning goals:

A. Raising Rigor for All
B. Whole Child / Social-Emotional Learning
C. Mastery of Core Subjects / Academic & Cognitive Development

In reviewing the initial activities there was specific mention of executive functioning skills, responsive classroom practices, Columbia Teachers' College Reading and Writing Workshops, and Orton-Gillingham training. There was an initial activity related to content articulation through monthly Professional Learning Committees (PLCs) but there is no indication that teachers of mathematics were involved in this activity. In reviewing the follow-up activities related to the goal of Mastery of Core Subjects/Academic and Cognitive Development, there is specific mention of Math Workshop training with Jennifer Lempp, author of *Math Workshop: Five Steps to Implementing Guided Math, Learning Stations, Reflection and More*, but not enough detail to assess the scope of the professional learning.

Secondary mathematics teachers had the option to participate in voluntary book clubs around the books cited earlier in this report: *Building Thinking Classrooms in Mathematics, Grades K-12* by Liljedahl, *Mathematical Mindsets* by Jo Boaler, and *Catalyzing Change* by National Council of Teachers of Mathematics. There is no evidence that this will continue as a practice.



Perceptual Data

Surveys and Focus Group Interviews were used to gather perceptual data related to the instructional practices and routines used to prepare learners for high levels of mathematics. The teachers also responded to two questions related to professional development.

The next section of this report identifies the survey questions and resulting data aligned with instructional practices and routines.

The analysis involved reviewing the data, creating inferences from the data, and drafting some considerations (Here's What, So What, Now What protocol).

Teacher Survey: Teachers were asked 3 questions about their instructional practices and routines. For the first 2 questions, the response options were:

- **N**ever: 0 times per week
- **R**arely: 1-2 times per week
- **O**ccasionally: 3-4 times per week
- **F**requently: Every day
- **A**lways: Multiple times per day

Question #1: How often do students participate in the following activities during mathematics instruction? Check all that apply:

Learning Strategies	N	R		O		F		A		AVERAGE
		N	%	N	%	N	%	N	%	
Engage in mathematical discussions	0	2	4%	10	20%	20	41%	17	35%	4.1
Communicate mathematical reasoning	0	2	4%	5	10%	2	53%	16	32%	4.1
Use mathematical practices, including math tools and visual representations	0	1	2%	10	20%	26	53%	12	25%	4.0
Work independently	0	2	4%	8	16%	31	63%	8	16%	3.9
Work collaboratively with a partner or in small groups	0	3	6%	14	29%	19	39%	13	27%	3.9
Solve problem sets to develop procedural fluency	0	3	6%	14	29%	17	35%	15	31%	3.9
Engage in activities that promote a growth mindset and mathematical identity	0	6	12%	11	22%	22	45%	10	20%	3.7
Connect mathematics to their own experiences and interests	0	7	14%	17	35%	19	39%	6	12%	3.5

Teacher responses, frequently and always, were used for comparison with other stakeholders (totals are reflected in the following chart).

Learning Strategy	F	A	Totals	
			N	%
Engage in mathematical discussions	20	17	37	76%
Communicate mathematical reasoning	26	16	42	86%
Use mathematical practices, including math tools and visual representations	26	12	38	78%
Work independently	31	8	39	80%
Work collaboratively with a partner or in small groups	19	13	32	65%
Solve problem sets to develop procedural fluency	17	15	32	65%
Engage in activities that promote a growth mindset and mathematical identity	22	10	32	65%
Connect mathematics to their own experiences and interests	19	6	25	51%

Question #2: How often do you use the following instructional practices? Check all that apply:

Teaching Strategies	N	R	O	F	A	AVERAGE
Bring attention to mathematics vocabulary	0	0	7	15	27	4.4
Use probing questions to promote reasoning and problem solving	0	0	6	15	28	4.4
Communicate the goal of the lesson in a language students can use and understand	0	2	2	23	22	4.3
Provide students with feedback	0	2	5	15	27	4.3
Use mathematical representations	0	1	8	17	23	4.3
Differentiate learning activities	0	3	7	15	24	4.2
Make connections between math concepts and real-world situations	0	3	11	21	14	3.9
Personalize tasks based on student interests and experiences	0	8	20	14	7	3.4

Teacher responses, frequently and always, were used for comparison with other stakeholders (totals are reflected in the following chart).

Teaching Strategy	F	A	Totals	
			N	%
Bring attention to mathematics vocabulary	15	27	42	86%
Use probing questions to promote reasoning and problem solving	15	28	43	88%
Communicate the goal of the lesson in a language students can use and understand	23	22	45	92%
Provide students with feedback	15	27	42	86%
Use mathematical representations	17	23	40	82%
Differentiate learning activities	15	24	39	80%
Make connections between math concepts and real-world situations	21	14	35	71%
Personalize tasks based on student interests and experiences	14	7	21	43%

Question #3: What structures do you use in a mathematics lesson? Check all that apply:

Strategies/Methods	N	%
• Mini-Lesson	46	95.8%
• Direct Instruction	44	91.7%
• Whole Group	43	89.6%
• Individual Practice	43	89.6%
• Small Group	40	83.3%
• 1:1 Conferencing	34	70.8%
• Gradual Release of Responsibility (I Do, We Do, You Do)	33	68.8%
• Centers & Stations	28	58.3%
• Do-Now	28	58.3%
• Problem or Inquiry Based Model (You Do, We Do, I Do)	26	54.2%
• Workshop	21	43.8%
• Other: Cooperative Learning	1	2.1%
• Other: 3 Reads to Pull out information in word problems, modeling,	1	2.1%
• Other: Number Sense Question/Activity at the start of the lesson	1	2.1%

There were 2 questions on the teacher survey that were related to professional learning:

Question #10: How often do you participate in professional development focused on mathematics?

1	2	3	4	5	Average
2 (4.1%)	5 (10.2%)	20 (40.8%)	12 (24.5%)	10 (20.4%)	3.5

Question #12: What professional development would you benefit from? Check all that apply:

	N	%
Developing growth mindset and positive mathematics identity	29	59.2%
Strategies for promoting student engagement and discussion in math	26	53.1%
Strategies for differentiating instruction	24	49.0%
Developing algebraic thinking in elementary school	23	46.9%
Effective use of assessment to guide instruction	22	44.9%
Supporting ELL students	19	38.8%
Guiding principles from the New Jersey State Standards	11	22.4%
Other: Using other resources. How to plan when we are given 20% less teaching time	1	2.0%
Other: Time to create workshop resources and to observe colleagues	1	2.0%
Other: Resources for differentiating instruction	1	2.0%
Other: PD on effective grading procedures and policies (additional rationale)	1	2.0%
Other: Sharing math stations and project ideas	1	2.0%
Other: Strategies for motivating robust colleagueship and innovation	1	2.0%

Teacher Survey Findings

Learning Strategies:

- Most teachers report that students engage in mathematical discussion (76%) and communicate mathematical reasoning (86%) during math instruction daily.
- All teachers except 1 report using mathematical practices, including tools and visual representations, at least 3 times a week, with many (78%) reporting they use them daily.
- 65% of the teachers report using problem sets to develop procedural fluency daily.
- 51% of the teachers report connecting mathematics to their students' experiences and interests daily.

Teaching Strategies:

- All teachers reported bringing attention to mathematics vocabulary and using probing questions to promote reasoning and problem-solving at least 3-4 times per week, with many (>85%) indicating these are daily instructional routines.
- Most teachers (92%) communicate the goal of the lesson in a language students can use and understand daily.
- 86% of teachers report providing feedback to students daily.
- 82% of teachers report using mathematical representations daily.
- Many teachers (80%) report differentiating learning activities daily, but fewer (43%) personalize tasks based on student interests and experiences.

Classroom Structures:

- Teachers report using mini-lessons (96%) and direct instruction (92%) most frequently as structures in math classrooms.
- Teachers report equal use of whole group and individual practice structures (90%) and slightly lower use of small group structures (83%).
- 83% of teachers report using small group structures, while workshops (44%) and centers/stations (58%) were rated lower.
- 71% of teachers report using 1:1 conferencing.
- Connecting math to students' experiences and interests and applying math to a real situation were rated lowest on the teacher survey.

Professional Development:

- On average most teachers report participating in professional development focused on mathematics regularly.
- Teachers indicated the areas of professional development they would find most beneficial are strategies for developing a student growth mindset and positive mathematical identity (59%), promoting student engagement and discussion in mathematics (43%), and differentiating instruction (49%).

Student Survey: Students were asked 2 questions that provided insight into the instructional routines and practices used in their mathematics classroom.
Note: Language was modified for different age learners.

What helps you learn math? Check all that apply:

- Working with a partner or in small groups
- Working by myself
- Talking about math with my classmates/Discussing math with my classmates
- Solving challenging problems
- Sharing how I solve a problem/Sharing problem solving strategies
- Using math tools or visuals/Using the mathematical practices
- Using math textbooks
- Practicing problems

Which of the following does your teacher do to help you learn math? Check all that apply:

- Tells you what you will learn in the lesson/Shares the goal of the lesson
- Helps you understand math vocabulary/Clarifies math vocabulary
- Gives you a task to help you learn math, even if it is different from what your classmate is doing/Provides individual students or small groups with different tasks that assist them in learning
- Tells you how you are doing and how you can get better/Provides feedback on your progress and offers suggestions for improvement
- Show you how math can be used in the real world/Demonstrates how math can be applied in real-world scenarios
- Connects math to things you like and know/Relates math to subjects or topics that interest you
- Uses pictures and drawings and other visuals to help you understand/Uses visual representations of math to help you understand math concepts
- Encourages you to keep trying even when math is hard/Asks questions to help you understand and solve problems on your own

Overall:

Learning Strategies	Elementary 391	Middle School 586	High School 737	Total	
				N 1,714	%
Practicing problems	208	402	533	1,143	67%
Working by myself	187	275	423	885	52%
Working with a partner or in small groups	191	376	414	981	57%
Discussing math with my classmates	86	282	372	740	43%
Solving challenging problems	186	214	334	734	43%
Sharing problem-solving strategies	90	223	291	604	35%
Using the mathematical practices (explained as math tools and visuals in the elementary and middle school surveys)	220	335	292	847	49%

Teaching Strategies	Elementary 391	Middle School 586	High School 737	Total	
				N 1,714	%
Clarifies math vocabulary	232	373	467	1,072	63%
Uses visual representations of math to help you understand math concepts	247	283	460	990	58%
Asks questions to help you understand and solve problems on your own	229	318	402	949	55%
Shares the goal of the lesson	217	403	357	977	57%
Encourages math perseverance in the face of math challenges	n/a	311	321	632/ 1323	48%
Provides feedback on your progress and offers suggestions for improvement	161	268	305	734	43%
Provides individual students or small groups with different tasks that assist them in learning	133	163	252	548	32%
Shows you how math can be used in the real world	94	217	352	663	39%
Connects math to things you like and know	123	251	201	575	34%

Student Survey Findings:

- Elementary students value practicing problems (54%), working with a partner or in small groups (49%), or working by themselves (48%) when learning mathematics.
- Elementary students learn best from teachers who use pictures, drawings, and other visuals (63%), focus on helping them understand mathematics vocabulary (59%), and ask questions to help them learn (56%).
- Middle school students learn best by working with a partner or small group (64%) and practicing problems (69%).
- Less than 10% of middle school students use a textbook to learn.
- High school students indicate a preference to work on their own (52%) as well as with others (57%).
- High school students recognized the value of math problem practice (73%).
- High school students appreciate learning mathematics through different modalities (64%) and seek clarity and transparency in their learning (50%).

Parent/Caregiver Survey: Parents/Caregivers were asked a question that provided some insight into the instructional routines and practices used in their child(ren)'s mathematics classroom. In addition, there were open-ended questions that afforded parents the opportunity to identify what was most effective and least effective about the Princeton Public Schools mathematics program.

Question #3: What strategies or methods help your child learn mathematics? Check all that apply:

- Working with a partner or in small groups
- Working alone
- Discussing mathematics problems & problem-solving strategies
- Using visuals or manipulatives
- Practicing problems
- Using feedback from the teacher
- Applying mathematics to a real situation
- There was a total of 339 responses for this item.

The table below summarizes those responses:

Strategies/Methods (Learning Strategies)	N	%
Practicing problems	261	77.0%
Discussing mathematics problems & problem-solving strategies	223	65.8%
Using feedback from the teacher	213	62.8%
Working with a partner or in small groups	165	48.7%
Working alone	156	46.0%
Using visuals or manipulatives	136	40.1%
Applying mathematics to a real situation	135	39.8%
Other Note: 10 of these specifically referenced help outside of the classroom from a family member or tutor	39	11.5%

Caregiver Survey Findings:

- Caregivers perceive that the strategy that best helps their child(ren) learn mathematics is practicing problems (77%). Caregivers also value discussing mathematics problems and problem-solving strategies (66%) as well as feedback from the teacher (63%).
- Caregivers do not perceive a difference in having their child(ren) work with a partner/small group (48%) or alone (46%). Finally, caregivers feel that using visuals or manipulatives (40%) and applying mathematics to a real situation (40%) are less impactful.

Caregiver Open-Ended Responses:

Caregivers expressed varying degrees of satisfaction with the math program. 32% reported being very satisfied or satisfied with the math program, while 30% expressed mixed feelings of both satisfaction and dissatisfaction and the largest number of caregivers, 37%, reported being dissatisfied or very dissatisfied with the math program.

A review of the caregiver's open-ended responses was most revealing in determining why there were significant differences in parental satisfaction. The reason most often provided for either being a strength of the program or a weakness was the teacher.

- 35% of the 216 responses to the question "What is most effective about the mathematics program?" identified specific teachers or qualities of effective teachers.
- 27% of the 247 responses to the question "What could be improved?" also identified teachers.
- Teachers continued to be a primary focus of caregivers' responses to the question, Is there anything else you would like to share about your child(ren)'s experience(s) related to learning mathematics at their school?

Here are some responses to further illustrate parental opinion:

- "Teachers, especially in the early grades, do a good job teaching different strategies to get students comfortable with the fundamental skills of mathematics. "
- "My children have learned well from teachers who can explain concepts in multiple ways, are patient, and have realistic expectations."
- "What matters most is that each math teacher needs to be inspiring; with inspiration, every student can challenge their limit with free knowledge readily available from the internet. Also, every student experienced mental health issues during the pandemic, almost every one of them had academic setbacks. The teachers really need to be inspiring and encouraging, making their classes interesting, selecting their teaching materials more prudently, NOT making scores and GPAs such a big deal, NOT making attendance and homework a big burden for the students."
- "Teachers play a big role in kids' interest in a subject. They have the power to open or close their minds. I don't believe teachers need to be tough in schools as one would in colleges."
- "From my experience, teachers' attitudes, confidence they give and build in kids goes a long way."
- "Having good teachers is the most important part. Unfortunately, I heard complaints about the teaching quality of certain math teachers (s). (e.g., not emphasizing concepts but telling to memorize)"

Perceptual Data Findings

- Teachers value mathematical practices, including tools and visual representations (78%), and less than half of the caregivers (40%) feel this is a strategy that helps their child learn math.
- 65% of the teachers use mathematical problem sets to develop procedural fluency daily, and 77% of the parents identified practicing problems as the strategy that helps their child learn mathematics.
- Connecting math to students' experiences and interests (43% of teachers) and applying math to a real situation (40% of caregivers) were rated lowest on both the teacher and caregiver surveys.
- Teachers report that students engage in mathematical discussions (76%) and communicate mathematical reasoning (86%) in mathematics classrooms daily. Elementary and middle school students did not rate "talking about math with my classmates" as highly.
- Teachers report that learning activities that involve the use of math tools, visual representations (78%) and problem sets to develop procedural fluency (65%) occur regularly. Students strongly agree (67%) that the use of problem sets helps them learn math. They are not as enthusiastic about the use of tools or visual representations (49%).
- Teachers report that students engage in learning activities both independently and within collaborative structures with about the same frequency. Elementary and high school students did not have a preference. However, middle school students preferred to work with a partner or in small groups.
- Teachers report that learning activities which connect mathematics to students' own experience and interests (51%) are implemented less frequently. However, students felt learning about authentic applications of math is valuable.

Conclusions and Recommendations:

Teaching and Learning Practices: Effective, research-based teaching and learning practices are not consistently utilized across classrooms.

A guiding principle for school mathematics stated in *Principles to Actions, Ensuring Mathematical Success for All* by the National Council of Teachers of Mathematics states, "an excellent mathematics program requires effective teaching that engages students in meaningful learning through individual and collaborative experiences that promote their ability to make sense of mathematical ideas and reason mathematically". It goes on to define the role of the teacher and the student. "The role of the teacher is to engage students in tasks that promote reasoning and problem-solving and facilitate discourse that moves the students toward a shared understanding of mathematics. The role of the student is to be actively involved in making sense of mathematics tasks by using various strategies and representations, justifying solutions, making connections to prior knowledge or familiar contexts and experiences, and considering the reasoning of others".

Recommendations:

- At the elementary level, additional professional learning related to the math workshop model would support teachers in their ability to differentiate mathematics learning. Teachers on the Program Evaluation Team suggested that Monday faculty meetings and grade-level meetings with principals could be used to facilitate grade-level conversations about best teaching practices in mathematics.
- At the middle school level, teachers would benefit from professional learning on effective collaboration strategies within instructional routines.
- At the high school level, teachers should provide structured choices regarding individual and group work. Providing opportunities for differentiated instructional modalities is also important.
- At the high school level, teachers need to be cognizant of the opportunities provided for practicing mathematics problems. It is critical to consider promoting mathematical discourse within these opportunities.
- At all levels it is important to ensure that objectives are clearly stated that learners can self-assess their progress towards the learning goals.

Student-Centered Learning: The current approach to instructing mathematics places a heavy emphasis on the teacher's role, resulting in limited opportunities for students to actively participate and engage in the learning process.

According to Peter Liljedal, the physical arrangement within a classroom has an impact on the thinking that happens in the learning space. In his book, *Building Thinking Classrooms in Mathematics, Grades K-12*, he explains, "at its core, a classroom is just a room with furniture. Absent the students and the teacher, a classroom is an inert space waiting to be inhabited, waiting to be used, waiting for thinking to happen. This is not to say that the classroom, in its inert form, has no role in what happens in it—it actually has a huge role in determining what kind of learning can take place in it. The research showed that rectilinear and fronted classrooms promote passive learning. On the other hand, a defronted classroom—a classroom where students sit facing every which way—was shown to be the single most effective way to organize the furniture in the room to induce student thinking".

Recommendation: The first step to establishing a more student-centered classroom is to examine the benefits of student collaboration. It is worth the time to have teachers think together about the classroom conditions needed to foster effective collaboration, including positive and productive communication, on-task behavior, equitable work, task analysis, leadership, and conflict management, and design ways to ensure that these are in place so that the collaborative structures will be effective.

Differentiated Instruction: The current approach to differentiated does not sufficiently address the learning needs of students.

Differentiated instruction is necessary for meeting the wide range of learning needs, whether students need additional time or support, or exceed grade-level expectations. Educators acknowledge that they differentiate instruction, but there is a significant gap between students who reported that the math tasks are personalized to their learning needs.

Recommendation: Teachers should routinely use diagnostic and formative assessments to create fluid, small groups, intermixed with heterogeneous groups where students learn from each other and avoid in-class ability tracking.

Type of Tasks and Learning Activities: Teachers, students, and caregivers place a strong emphasis on the use of problem sets.

Practicing problems involves mimicking solutions to routine problems rather than creating solutions to non-routine problems. According to the National Council of Teachers of Mathematics, it is unproductive to believe that mathematics learning should focus on practicing and memorizing routine mathematical procedures. Rather, mathematics learning should focus on developing an understanding of concepts and procedures through problem-solving and discourse. This implies that the role of the student is to be actively involved in making sense of mathematical tasks by using varied strategies and representations, justifying solutions, making connections to authentic applications, and considering the reasoning of others.

Peter Liljedal, author of *Building Thinking Classrooms in Mathematics, Grades K-12*, stresses the importance of problems or tasks to promote higher-order thinking in a mathematics classroom. He states, "If we want our students to think, we need to give them something to think about—something that will not only require thinking but also encourage thinking. In mathematics, this comes in the form of a task, and having the right task is important. The research revealed that we have to give thinking tasks".

Recommendation: Review the nature of the problem sets assigned in class and as homework to ensure that there is a balance of purpose; both reinforcing fluency and skill and promoting the use of mathematics to solve authentic, non-routine problems.

Mathematical Mindset and Mathematical Identity: Missing as a routine practice from educators, caregivers, and student surveys was the importance of the intentional development of students' mathematical mindset.

A positive mathematical identity is especially necessary for an educational environment emphasizing excellence and acceleration. When students develop a positive mathematical disposition, they are better equipped to pursue more challenging mathematical courses that go beyond those courses that are required for graduation.

Recommendations:

- Provide professional development opportunities on how to support students in developing a growth mindset and positive mathematical identity. Professional learning in this area was a need expressed by mathematics teachers.
- Learners can benefit from being stimulated by "Classroom Walls that Teach" as described by Lee Ann Houlsey. Teachers might consider adding more "messages" related to critical concepts like growth mindset and interactive word walls to support the use of precise mathematical language and student work to the classroom walls.

Professional Development

In *Principles to Actions, Ensuring Mathematical Success for All*, it is stated that "in an excellent mathematics program, educators hold themselves and their colleagues accountable for the mathematical success of every student and for the personal and collective professional growth toward effective teaching and learning in mathematics."

Jim Collins, the author of *Good to Great*, reminds us that "a professional does not accept the status quo, even when it is reasonably good, and continues to learn and grow." It is critical to note that the research emphasizes that mathematics teachers are professionals who do not do this work in isolation. They cultivate and support a culture of professional collaboration and continual improvement, driven by an abiding sense of interdependence and collective responsibility.

Doerr, Goldsmith, and Lewis (2010) propose that there are 4 major areas for effective professional learning for mathematics teachers:

- Teachers' mathematical knowledge and their capacity to use it in practice
- Teachers' capacity to notice, analyze, and respond to students' thinking
- Teachers' beliefs and dispositions that foster their continued learning
- Teachers' collegial relationships and learning structures that can support and sustain their learning

Research evidence indicates that there are several features of high-quality professional learning that support these goals. They include:

- Substantial time investment over a sustained period
- Systemic support for teachers' learning
- Opportunities for teachers to participate in active learning
- Opportunities for teachers to study the mathematics underlying the curriculum that they teach

Recommendations: Teachers would benefit from a variety of professional learning opportunities to develop research-based practices that support student learning.

Given the priority of ensuring that the mathematics program in the Princeton Public School District prepares students for high level mathematics, it would be valuable to include more targeted professional development for teachers of mathematics in the district Professional Development Plan.

The design of professional learning for teachers of mathematics needs to be engaging and rigorous. Elementary teachers often benefit from learning that promotes deeper conceptual understanding of the discipline. It is critical for them to understand the readiness of the learner so that they can facilitate the shift from concrete to representational to abstract thinking. Secondary teachers would benefit from learning how to foster and support productive struggle as the content becomes more challenging. Adding collaborative inquiry to daily instructional routines can help students gain persistence and a growth mindset. Finally, at all levels, ensuring that learners apply the concepts and skills within non-routine scenarios promotes thinking like a mathematician instead of remembering how to mimic solutions.

Professional learning opportunities do not necessarily require stand-alone initiatives. They can include tapping teacher leaders, routinely engaging with LinkIt and other assessment results during data meetings, and strategically utilizing existing expertise within the community of Princeton. Teachers, regardless of their years of experience or level of expertise, enhance their practice when they engage as a learning community to deepen their understanding of best practices, collaborate, and exchange instructional strategies. Opportunities for cross-grade collaboration are necessary for building a coherent mathematics program. Embedded professional learning offered in a coaching model enables teachers at all levels to continue to refine their professional practice and measure the impact on student learning.

Some of the specific professional learning themes include:

- Differentiated instruction
- Integrating social-emotional outcomes into the curriculum with attention to those that foster student agency, growth mindset, and the development of a positive mathematical identity
- Student-centered learning environments and instructional practices
- Using effective collaboration strategies within the learning environment to increase learner engagement
- Higher-order thinking
- Problem-based or inquiry-based models of instruction

Evaluation Question #3

How are students provided with equitable pathways to achieve high-level mathematics and supported to be successful?

Equity and Access

How are students provided with equitable pathways to achieve high-level mathematics and supported to be successful?

At the beginning of the Princeton Public Schools mathematics program evaluation, the Program's Evaluation Team agreed upon the following definition of equity:

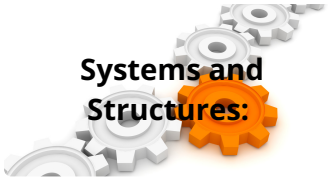
"When school provides each student with what they need to be successful, and students have access to high levels of learning mathematics without barriers or obstacles".

The team further enhanced its understanding of equity and access by reviewing the National Council of Teachers of Mathematics (NCTM) Principles to Action-Executive Summary, which explains that equity and access exist when all students have:

- Access to a high-quality mathematics curriculum
- Effective teaching and learning
- High expectations
- Support and resources needed to maximize their learning potential

The accompanying data was collected and analyzed to determine the degree to which students in Princeton Pubic Schools have equitable access to high-level mathematics.

- Systems and Structures: Course enrollment and support structures
- Perceptual Data: Caregiver, teacher, and student surveys and focus groups



Course Enrollment:

The following chart, provided by the district, represents demographic information about current enrollment in the Princeton School District:

School	Female	Male	American Indian	Asian	Black	Hispanic	Pacific Islander	Multi	White	Low Income	ELL	Special Ed.	504	Total
Princeton High School	746	775	3	416	81	149	0	149	723	164	58	187	173	1521
Princeton Middle School	389	431	1	181	58	82	0	106	391	107	39	132	73	820
Community Park School	150	140	0	29	15	57	0	40	149	48	24	26	10	290
Johnson Park School	183	239	0	86	32	71	0	64	168	95	51	93	3	422
Littlebrook Elementary School	191	211	1	137	17	16	0	63	163	30	34	56	8	402
Riverside Elementary School	137	157	0	43	16	15	0	48	167	17	26	57	15	294
YWCA-PK	18	27	0	12	4	6	0	4	19	10	0	0	0	45
Marcy T. Crimmins	8	6	0	0	4	5	0	0	0	8	0	0	0	14
PPS Out Of District	13	38	0	8	8	9	0	4	19	9	0	48	2	51
Total	1835	2024	5	912	235	410	0	478	1799	488	232	599	284	3859

School	Female	Male	American Indian	Asian	Black	Hispanic	Pacific Islander	Multi	White	Low Income	ELL	Special Ed.	504	Total
Princeton High School	49 %	51 %	0.2 %	27.4 %	5.3 %	9.8 %	0 %	9.8 %	47.5 %	10.8 %	3.8 %	12.3 %	11.4 %	100 %
Princeton Middle School	47.4 %	52.6 %	0.1 %	22.1 %	7.1 %	10 %	0 %	12.9 %	47.7 %	13 %	4.8 %	16.1 %	8.9 %	100 %
Community Park School	51.7 %	48.3 %	0 %	10 %	5.2 %	19.7 %	0 %	13.8 %	51.4 %	16.6 %	8.3 %	9 %	3.4 %	100 %
Johnson Park School	43.4 %	56.6 %	0 %	20.4 %	7.6 %	16.8 %	0 %	15.2 %	39.8 %	22.5 %	12.1 %	22 %	0.7 %	100 %
Littlebrook Elementary School	47.5 %	52.5 %	0.2 %	34.1 %	4.2 %	4 %	0 %	15.7 %	40.5 %	7.5 %	8.5 %	13.9 %	2 %	100 %
Riverside Elementary School	46.6 %	53.4 %	0 %	14.6 %	5.4 %	5.1 %	0 %	16.3 %	56.8 %	5.8 %	8.8 %	19.4 %	5.1 %	100 %
YWCA-PK	40 %	60 %	0 %	26.7 %	8.9 %	13.3 %	0 %	8.9 %	42.2 %	22.2 %	0 %	0 %	0 %	100 %
Marcy T. Crimmins	57.1 %	42.9 %	0 %	0 %	28.6 %	35.7 %	0 %	0 %	0 %	57.1 %	0 %	0 %	0 %	100 %
PPS Out Of District	25.5 %	74.5 %	0 %	15.7 %	15.7 %	17.6 %	0 %	7.8 %	37.3 %	17.6 %	0 %	94.1 %	3.9 %	100 %
Total	47.6 %	52.4 %	0.1 %	23.6 %	6.1 %	10.6 %	0 %	12.4 %	46.6 %	12.6 %	6 %	15.5 %	7.4 %	100 %

Course enrollment was analyzed at middle and high school levels to assess the extent to which the courses reflect the diversity of the student population based on gender, race and ethnicity, multilingual learners, students who receive free and reduced lunch, and students who receive special education services. It is important to note that the analysis does not include course enrollment data for the elementary school since students at that level learn mathematics with their general and/or special education teacher and are not separated into levels or courses.

6th Grade Enrollment

Course Breakdown by Gender, Race/Ethnicity, and Support Service

Sub-groups	Gender		Race/Ethnicity					Support Service		
	Female	Male	Asian	Black	Hispanic	Multi-Racial	White	Free and Reduced Lunch	Multilingual Learners	Special Education
Overall representation in 6th grade (266)	123 (46%)	143 (54%)	56 (21%)	21 (8%)	22 (8%)	38 (14%)	129 (49%)	42 (16%)	15 (56%)	62 (23%)
Pre-Algebra Accelerated (231)	108 (47%)	123 (53%)	54 (23%)	15 (6%)	16 (7%)	34 (16%)	112 (48%)	30 (13%)	14 (6%)	29 (13%)
ICRP Pre-Algebra Accelerated (24)	9 (38%)	15 (62%)	2 (8%)	3 (13%)	3 (13%)	2 (8%)	14 (58%)	6 (25%)	1 (4%0	23 (96%)
Math 6 (11)	6 (55%)	5 (45%)	0	3 (27%)	3 (27%)	2 (18%)	3 (27%)	6 (55%)	0	10 (91%)

Distribution of Subgroups by Course

Subgroup	Overall representation in 6th grade (Total 266)	Pre-Algebra Accelerated	ICRP Pre-Algebra	Math 6
Female	123	108 (88%)	9 (7%)	6 (5%)
Male	143	123 (86%)	15 (10%)	5 (35%)
Asian	56	54 (96%)	2 (4%)	0
Black	21	15 (72%)	3 (14%)	3 (14%)
Hispanic	22	16 (72%)	3 (14%)	3 (14%)
Multi-Racial	38	34 (90%)	2 (5%)	2 (5%)
White	129	112 (87%)	14 (11%)	3 (2%)
Free and Reduced Lunch	42	30 (72%)	6 (14%)	6 (14%)
Multilingual Learners	15	14 (93%)	1 (7%)	0
Special Education	62	29 (47%)	23 (37%)	10 (16%)

7th Grade Enrollment

Course Breakdown by Gender, Race/Ethnicity, and Support Service

Sub-groups	Gender		Race and Ethnicity						Support Service		
	Female	Male	Asian	Black	Hispanic	Multi-Racial	Native American	White	Free and Reduced Lunch	Multilingual Learners	Special Education
Overall representation in 7th grade (290)	127 (44%)	163 (56%)	56 (19%)	20 (7%)	36 (12%)	34 (12%)	1 <1%	143 (49%)	46 (16%)	9 (3%)	62 (21%)
Algebra 1 Accelerated (104)	51 (49%)	53 (51%)	33 (32%)	4 (4%)	3 (3%)	13 (13%)	1 <1%	50 (48%)	3 (3%)	1 (1%)	4 (4%)
Algebra I Part 1 (149)	66 (44%)	83 (56%)	22 (15%)	12 (8%)	22 (15%)	16 (11%)	-	77 (52%)	28 (19%)	8 (5%)	22 (15%)
ICRP Algebra 1 Part 1 (22)	5 (23%)	17 (77%)	1 (4%)	1 (4%)	3 (14%)	3 (14%)	-	14 (64%)	5 (23%)	-	21 (96%)
Math 7 (15)	5 (33%)	10 (67%)	0	3 (20%)	8 (53%)	2 (13%)	-	2 (13%)	10 (67%)	-	15 (100%)

Distribution of Subgroups by Course

Subgroup	Overall representation in 7th grade (Total 290)	Algebra I Accelerated	Algebra I Part 1	ICRP Algebra I Part 1	Math 7
Female	127	51 (40%)	66 (52%)	5 (4%)	5 (4%)
Male	163	53 (33%)	83 (51%)	17 (10%)	10 (6%)
Asian	56	33 (59%)	22 (39%)	1 (2%)	0
Black	20	4 (20%)	12 (60%)	1 (5%)	3 (15%0
Hispanic	36	3 8%	22 (61%)	3 (8%)	8 (22%0
Multi-Racial	34	13 (38%)	16 (47%)	3 (9%)	2 (6%)
Native American	1	1	-	-	-
White	143	50 (35%)	77 (54%)	14 (10%)	2 (1%)
Free and Reduced Lunch	46	3 (6%)	28 (61%)	5 (11%)	10 (22%)
Multilingual Learners	9	1 (11%)	8 (89%)	0	0
Special Education	62	4 (6%)	22 (35%)	21 (35%)	15 (24%)

8th Grade Enrollment

Course Breakdown by Gender, Race/Ethnicity, and Support Service

Sub-groups	Gender		Race and Ethnicity						Support Service		
	Female	Male	Asian	Black	Hispanic	Multi-Racial	Native American	White	Free and Reduced Lunch	Multilingual Learners	Special Education
Overall representation in 8th grade (316)	156 (49%)	160 (51%)	70 (22%)	22 (7%)	34 (11%)	39 (12%)	0	151 (48%)	33 (10%)	15 (5%)	42 (13%)
Algebra II Accelerated (168)	86 (51%)	82 (49%)	61 (36%)	2 (1%)	3 (2%)	20 (12%)	0	82 (49%)	3 (2%)	2 (1%)	6 (4%)
Algebra I Part 2 (122)	61 (50%)	61 (50%)	9 (7%)	14 (12%)	21 (17%)	15 (12%)	0	63 (52%)	19 (16%)	13 (11%)	10 (8%)
ICRP Algebra I Part 2 (20)	7 (35%)	13 (65%)	0	4 (20%)	8 (40%)	2 (10%)	0	6 (30%)	8 (40%)	0	20 (100%)
Math Exploration (6)	2 (33%)	4 (67%)	0	2 (33%)	2 (33%)	2 (33%)	0	0	3 (50%)	0	6 (100%)

Distribution of Subgroups by Course

Subgroup	Overall representation in 8th grade (Total 321)	Algebra II Accelerated	Algebra I Part 2	ICRP Algebra I Part 2	Math Exploration
Female	156	86 (54%)	61 (39%)	7 (3%)	6 (4%)
Male	160	82 (51%)	61 (38%)	13 (8%)	5 (3%)
Asian	70	61 (87%)	9 (13%)	0	0
Black	22	2 (9%)	14 (64%)	4 (18%)	2 (9%)
Hispanic	34	3 (9%)	21 (62%)	8 (24%)	2 (5%)
Multi-Racial	39	20 (51%)	15 (39%)	2 (5%)	2 (5%)
Native American	0	0	0	0	0
White	151	82 (54%)	63 (42%)	6 (4%)	0
Free and Reduced Lunch	33	3 (9%)	19 (58%)	8 (24%)	3 (9%)
Multilingual Learners	15	2 (13%)	13 (87%)	0	0
Special Education	42	6 (14%)	10 (24%)	20 (48%)	6 (14%)

High School :

Course Breakdown by Gender, Race/Ethnicity,

	Female	Male	Asian	Black	Hispanic	Multi-Racial	White	Free and Reduced Lunch	Multilingual Learners
PHS School Enrollment	49%	51%	27.4%	5.3%	9.8%	9.8%	47.5%	10.8%	3.8%
AP Calc AB	52%	52%	38%	2%	-	14%	45%	_	_
AP Calc BC	49%	51%	10%	_	2%	12%	25%	_	_
AP Statistics	44%	56%	68%	_	3%	9%	19%	_	_
Multi-Variable Accelerated	50%	50%	71%	_	_	13%	13%	4%	_
Geometry 1 Accelerated	56%	44%	30%	4%	_	8%	57%	3%	_
Pre-Calculus Accelerated	56%	44%	43%	3%	1%	9%	43%	5%	_

Enrollment in Advanced Placement Courses

Course	Students Who Receive Free and Reduced Lunch	Students Who Receive Special Education Services	Multilingual Learners
AP Calculus AB	1%	0%	0%
AP Calculus BC	0%	0%	0%
AP Computer Science	0%	0%	0%
AP Statistics	0.7%	0.8%	0%

A 504 Plan provides students with accommodations to meet the needs of the student and ensure that student's education is not hindered because of their disability. The following illustrates the number of students in advanced courses at the high school who have 504 plans.

Course	504 Plans
PHS	11.4%
AP Calc AB	19%
AP Calc BC	3%
AP Statistics	3%
Multi-Variable Accelerated	4%
Geometry 1 Accelerated	10%
Pre-Calculus Accelerated	10%

Course Enrollment Findings

- Students who receive free and reduced lunch make up the largest population of students in 6th grade special education courses.
- The percentage of Black and Hispanic students in special education courses is greater than those enrolled in the grade level.
- Of the students enrolled in Algebra I Accelerated, 4% receive special education services.
- There are three times as many males enrolled in ICRP Algebra Part I (77%) compared to females (23%).
- Enrollment reveals that 32% of Asian students are enrolled in Algebra I Accelerated. Asian students comprise 19% of the class.
- Analysis of free and reduced lunch (3%), students who receive special education services (4%), and multilingual learners (4%) reveal that the representation of these student populations in Algebra I Accelerated does not reflect grade-level demographics.
- Students who receive free and reduced lunch represented 64% of the ICRP Algebra I Part 1 course.
- Students who are White and Asian represent 85% of enrollment in Algebra II Accelerated.
- Enrollment in accelerated courses increased 5% for Asian students from the previous grade level.
- Only 2% of 8th grade students who received free and reduced lunch were enrolled in Algebra II Accelerated.
- Students who receive special education services account for 4% of students enrolled in Algebra II Accelerated.
- Multilingual learners represented 2% of those enrolled in Algebra II Accelerated.
- Students who receive free and reduced lunch accounted for the largest population of students receiving special education services through ICRP Algebra I Part 2 (40%) and Math Exploration (50%).
- Analysis of advanced courses at the high school revealed a similar disparity to that found in middle schools. The enrollment of Hispanic and Black students in accelerated math courses is less than those of Asian and White peers. This trend is also evident for students who receive free and reduced lunch, multilingual learners, and students who receive special education services.

Support Offerings:

The following are structures that students can access for additional time and support in mathematics. Information describing support services was found on the district website.

Gifted and Talented:

The New Jersey Department of Education, Strengthening Gifted and Talented Educated Act, defines a gifted and talented student as a "student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities." The Princeton Public Schools provides the QUEST Multi-Tiered System of Support at the elementary school and access to advanced courses in mathematics at the middle school, including Algebra I, Algebra II, and Geometry.

Elementary School:

FOCUS: time dedicated within each school day to complete work and read.

Accelerated Intervention Services (AIS):

The AIS program provides supplemental instruction to accelerate students' learning so that they are able to meet grade-level benchmarks in reading, writing, and mathematics. Students are selected to participate in the AIS program based on a set of criteria for each grade level.

AIS in Grades K-5

Students in grades K-5 receive AIS instruction during the Focus Period, which provides a time for all students to engage in activities that support or challenge students' strengths and needs. Accelerated Intervention Services (AIS) is supplemental to the general education program. It is not replacement instruction. Students receive full mathematics instruction from their classroom teacher. AIS offers extra help to students in addition to classroom instruction. The program is based on the individual needs of the students being served. Therefore, the focus of each AIS class will change with those needs. The instructional format is established in collaboration with the classroom teacher. The targeted weaknesses and goals identified will drive the AIS instruction.

Goals of the AIS Program:

- support students who are experiencing weaknesses in mathematics
- identify and evaluate individual strengths and weaknesses
- demystify student so as to make him/her aware of his/her strengths and weaknesses
- teach students strategies to strengthen weaknesses and, ultimately, become a successful learner

AIS Mathematics Program:

- initial math inventory given to inform and guide instruction
- use of hands-on activities and manipulatives to develop a clear understanding of the underlying mathematics concepts
- timed fact tests
- math skill development and problem-solving practice
- computer programs to drill facts, practice basic processes, and develop the ability to solve mathematical story problems

Princeton Middle School:

AIS in Grades 6-8:

Middle school students enroll in a "workshop" class for mathematics. Workshop classes allow students to be nurtured in a smaller class setting and work on targeted skills. Based on students changing academic needs, students may enter or exit the AIS program periodically during the school year.

PAWS: time dedicated within each school day to complete work and read.

Princeton High School:

Tiger Time: time dedicated within each school day to complete work and read.

Plus classes: The purpose of the PLUS class is to enable students to achieve their potential by providing academic support in identified areas of need. These areas will be assessed, and progress will be monitored to show the growth that supports their success.

Plus Class Enrollment:

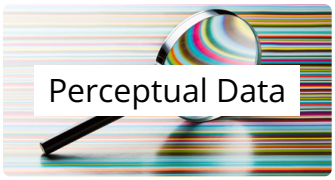
Course	# of Students
Algebra 1 Plus	4
Algebra 2 Plus	2
Geometry 1 Plus	9
Pre Calc Plus	5

Princeton High School Ideas Center: The IDEAS Center at Princeton High School offers students a place to study with the assistance of peer tutors, university students, or teachers. More than 100 peer tutors and Princeton University students volunteer their services to help students in all classes offered at Princeton High School. All peer tutors have received recommendations from teachers for the subject they are tutoring.

Multilingual Learners:

Dual Language Immersion Program: In the Dual Language Immersion (DLI) program at Community Park School, students in Kindergarten through 5th grade spend approximately 50 percent of their core academic day learning in Spanish and the other 50 percent learning in English. Every student has two main teachers, one for English instruction and one for Spanish.

The middle school DLI program includes a Spanish language class in addition to Social Studies in Spanish.



Teacher Surveys and Focus Groups:
Teachers responded to the following survey questions:

1. To what extent do students have access to
   - High-quality curriculum
   - Effective teaching and learning
   - High-expectations
   - Support and resources to maximize learning potential
   - Adequate time to develop conceptual understanding foundational to success and enjoyment of mathematics
   - Opportunities to take advanced coursework that prepares them for future goals
   - Accommodations that address differences to meet the common goal of all students achieving high levels of learning
2. What is in place so every child reaches high levels of mathematics?
3. What additional resources and supports are available to students in attaining high levels of mathematics?
4. What resources would you recommend?

Access: The following chart summarizes teachers' responses indicating the extent to which students have access to components of teaching and learning that impact access to high-level mathematics and advanced courses.

To what extent do students have access to	Strongly disagree	Disagree	Somewhat agree	Agree	Strongly agree
High-quality curriculum	0%	10%	16%	45%	20%
Effective teaching and learning	0%	14%	14%	43%	29%
High Expectations	0%	14%	14%	43%	29%
Support and resources to maximize learning potential	8%	12%	31%	31%	18%
Adequate time to develop conceptual understanding foundational to success and enjoyment of mathematics	4%	8%	35%	37%	16%
Opportunities to take advanced coursework that prepares them for future goals	12%	18%	27%	29%	14%
Accommodations that address differences to meet the common goal of all students achieving high levels of learning	6%	10%	29%	39%	16%

The following questions were asked to determine what support structures are in place and which are needed so every child reaches high levels of mathematics:

1. What is in place so every child reaches high levels of mathematics?
2. What additional resources and supports are available to students in attaining high-levels of mathematics?

What is in place so every child reaches high levels of mathematics?	
Differentiated instruction	89%
Opportunities for small group instruction within the school day	76%
Support specialist to address specific student needs (e.g., special education teachers, teachers of multi-lingual learners, school counselors)	74%
Resources and materials designed to meet the needs of diverse learners	59%
Parental learning opportunities to support students in learning mathematics	13%

Teachers recommended the following additional resources and support. Recommendations were sorted into categories and ranked in order of teacher preference.

- Curricular resources and materials for extending concepts, advanced learner support, enrichment, math stations, and games
- Small group instructional support: 1-1 conferencing, tutoring, and before and after school math programs
- Additional time for teachers to develop project-based tasks; collaborate with AIS and special education teachers
- Additional time for students to have time for math in their school schedule
- Increase the number of teachers: Increase AIS and SE teachers, and add a “bilingual requirement” for hiring special education teachers
- Professional learning: Best practices for teaching mathematics, grade level lab sites, common planning time, and feedback from colleagues and supervisors
- New curriculum to address the needs of multi-lingual learners and special education students
- Parent engagement, such as family math night

Teacher Survey Findings

- Teachers strongly agree or agree that students have access to a high-quality curriculum (65%), effective teaching practices (72%), and high expectations (72%).
- Teachers do not feel strongly (27% somewhat, 18% disagree, 12% strongly disagree) that students have opportunities to take advanced coursework that prepares students for future goals.
- More than 75% of teachers agree that differentiated instruction, small group targeted instruction, and supplemental instruction via a support specialist are in place for students to support students in attaining high levels of mathematics.
- Teachers indicated that additional materials, support educators and classes, and professional learning opportunities would be beneficial in supporting students in attaining high levels of mathematics.

Caregiver Surveys and Focus Groups: Caregivers were surveyed to gain their perspective on the extent to which students have access to support that leads to high levels of mathematics and coursework.

To what extent do students have access to:	Strongly disagree	Disagree	Somewhat agree	Agree	Strongly agree
High-quality curriculum	9%	17%	34%	27%	9%
Effective teaching and learning	16%	18%	31%	24%	-
High Expectations	11%	18%	28%	28%	15%
Support and resources to maximize learning potential	17%	28%	26%	18%	7%
Adequate time to develop conceptual understanding foundational to success and enjoyment of mathematics	9%	13%	36%	23%	8%
Opportunities to take advanced coursework that prepares them for future goals	14%	19%	34%	23%	7%
Accommodate differences to maximize learning	18%	22%	28%	21%	6%

How do you support your children when they find mathematics difficult?	N	%
Provide assistance by explaining concepts or problem-solving strategies	202	66%
Encourage them to keep trying and not give up	187	61.1%
Encourage them to seek help from their teacher or classmates when needed	182	59.5%
Encourage them to try a different strategy	110	35.9%
Utilize online mathematics resources or educational apps to supplement their learning	102	33.3%
Seek additional resources or tutoring to help them with challenging mathematics topics	92	30.1%
My child prefers to work independently and does not seek support	55	18%
I am uncertain about how to provide support when my child encounters mathematics challenges	23	7.5%

Caregiver Survey Findings

High-Quality Curriculum:

- The vast majority of elementary school caregivers (90%) believe students have access to a high-quality curriculum, whereas most middle and high school caregivers do not (58%).

Effective Teaching and Learning:

- The majority of elementary school caregivers (60%) agree that students have access to effective teaching and learning, whereas middle school (40%) and high school (40%) caregivers somewhat agree.

High Expectations:

- The majority of middle school caregivers disagree or strongly disagree (54%) that students have access to high expectations, whereas elementary caregivers (33%) and high school caregivers (42%) of parents agree.
- Of the 247 caregivers who responded to the open-ended question, what aspect of the mathematics program could be improved to support your child's learning better, 18% identified a lack of rigor. A review of open-ended responses revealed that caregivers may have equated high expectations with access to advanced courses.

Adequate Resources:

- All three caregiver groups agreed that students do not have access to adequate resources and support (40% of elementary school caregivers, 48% of middle school caregivers, and 40% of high school caregivers).

Adequate Time:

- The overall consensus among caregivers was that students have access to adequate time.
- Over 45% of elementary school caregivers agree or strongly agree with the statement that students have adequate time. While 37% somewhat agree, the remaining group disagree or strongly disagree with this statement.
- Of the middle school caregivers surveyed 40% agree or strongly agree with the statement that students have adequate time, while 40% stated they somewhat agree and the remainder of caregivers strongly disagree (8%).
- At the high school, 50% of caregivers agree or strongly agree, 38% somewhat agree, and 12% of parents disagree.

Consistent Opportunities to Learn:

- The majority (45%) of elementary caregivers somewhat agree that students have consistent opportunities to learn. While the remainder of the caregivers at the elementary level held the following opinions: 34% agree and strongly agree, and 20% disagree and strongly disagree.
- Middle school caregivers were almost equally divided in their opinions: agree and strongly agree (35%), disagree and strongly disagree (34%), and somewhat agree (31%).
- Likewise, high school caregivers were closely divided on their opinions: disagree and strongly disagree (38%), agree and strongly agree (36%), and somewhat agree (31%).

Accommodating differences to meet the common goal of all students achieving high levels of learning

- Of the elementary school caregivers surveyed, 37% agree or strongly agree with this statement, while almost an equal number (35%) somewhat agree. The remaining caregivers (28%) disagree or strongly disagree.
- Middle school caregivers (53%) disagree or strongly disagree with this statement, while 31% agree or strongly agree. The remaining middle school caregivers (22%) somewhat agree with the statement.

Student Surveys and Focus Groups: Students were surveyed to gain their perspective on the extent to which students have access to support that leads to high levels of mathematics and coursework.

What else do you use to help you learn math? Check all that apply.	Elementary 391		Middle School 586		High School 737		Totals 1714	
	N	%	N	%	N	%	N	%
I work with another teacher during the school day	34	9%	29	5%	35	5%	98	6%
I have a tutor at home	28	7%	91	16%	123	17%	242	14%
I go to resource room or learning lab during the school day	8	2%	19	3%	36	5%	63	4%
My caregiver or family member helps me at home	195	50%	260	44%	176	24%	631	37%
I have extra time when I take tests and complete homework	61	16%	103	18%	123	17%	287	17%
I take a math class outside of school	61	16%	80	14%	37	5%	178	10%
I talk about math and complete my work in the language that I speak at home	65	17%	98	17%	84	11%	247	14%
I work on math during FOCUS/PAWS	46	12%	198	34%	n/a	n/a	244	25%
I don't use any of these	112	29%	122	21%	325	44%	559	33%

Student Survey and Focus Group Findings

Student Support:

- Students reported that the primary way they receive additional support is at home from a caregiver or family member (37%).
- Students reported that they work on math during PAWS or FOCUS time (35%).
- 25% of students responded that they work with a tutor or take a math class outside of the school day (Kumon and Russian Math School).

Spanish Speaking Students:

- 8 elementary students responded to the elementary Spanish survey. No students responded at the middle school, and 5 Spanish-speaking students participated from the high school.
- Spanish-speaking students surveyed in 3-5 reported (40%) receiving support at home from a family member.
- At the high school level, only 1 of the students reported accessing or receiving some form of support to help them advance in mathematics.

Conclusions and Recommendations

Course Access: The racial/ethnic distribution of students in advanced courses does not reflect the distribution of students across grade levels. Black and Hispanic students, students who receive free and reduced lunch, students who receive special education services, and multilingual learners are consistently underrepresented in middle and high school advanced courses. Enrollment patterns and trends reflect a disproportionate number of multilingual learners, Black and Hispanic students enrolled in basic mathematics coursework, ICRP courses, and non-AP Mathematics courses.

Recommendations: To ensure every student has an equal opportunity to excel in mathematics, Princeton Public Schools needs to improve and align its existing systems. This entails creating a comprehensive and unified curriculum and enhancing teaching and learning practices. It requires building a support system that caters to the unique needs of every student and nurturing students' mathematical identities so that they acquire the motivation and self-determination to pursue advanced mathematics courses when the time is right. A common understanding of the factors that lead to inequitable learning situations is necessary to take the actions required to address these disparities effectively.

Understanding of Equitable Access: A lack of clear understanding exists regarding the factors contributing to equity, and there are differing viewpoints on whether these factors even exist. This divergence in perspectives makes it challenging to undertake the necessary actions required to address these disparities effectively. Differences in perception clearly exist between educators and caregivers on the following: curricula, quality of instruction, resources, and supports, high expectations, and mathematical identity and agency.

Recommendation: Professional learning is necessary for all educators to understand obstacles to equitable access. Providing an equitable and inclusive mathematics program requires reflective practice to develop productive beliefs and corresponding systems supporting all students in achieving high-level mathematics. Improved communication with caregivers is necessary to ensure all stakeholders are informed of the goals of the mathematics program and the actions taken to achieve those goals.

Support Structures: Support structures exist but are insufficient in providing all students with equitable access to high-level mathematics.

The Princeton Public Schools has several program options to address the Individual Education Programs of students as federal law requires. There is a clearly outlined process for students to receive these services. The provision of instruction and interventions to students within a framework of a Multi-Tiered System of Support (MTSS) improves educational outcomes for all students, including those with Section 504 and IEP plans. The district is developing an emerging 3-tier MTSS intervention structure in an effort to support students at varying levels of readiness.

The New Jersey Department of Education, *Strengthening Gifted and Talented Educated Act,* defines a gifted and talented student as a "student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities." The Princeton Public Schools provides the QUEST Multi-Tiered System of Support at the elementary school and access to advanced courses in mathematics at the middle school, including Algebra l, Algebra ll, and Geometry.

In-school support is available during FOCUS, PAWS, and Tiger Time but is optional and dependent on student initiative. Plus is also available at the high school but is underutilized and also optional. The Dual Language Immersion Program at Community Park Elementary School has the potential not only to provide students with the opportunity to become biliterate but also to support multilingual learners in advancing in mathematics.

In addition, the middle school has identified a school-wide goal and a new support program for students who are not meeting grade-level expectations. These students will receive two extra instructional periods with their core math teachers every five days. This structure will allow teachers to respond to student's needs as they emerge in class.

Administrators, teachers, support staff, and students are enthusiastic and proud of the Community Park Dual Language Immersion Program. Community Park has been recognized as a Model Program for Spanish Dual Language Immersion by the New Jersey Department of Education. Recommendations from the Dual Language Immersion Tri-State Audit conducted in 2022 are currently being implemented to expand the scale and effectiveness of the current Dual Language Immersion program within the district.

Recommendations: Eliminate or modify support programs that are redundant and/or result in minimal impact on student learning.

Support classes at the secondary level could be leveraged more efficiently. The recently introduced mathematics exploratory class in the middle school and the Plus program in the high school align with the NCTM's recommendations for a "stacked or corequisite mathematics class." This approach places students in standard grade-level courses alongside their peers but also provides an extra period for further mathematical assistance and time (NCTM, 2020). While both programs are optional, the middle school automatically enrolls students, giving them an option to decline. The Plus classes in high school require students to enroll. If students do not have a strong mathematical identity or agency, they may not take advantage of these classes. Students might benefit from a similar enrollment approach in Plus, as the one used in middle school.

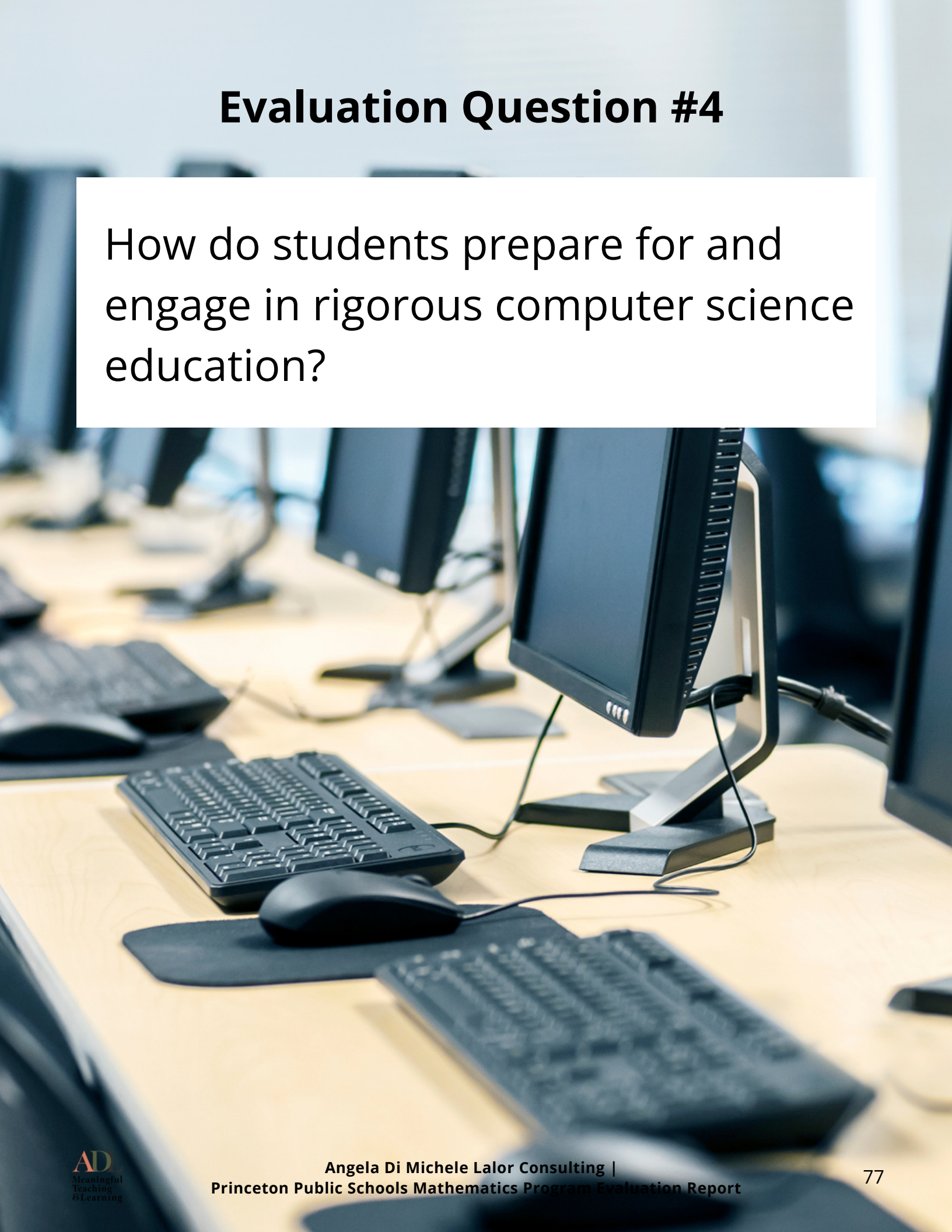
It is important that instructional support classes like Plus and the middle school exploratory class and the teachers of these classes avoid labels that undermine student learning. “One role of mathematics teachers and leaders is to ensure continual affirmation of students’ positive mathematical identities through their learning experiences, feedback, and building on their strengths that will support them in developing resilient, positive identities (NCTM, 2021).” These and other asset-based approaches to learning are necessary to support students in developing the mindset to persevere when mathematics is challenging and rely on the conceptual understandings, skills, and strategies they have learned to address new and unfamiliar problems.

Increase access to the Dual Language Immersion Program and provide additional support for multilingual learners.

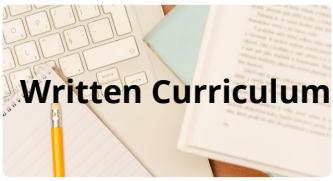
Fully utilize the Dual Language Immersion Program to reduce barriers that hinder access to high-level mathematics coursework for Spanish-speaking students. Consider expanding the Dual Language Immersion Program to include secondary grade levels, inclusive of mathematics coursework. Engage Spanish-speaking caregivers from all Princeton Public Schools elementary schools to highlight the program’s benefits. Ensure educators employ effective methods and use bilingual resources to support Multilingual learners in the classroom.

Evaluation Question #4

How do students prepare for and engage in rigorous computer science education?



Computer Science



The analysis of the written curriculum included the examination of the mathematics curriculum at elementary and middle school to determine if the New Jersey Learning Standards for Computer Science and Design Thinking had been integrated into the mathematics curriculum. The written curricula for computer science courses at the high school were examined to determine alignment with the Computer Science and Design Thinking standards.

Elementary School Curriculum:

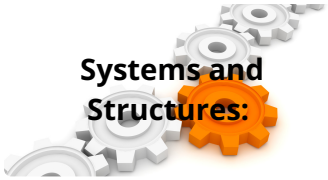
- No separate computer science curriculum
- No evidence of the New Jersey Learning Standards for Computer Science and Design Thinking in the curriculum

Middle School Curriculum:

- No evidence of integration of the New Jersey Learning Standards for Computer Science and Design Thinking in the curriculum

High School Curriculum:

- AP Computer Science Principles was last updated in 2016 before the adoption of the new standards
- Introduction to Java Programming was last updated in February 2020. It is a public document and provides an overview of units but no standards.
- IOS App Development was updated in August 2021. Some units aligned with Career and Technical Education (CTE) standards.
- Algorithms & Data Structures was updated in February 2020. It provides an overview of the course but does not include standards.
- Object Orientated Java was updated February 2020 but is not complete.



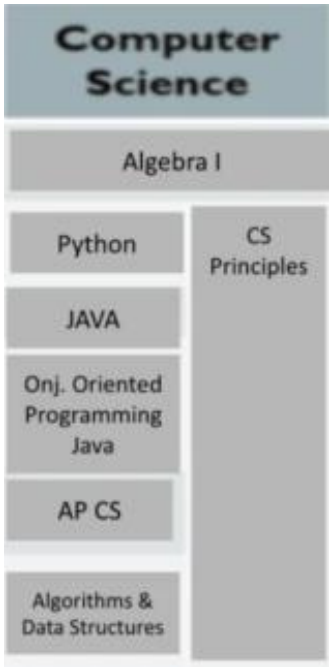
Elementary School:

- There is no information regarding computer science integration at the elementary school.
- Tier 1 Technology Support Associates are available at the elementary school level.

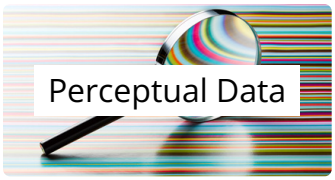
Middle School:

- Students can take computer science courses at the middle school during their Exploratory class time. Offerings include Computers, Tech Prep STEM Coding and Digital Art.
- Another opportunity to participate in computer science is the Princeton Middle School Student Technology Club
- There is a computer technology teacher at the middle school.

High School Course:



- Computer Science courses (Python Programming, Intro to Computer Science Using Java, Object Oriented Programming Using Java, AP Computer Science in Java) can be taken concurrently with mathematics courses but must be taken sequentially with other Computer Science courses.
- A Python Portfolio is offered as an alternative to an in-person course so students can enter the computer science course pathway through Java.
- Computer science courses must be taken sequentially. Most courses also have a mathematics requirement.



Perceptual Data:

The High School Computer Science Focus Group provided valuable insights into the state of computer science education in the Princeton Public Schools which are captured in the following notes:

- Classes are overcrowded
- Not all students who take computer science classes have met the math requirements. Therefore, they need 1:1 support.
- The driving force behind student enrollment in computer science courses is interest, and sometimes the math requirement is waived.
- Classrooms are outdated. They do not promote learning. They are not conducive to collaboration, or support. Students need to be responsible for their own learning.
- Website needs to be updated - Python Portfolio requirements need to be posted earlier.
- Class demographics do not match school demographics. It is improving but more accessibility is needed. The Princeton High School should follow higher education initiatives to support more girls in STEM.
- Student need to learn computer science at their own pace; differentiation and individualization is needed.
- Teachers in the high school should work in tandem with the tech department. Sometimes, there are issues with computer access that interfere with instruction. There should be different hierarchies or access to different systems.
- Python Portfolio should be completed by the end of March. Students should complete the portfolio independently.
- There needs to be more communication with the guidance department because some students do not have the pre-requisites or background, These students take the place of someone who would benefit from the class.
- There is a shortage of computer science teachers.
- Computer science committee is needed to establish a K – 12 program. There is no integration of computer science at the elementary school and limited exposure at middle school.

Conclusions

The computer science classes are in high demand among students. There are more students interested in taking computer science courses than can be accommodated based on the number of instructors and the space in which the computer science classes are held at the high school.

The Asynchronous Python Portfolio Project Independent/Self-Study was developed to provide more opportunities for students to enroll in computer science courses at the high school level. Providing computer science courses at the middle school was also considered an option for creating more availability at the high school. However, creating more courses requires an increase in the number of computer science teachers.

The course catalog for computer science courses clearly describes courses and pre-requisite requirements. However, guidance counselors approve student enrollment in computer science classes for those who have not met the math requirement. These students often require additional support and guidance to ensure their success.

There is a noticeable disparity between the demographics of computer science classes and the overall school population, highlighting the necessity for greater accessibility and inclusion, particularly for girls.

The computer science equipment is outdated. Classrooms are not collaborative and supportive learning environments. Additionally, issues related to computer access and instruction occur at the high school due to structures and policies regarding technology.

The importance of computer science is not effectively communicated through the district website. Information regarding the courses is limited, with the most extensive information being found in the high school course catalog. No information regarding computer science or technology is available on the middle school or elementary school.

Computer science curricula has not been updated to reflect the new standards.

Recommendations

Any recommendation requires increasing the number of computer science teachers in the district. Investments should be made in modernizing classrooms to create interactive and collaborative learning environments. Additionally, computer teachers and the tech department need to work more closely together to address issues related to computer access and instruction. Access to different systems should be streamlined.

Computer science education needs to be more accessible to all students. Efforts should be made to increase the diversity of students enrolled in the computer courses. It is recommended that the district consider establishing a mentor program to support underrepresented students in computer science. Improved guidance and mentorship can help students make informed choices and succeed in computer science. Improved communication with the guidance department is essential to ensure students meet prerequisites and have the necessary background for computer science courses.

Establishing a computer science committee to develop a K-12 computer science program is essential. The curriculum needs to be updated to align with the New Jersey Learning Standards for Computer Science and Design Thinking. Efforts should be made to integrate the computer science standards into the elementary and middle school curricula so more students are exposed to computer science learning experiences. Additional courses should be made available to students in middle school.