The Quantile® Framework for Mathematics

A Practical Approach: Linking Assessment to Instruction

Presented by:
Jane Scott, Senior Educational Facilitator
MetaMetrics®, Inc.
jscott@Lexile.com
The Quantile Framework For Mathematics

• What is the Quantile Framework for Mathematics?
• Why do I need to know about it?
Along the way we’ll discuss...

- ...the use of Quantiles as a measurement system
- ...how to profile students, forecast readiness, and identify skill difficulty
- ...differentiation opportunities for all students
- ...the **FREE online resources** found at www.Quantiles.com
Imagine...

...what if there was a means of determining student readiness to address various math concepts?

...what if there existed a tool that could drill a math concept all the way down to foundational knowledge?
Think about the following problem:

*Each cup of soda sells for 25¢. How many cups of soda must be sold to collect $8.25?*

- What are the skills that a student would need to employ in order to solve this problem?
- In what grade would a student possibly face this question?
Skills/concepts you may have thought of:

- being able to read the problem
- basic number sense
- skip count by 25
- counting/grouping strategies
- value of coins/money
- odd numbers can be divided evenly
- division: division facts, an understanding of subtraction, understanding of division steps/process, multiplication facts, 2-digit quotients, placement of digits in the quotient,
- decimals/money sense
- algebraic equation

Of course, there are many other skills along the way!
Two issues that Math educators deal with on a daily basis:

How to determine student readiness?

How to establish the degree of difficulty for various skills in mathematics?
MetaMetrics’ Mission/Unification

To provide a means of *matching instructional materials to student ability*, in order to foster better educational practices and provide a means to track student progress.

(Same mission behind Lexile Framework development!)
Let’s explore where you can receive a Quantile measure on your students!
The Quantile Framework for Math is *linked* to:

- State Assessments
- Norm-Referenced Assessments
- Formative Assessments
- Math Programs
- Online Curriculum
Assessments Used in Wyoming

- Criterion-Referenced Assessment in Reading and Mathematics (PAWS-Proficiency Assessments for Wyoming Students), Grades 3-8
## Individual Student Report:

**Student Report**

- **First Name:** Madison
- **Middle Initial:** P
- **Last Name:** Allen
- **Grade:** 3
- **Birthdate:** 07/14/2006
- **Student ID:** 84738475
- **Test Window:** 03/03/14 - 03/28/14
- **School:** School 1
- **District:** District 1

### Purpose of Report

This report provides information about your child's performance on the Proficiency Assessment for Wyoming Students (PASWS) and the Student Assessment of Writing Skills (SAWS). This report will help you understand your child's performance in reading and math (grades 3-8), science (grades 4 and 8), and writing (grades 3, 5, and 7) for the 2013-2014 school year.

### Glossary of Terms

- **Scale Score:** Your child's raw score (total number of points earned) transformed into a score on a scale.
- **Score Ranges:** The range of scale score points assigned to each proficiency level. Each subject area has a unique range of points.
- **Domain Performance:** Describes your child's performance in sub-categories (domains) of each content area. The Scale Score column indicates your child's performance in relation to the overall reading scale (above). The Domain Performance column shows your child's percent correct in each of the measured domains.
- **State Percentile Rank:** State Percentile Rank indicates your child's performance in relation to other Wyoming students in the same grade. The percentile shows the percentage of Wyoming students in the same grade who obtained scores equal to or less than your child's score.

### Lexile® Measure

Lexile® Measures help readers select materials at their reading level. This can serve as a guide in selecting books for your child.

### Quantile® Measure

Quantile® Measure: Similar to the Lexile and can help you identify suitable activities to do at home. These activities will help your child practice mathematical skills leading to increased mathematical understanding.

### State Conversion Tables

<table>
<thead>
<tr>
<th>Subject</th>
<th>Total</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>620</td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>810</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Writing</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

### CONTENT PERFORMANCE BY DOMAIN

#### Language Arts (Reading)

<table>
<thead>
<tr>
<th>Sub-Subject</th>
<th>Score</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature: Craft and Structure</td>
<td>340</td>
<td>99%</td>
</tr>
<tr>
<td>Literature: Key Ideas and Details</td>
<td>704</td>
<td>59%</td>
</tr>
<tr>
<td>Informational Text: Craft and Structure</td>
<td>752</td>
<td>64%</td>
</tr>
<tr>
<td>Informational Text: Key Ideas and Details</td>
<td>742</td>
<td>93%</td>
</tr>
<tr>
<td>Language</td>
<td>837</td>
<td>64%</td>
</tr>
</tbody>
</table>

#### Math

<table>
<thead>
<tr>
<th>Sub-Subject</th>
<th>Score</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Operations - Base 10</td>
<td>773</td>
<td>65%</td>
</tr>
<tr>
<td>Geometry</td>
<td>410</td>
<td>80%</td>
</tr>
<tr>
<td>Number Operations - Fractions</td>
<td>663</td>
<td>78%</td>
</tr>
<tr>
<td>Operations and Algebraic Thinking</td>
<td>493</td>
<td>46%</td>
</tr>
<tr>
<td>Measurement &amp; Data</td>
<td>309</td>
<td>50%</td>
</tr>
</tbody>
</table>

### Science

<table>
<thead>
<tr>
<th>Topic</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

### SAWs

<table>
<thead>
<tr>
<th>Component</th>
<th>Total Possible</th>
<th>Student Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrative Total</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Idea Development</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Organization</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Voice</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Conventions</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Informative/Explanatory Total</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

For more information about the PASWS and SAWs Assessments, visit the website at www.WY Assessment.com. For additional resources and information, visit the Wyoming Department of Education website at www.WYEducation.gov.
PAWS and Quantiles

A child entering gr. 5 from gr. 4 with a 700Q measure on the grade 4 PAWS, must grow a minimum of 100Q in grade 5 to be considered Proficient at the end of the year.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Below Basic</th>
<th>Basic</th>
<th>Proficient</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>470Q and Below</td>
<td>475Q to 710Q</td>
<td>715Q to 980Q</td>
<td>985Q and Above</td>
</tr>
<tr>
<td>4</td>
<td>450Q and Below</td>
<td>455Q to 750Q</td>
<td>755Q to 1040Q</td>
<td>1045Q and Above</td>
</tr>
<tr>
<td>5</td>
<td>590Q and Below</td>
<td>595Q to 795Q</td>
<td>800Q to 1135Q</td>
<td>1140Q and Above</td>
</tr>
<tr>
<td>6</td>
<td>670Q and Below</td>
<td>675Q to 910Q</td>
<td>915Q to 1210Q</td>
<td>1215Q and Above</td>
</tr>
<tr>
<td>7</td>
<td>775Q and Below</td>
<td>780Q to 990Q</td>
<td>995Q to 1240Q</td>
<td>1245Q and Above</td>
</tr>
<tr>
<td>8</td>
<td>805Q and Below</td>
<td>810Q to 980Q</td>
<td>985Q to 1260Q</td>
<td>1265Q and Above</td>
</tr>
</tbody>
</table>

Test Administration. PAWS will be administered between March 2nd and March 27th, 2015.
<table>
<thead>
<tr>
<th><strong>Formative Assessments Linked to the Quantile Framework</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="measured progress" /></td>
</tr>
<tr>
<td><img src="image" alt="A+ courseware" /></td>
</tr>
<tr>
<td><img src="image" alt="Scholastic" /></td>
</tr>
<tr>
<td><img src="image" alt="i-Ready" /></td>
</tr>
</tbody>
</table>
Math Program Linked to the Quantile Framework

Vmath, TransMath, Inside Algebra
Online Curriculum Linked to the Quantile Framework

Conceptua® Fractions
Let’s explore Standards that have been aligned to the Quantile Framework for Mathematics

OR

(How an educator determines the difficulty of any math standard in their curriculum!)
Wyoming Standards

Math Skills Database

Search the Math Skills Database for Quantile Skills and Concepts (QSCs) using your state standards. The database contains targeted, free resources appropriately matched to students by Quantile measure and math content.

Search Criteria

Standard Search
Keyword Search

Wyoming

Course
Kindergarten
Grade 1
Grade 2
Grade 3
Grade 4
Grade 5
Grade 6
Grade 7
Grade 8
Algebra 1
Geometry
Algebra 2
Integrated Mathematics I
Integrated Mathematics II
Integrated Mathematics III
Wyoming Standards

Math Skills Database

Search the Math Skills Database for Quantile Skills and Concepts (QSCs) using your state standards. The database contains targeted, free resources appropriately matched to students by Quantile measure and math content.

Search Criteria: Wyoming Grade 5 All Standards

5.OA.1: Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these...
5.OA.2: Write simple expressions that record calculations with numbers, and interpret numerical expressions...
5.OA.3: Generate two numerical patterns using two given rules. Identify apparent relationships between...
5.NBT.1: Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it...
5.NBT.2: Explain patterns in the number of zeros of the product when multiplying a number by powers of 10.
5.NBT.3.a: Read and write decimals to thousandths using base-ten numerals, number names, and expanded form...
5.NBT.3.b: Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and...
5.NBT.4: Use place value understanding to round decimals to any place.
5.NBT.5: Fluently multiply multi-digit whole numbers using the standard algorithm.
5.NBT.6: Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit...
5.NBT.7: Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and...
5.NF.1: Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given.
5.NF.2: Solve word problems involving addition and subtraction of fractions referring to the same whole,...
5.NF.3: Interpret a fraction as division of the numerator by the denominator (a/b = a/b). Solve word...
5.NF.4.a: Interpret the product (a/b) x q as a parts of a partition of q into b equal parts; equivalently, as...
5.NF.4.b: Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the...
5.NF.5.a: Comparing the size of a product to the size of one factor on the basis of the size of the other...
5.NF.5.b: Explaining why multiplying a given number by a factor greater than 1 results in a product greater...
5.NF.6: Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using...
Common Core Standards

Math Skills Database

Search the Math Skills Database for Quantile Skills and Concepts (QSCs) using your state standards. The database contains targeted, free resources appropriately matched to students by Quantile measure and math content.

Search Criteria: Common Core

Course
- Kindergarten
- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Grade 5
- Grade 6
- Grade 7
- Grade 8
- Algebra 1
- Geometry
- Algebra 2
- Mathematics I
- Mathematics II
- Mathematics III

MetaMetrics develops scientific measures of academic achievement and complementary technology goals by providing unique insights about their ability level and potential for growth.
Let’s explore resources that have been calibrated to the Quantile Framework for Mathematics
Differentiation Opportunities:
# Math Textbooks are Calibrated

## Go Math! Grade 6 Common Core Edition

<table>
<thead>
<tr>
<th>Title</th>
<th>Go Math! Grade 6 Common Core Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publisher</td>
<td>Houghton Mifflin Harcourt</td>
</tr>
<tr>
<td>Course</td>
<td>Grade 6</td>
</tr>
<tr>
<td>ISBN-13</td>
<td>9780547597783</td>
</tr>
<tr>
<td>ISBN-10</td>
<td>0547587783</td>
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</tbody>
</table>

### Table of Contents

#### Chapter 1: Whole Numbers and Decimals

**Lesson 1: Divide Multi-Digit Numbers** *(Hide related QSCs) (690Q)*

<table>
<thead>
<tr>
<th>QSC ID</th>
<th>Skill</th>
<th>Quantile Measure</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSC171</td>
<td>Estimate and solve division problems with multi-digit divisors; explain solution.</td>
<td>690Q</td>
<td>21</td>
</tr>
<tr>
<td>QSC203</td>
<td>Solve one-step linear equations and inequalities and graph solutions of the inequalities on a number line in number and word problems.</td>
<td>650Q</td>
<td>46</td>
</tr>
</tbody>
</table>

**Lesson 2: Prime Factorization** *(Hide related QSCs) (780Q)*

<table>
<thead>
<tr>
<th>QSC ID</th>
<th>Skill</th>
<th>Quantile Measure</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSC232</td>
<td>Write numbers using prime factorization.</td>
<td>780Q</td>
<td>11</td>
</tr>
</tbody>
</table>

**Lesson 3: Least Common Multiple** *(Hide related QSCs) (780Q)*
MetaMetrics has developed a FREE Summer Math Program: SUMMER m + π CHALLENGE
Research indicates that:

- Summer math loss is more pronounced than reading loss
- Students lose math ability regardless of household income level
- Parents are more likely to read with their children than practice math skills
- Math practice is less intuitive and more technical than reading practice
- On average, all students, regardless of socio-economic status, lose approximately 2.6 months of grade level equivalency in mathematical computation over the summer months each year

Summer Math Challenge Overview

- **Free** initiative for parents and their children
- Email-based math skills maintenance program
- Focus on **reinforcing skills** acquired during previous school year
- Target students **entering grades 3-6** in the fall
  (skills in grades 2-5 reviewed in SMC)
- Entry level can be based on Quantile score or parent input
- One math Common Core concept addressed per week through daily emails of activities and resources
- Visit [www.Quantiles.com](http://www.Quantiles.com) to
  - Register for daily emails
  - Track student progress
  - Provide feedback on Program
Summer Math Challenge

Sample Daily Email

Grade 3 (Medium), Week 5: Finding Area
July 21, 2014: Gotcha Covered

Hello Jane,

It’s hard to believe it is already week five!

Today’s activities will focus on finding the area of squares, rectangles, and some other special shapes. The video shows how to find the area of a square. In the video, please note that the teacher uses a dot to show multiplication rather than an x. Your child may remember his or her teacher writing the formula for finding area as Area = length × width. Either multiplication symbol can be used.

Your child will be a “measuring professional” when this interactive activity is finished! He or she will be finding the area and perimeter of rectangular room sections at a party. Remember that perimeter is the distance around the outside edges of the rooms.

Here are the directions your child should follow.
• Click the link below.
• Then click “Let’s Go.”
• Read the directions in the upper right corner.
• Below these directions are the areas and perimeters of the room sections to design.
• Click in the corner of a square to drag it to make a room with the correct area and perimeter.
• Click on one line to move it over to the space where it needs to be placed.
• The design can be checked at any time by clicking on the green “Check it” button.

Tomorrow will bring another day of finding area!

Note that this game is not compatible with iPads or iPhones. As an alternate activity, click the link below to print out the practice page for your child to complete. Use the answer key on the second page to check the answers together.

Today’s Resources:
Videos
How do you find the area of a rectangle? (Virtual Nerd)
Interactive Activities
Party Designer (Math Playground)
Practice Pages
Finding Area (Common Core Sheets)
Helpful links:
Missed a day? Go to the Summer Math Challenge dashboard to get caught up!
Learn more about the skills and concepts associated with today’s activity.
Contact Quantiles.com for support.
Welcome to the Summer Math Challenge Dashboard

Click on the squares below to learn more about the math concepts for each week. Click on your child’s name to update their profile.

Lucy (Grade 3) Download Certificate

- **SUMMER MATH CHALLENGE**
  - Week 1: Multiplication Facts
  - Week 2: Advanced Multiplication
  - Week 3: Fractions
  - Week 4: Compare and Order Fractions
Summer Math Challenge

This Certificate of Completion is Awarded to:

Lucy

For successfully reviewing the following math concepts* included in the Summer Math Challenge:

- **Multiplication Facts**
  - Week 1
  - Concept ID: 118

- **Advanced Multiplication**
  - Week 2
  - Concept ID: 162

- **Fractions**
  - Week 3
  - Concept ID: 538

- **Compare and Order Fractions**
  - Week 4
  - Concept ID: 115

- **Finding Area**
  - Week 5
  - Concept ID: 146

*For more information about these concepts, please visit [quantiles.com/tools/math-skills-database/keyword-search](http://quantiles.com/tools/math-skills-database/keyword-search) and enter the Concept ID in the keyword search field.

To complete this week’s activities visit quantiles.com/summer-math!

Certified By ___________________________  Date ___________________________
Timeline for Summer Math Challenge

• **April 1, 2014** – Summer Math enrollment begins

• **June 23, 2014** – parents begin receiving Summer Math emails

Not too late to sign up!
Activities will be available 2014-2015 school year!
Adding grade 6 next year!
WDE partners with MetaMetrics for free summer learning

Posted: Saturday, May 31, 2014 12:00 am

CHEYENNE, Wyo. — The Wyoming Department of Education in partnership with MetaMetrics, is trying to negate the effects of summer learning loss with two new summer learning initiatives: Find a Book, Wyoming, and The Summer Math Challenge. Wyoming students grow in their reading and mathematics abilities during the academic school year. However, students can slip in their abilities over the summer months. This phenomenon is called "summer learning loss," and is well documented by researchers throughout the country. The following two programs are specially geared to help stop summer learning loss and are free to Wyoming students.

Find a Book, Wyoming: Research shows that when students read high-interest, ability appropriate books over the summer, they can actually grow and improve their reading ability. The Find a Book, Wyoming tool supports and facilitates this research-based solution. Find a Book, Wyoming enables students, educators and parents to build custom reading lists based on their reading ability as well as personal interests. The tool also enables students, parents and educators to check the availability of books at their local library, as well as submit a pledge to read this summer. To access the Find a Book, Wyoming tool, visit lexile.com/fab/wy.

The Summer Math Challenge: The Summer Math Challenge is a math skills maintenance program based on grade-level state standards for mathematics. The program is targeted to students who have just completed second through fifth grade and is designed to help them retain math skills learned during the previous school year. Parents who enroll their child, receive daily emails with targeted activities and resources to help children retain the math skills learned during the previous school year. The Summer Math Challenge begins June 23 and runs until Aug. 1. For more information about the Summer Math Challenge, visit quantiles.com/content/summer-math-challenge.

Both learning tools use measures that are reported on the Proficiency Assessments for Wyoming Students for grades 3-8 and 11. Find a Book, Wyoming uses a student’s reading score, reported as a Lexile measure, to provide a corresponding list of texts that fall within the student’s reading ability. The Summer Math Challenge uses a student’s mathematics score, reported as a Quantile® measure, to produce activities tailored to the student’s mathematical ability. Both tools have features that allow students, parents and educators to estimate a Lexile or Quantile measure if it is not known. For more information, contact Julie Magee at julie.magee@wyo.gov or 307-777-8740.
What is the Quantile Framework for Mathematics?
The Quantile Framework for Mathematics is...
Metric for Measurement

Quantile as Fahrenheit

Math as Temperature

...not an indicator of mastery
...not the curriculum
...not the math program
...not a grade equivalent
The Quantile Framework for Mathematics is...

placing the difficulty of a skill, student ability, and resources all on the same scale!

Compare and order fractions using common numerators or denominators. (710Q)

Resource (710Q)

Other Resources www.Quantiles.com

Wendi (700Q)

Quantile Scale <-> Thermometer
Taxonomy of the Quantile Framework

• The Quantile Framework has over 500 QSCs (Quantile Skills and Concepts) that have been tested across the nation.

• QSCs are delivered as a taxonomy of skills, concepts and processes in specific terms.
What is a QSC? (Quantile Skill and Concept)

- Within the Quantile Framework, **QSC** is the term **we** use to reference a Skill and Concept.
- A specific mathematical skill or concept, e.g.,

  “Use models to investigate the concept of the Pythagorean Theorem” is:

  **QSC 271**

  (Quantile Skill and Concept)

  with a Quantile measure of difficulty: **1010Q**
Measures Reported

- Measures reported from EM400Q to 1600Q
- Measures below 0Q are reported as “EM” or “Emerging Mathematician”
- “Model the concept of addition for sums to 10” EM 260Q.
- The “EM” replaces the negative sign in the measure.
### A Sample of QSCs in the EM space:

<table>
<thead>
<tr>
<th>QSC ID</th>
<th>Quantile Measure</th>
<th>Description</th>
<th>Strand</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSC65</td>
<td>EM60Q</td>
<td>Rote count 101 to 1000.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC627</td>
<td>EM60Q</td>
<td>Use models to determine properties of basic solid figures (slide, stack, and roll).</td>
<td>Geometry</td>
</tr>
<tr>
<td>QSC676</td>
<td>EM60Q</td>
<td>Read and write word names for numbers from 13 to less than 100.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC24</td>
<td>EM60Q</td>
<td>Rote count beginning at 1 or at another number by '1s, and rote count by 2s, 5s and 10s to 100 beginning at 2, 5, or 10.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC537</td>
<td>EM60Q</td>
<td>Identify and name spheres and cubes.</td>
<td>Geometry</td>
</tr>
<tr>
<td>QSC1003</td>
<td>EM60Q</td>
<td>Know and use related addition and subtraction facts.</td>
<td>Numerical Operations</td>
</tr>
<tr>
<td>QSC30</td>
<td>EM90Q</td>
<td>Group objects by 2s, 5s, and 10s in order to count.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC25</td>
<td>EM100Q</td>
<td>Read and write numerals using one-to-one correspondence to match sets of 11 to 100.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC26</td>
<td>EM100Q</td>
<td>Read and write word names from zero to twelve.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC536</td>
<td>EM100Q</td>
<td>Identify, draw, and name basic shapes such as triangles, squares, rectangles, hexagons, and circles.</td>
<td>Geometry</td>
</tr>
<tr>
<td>QSC564</td>
<td>EM100Q</td>
<td>Measure time using nonstandard units.</td>
<td>Measurement</td>
</tr>
<tr>
<td>QSC1005</td>
<td>EM100Q</td>
<td>Tell time to the nearest hour and half-hour using digital and analog clocks.</td>
<td>Measurement</td>
</tr>
<tr>
<td>QSC20</td>
<td>EM110Q</td>
<td>Organize, display, and interpret information in concrete or picture graphs.</td>
<td>Data Analysis, Statistics, and Probability</td>
</tr>
<tr>
<td>QSC27</td>
<td>EM110Q</td>
<td>Read and write numerals from 30 to 100.</td>
<td>Number Sense</td>
</tr>
<tr>
<td>QSC75</td>
<td>EM110Q</td>
<td>Identify missing addends for addition facts.</td>
<td>Algebra and Algebraic Thinking</td>
</tr>
</tbody>
</table>

**Quantile Scale**

- **400Q** - Harder skills
- **300Q**
- **200Q**
- **100Q**
- **0Q**
- **EM100Q**
- **EM200Q**
- **EM300Q** - Easier skills
Quantiles Measures: Empirically Derived

- Identify items that meet psychometric criteria
- Quantile measures are determined using field test results. Data from the actual performance of examinees is used.
- The results are also reviewed by a group of subject-matter experts (SMEs).
- Analysis and scale development
- Empirical scaling is more replicable than expert judgment alone.
The Quantile scale is:

1. **Unidimensional** *(i.e., one score describes mathematics achievement across the strands)*

2. **Developmental** *(i.e., higher the measure, the more complex the math skill is or proficient the student is!)*

*Note: The opposite is true in the EM space.*
Content Strands in Mathematics

The Quantile Framework for Mathematics

Algebra and Algebraic Thinking
Number Sense
Numerical Operations
Measurement
Geometry
Data Analysis, Statistics & Probability

Strand assignments are included in
The Quantile Framework for Mathematics
Unidimensional Construct

One score is representative of overall mathematical ability

Quantile Scale

EM400
Kindergarten

1600+
Pre-Calculus

810Q
Relationships among radius, diameter, circumference

930Q
Relationships with diameter, circumference, pi

870Q
Discounts, Taxes, Commissions (%)

840Q
Compare and order rational numbers

810Q
Use tables to determine ratio/rate of change

870Q
Circle graphs with ratios & percents
What is the measure of $\angle A$?

<table>
<thead>
<tr>
<th>Step</th>
<th>Strand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize it’s a triangle &amp; right triangle</td>
<td>Geometry</td>
</tr>
<tr>
<td>Sum of the interior angles sum to $180^\circ$.</td>
<td>Geometry</td>
</tr>
<tr>
<td>A right angle is $90^\circ$.</td>
<td>Measurement</td>
</tr>
<tr>
<td>Set up “equation” &amp; solve</td>
<td>Algebra and Algebraic Thinking</td>
</tr>
<tr>
<td>Calculations</td>
<td>Numerical Operations</td>
</tr>
</tbody>
</table>

[Diagram of a triangle with angles $A$, $B$, and $C$, and a right angle at $B$.]
The Quantile Scale is developmental within one strand

Measurement

240Q Length
400Q Perimeter
840Q Volume of rectangular solids
930Q Circumference
1040Q Area of triangles, parallelograms, circles, & trapezoids
The Quantile Scale is developmental

**across** strands

**Numerical Operations**

240Q:
Use Skip counting to model multiplication

**Algebra & Algebraic Thinking**

360Q:
Describe & demonstrate patterns in skip counting

**Data Analysis, Statistics & Probability**

470Q:
Display, read, or interpret data on a line graph
Activity: Let’s think about... The Value of Skill Difficulty

- What does each skill mean?
- In which grade is the skill introduced?
- Which content strand does each skill come from?

- Solve problems involving elapsed time.
- Use a coordinate grid to solve problems. Describe the path between given points on the plane.
- Divide using single-digit divisors, with and without remainders.
Activity cont’d: The Value of Skill Difficulty

Which skill is most difficult?

- Solve problems involving elapsed time.
- Use a coordinate grid to solve problems. Describe the path between given points on the plane.
- Divide using single-digit divisors, with and without remainders.
Activity cont’d: The Value of Skill Difficulty

Which skill is most difficult?

- Solve problems involving elapsed time. **450Q**
- Use a coordinate grid to solve problems. Describe the path between given points on the plane. **480Q**
- Divide using single-digit divisors, with and without remainders. **450Q**
Why do I need to know about the Quantile Framework for Mathematics?
www.Quantiles.com

The Quantile Framework for Mathematics
Linking assessment with mathematics instruction

Skills, Concepts, Resources

(The Math Skill Database where QSCs have been aligned to state curriculums and CCSSI)

Test of Mathematical Achievement

(a product, or state assessment that a student completes to determine math ability)
Picturing Mathematics Using the Quantile Map
Activity: Student Ability vs Skill Difficulty

- Place the Quantile Map flat on your table.
- Each person needs one pink and one blue strip of paper from your table.
- We will work together to discuss the various gaps indicated by examining the Quantile measure of a skill compared to various student Quantile measures.
Focus Skill: Identify relations as directly proportional, linear, or nonlinear using rules, tables, and graphs. (850Q)

Laura’s Ability 350Q

What must happen to close this gap?
Ready for success?

Matching the “at risk” student to the skill using the Quantile Framework, helps insure they are ready for instruction!

After the introductory lesson there is...

...guided practice,
...during/after school tutoring,
...homework practice,
...review in the next day or so, serves to increase a student’s success rate!
Focus Skill: Organize and compare one set of information in histograms and bar graphs. (970Q)

Marcus is ready for this skill!

Marcus 950Q

Focus Skill Difficulty 970Q
Focus Skill: Estimate and compute sums and differences with decimal numbers. (580Q)

Juanita only needs a review of this skill and then move on to enrichment activities!

Juanita 1050Q

Focus Skill Difficulty 550Q
What is the student’s Quantile Learning Frontier?
The Quantile range identifies the learning frontier of mathematical skills in which a student can have success after some introductory instruction.

This range is 50 above and 50 below the indicated Quantile score.

student Quantile score = 600

The Quantile range or Learning Frontier is: 550 to 650
What happens when students are not ready or too advanced for the focus skill to be taught?
An Essential Feature of the Quantile Framework: the Knowledge Cluster!

A Knowledge Cluster has 4 parts:

1. Focus skill
2. Prerequisite skills to ensure prior knowledge
3. Supporting skills to add depth across content strands
4. Impending skills to point to what students will encounter next
# Quantile Knowledge Clusters

<table>
<thead>
<tr>
<th>Prerequisite Skill:</th>
<th>Supporting Skill:</th>
<th>Supporting Skill:</th>
<th>Supporting Skill:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify corresponding parts of similar and congruent figures. (770Q)</td>
<td>Determine and use scale factors to reduce and enlarge drawings on grids to produce dilations. (990Q)</td>
<td>Given a proportional relationship represented by tables, graphs, models, or algebraic or verbal descriptions, identify the unit rate. (900Q)</td>
<td>Write a proportion to model a word problem; solve proportions. (720Q)</td>
</tr>
</tbody>
</table>

### Focus Skill:

Use proportions to express relationships between corresponding parts of similar figures. (920Q)

### Impending Skill:

Use proportional reasoning to solve problems related to similar and congruent polygons. (950Q)

Verify how properties and relationships of geometric figures are maintained or how they change through transformations. (1070Q)

Verify how properties and relationships of geometric figures are maintained or how they change through transformations. (1070Q)
The Quantile Framework for Mathematics

is...

placing the
difficulty of a skill,
student ability,
and
resources
all on the same scale!

Compare and order fractions
using common
numerators or denominators. (710Q)

Resource
(710Q)

Other Resources
www.Quantiles.com

Sam
550Q)

Quantile Scale <-> Thermometer
Knowledge Clusters—applications

• To inform instruction that addresses the needs and abilities of each student
• To provide insight into content background necessary for success
• To add depth and breath to concepts in mathematics
• To adjust IEPs according to Quantile measures
• To provide a resource for meeting the needs of all RTI tiers
One size does not fit all...

...when it comes to Math instruction!
Benefits of the Quantile Framework

• **LINK:**
  student ability to skill difficulty (using a common measure)

• **FORECAST:**
  student success rate (after introductory lessons)

• **DIFFERENTIATE:**
  math instruction for struggling students

• **TRACK:**
  growth over time
### Aligning your curriculum

<table>
<thead>
<tr>
<th>CCState Standard ID</th>
<th>MetaMetrics QSC Identification number</th>
<th>MetaMetrics description of the skill or concept</th>
<th>Quantile measure of skill difficulty</th>
<th>The strand assignment for our QSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.G.4</td>
<td>QSC318</td>
<td>Use nets or formulas to find the surface area of prisms, pyramids, and cylinders in number and word problems.</td>
<td>1040Q</td>
<td>Measurement</td>
</tr>
</tbody>
</table>

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Applications of the Quantile Measure

Jenny, Grade 6 650Q

Quantile Scale

Textbooks → Quantile Teacher Assistant

Websites & Games

Worksheets & other Downloadables

Math Literature Connections

Other Instructional Products

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A Snapshot of the Quantile Website

Math Skill Database

QSC Search

- Curriculum Alignment
- Knowledge Clusters
- Textbook lesson alignment
- Instructional Resources

Math At Home

Find your Textbook

Quantile Teacher Assistant
Summer Math Challenge
- Prevent Summer Math loss
- For rising 3rd - 6th grade students
- Daily emails with fun activities and resources
- Register now for FREE

The Quantile Framework for Mathematics:
Linking assessment with mathematics instruction.

EXPLORE
Benefits of www.Quantiles.com for Educators:

- Resources to assist with differentiation
- Reduce loss of math knowledge over the summer
- Resources have been calibrated to the Quantile Framework
- Support at-risk math students as well as the gifted student
- Teachers can recommend practice tutorials prior to classroom assessments
- Resources to support RTI recommendations or Individual Educational Plans
- Classroom teacher can maintain contact with a homebound student
- Peer teachers can work together in a streamlined fashion
- Emails to upcoming students
- All resources are free and web based
Benefits of www.Quantiles.com for Families:

- Students can take ownership of their learning
- Practice math skills w/ caregivers during the summer months
- Strengthen math skills of children during the school year
- Additional help at home when an assignment needs clarification.
- Students can review the skills from their textbook prior to a test
- Support RTI recommendations or Individual Educational Plans for their child
- Tutorial videos to help reteach or review math concepts taught in the classroom
- Previous grade level math can be reviewed for upcoming school year
- All resources are free, web based and calibrated to the classroom math textbook
When to use the Quantile Framework

- Curriculum insight
- Parental suggestions
- Tutorial guidance
- Co-teaching opportunities
Pulling it all together

Student Measure
Skill Difficulty
The Curriculum
Assessments
Textbooks
Lesson Planning using Quantiles

Let’s take a look at how the Quantile website can assist a teacher in meeting the needs of a *single student*, Laura or that of a *small group* at similar level.
Let’s look at **Student Readiness** and **Task Difficulty**

Focus Skill: Describe data using the mean. (850Q)

**Skill Difficulty** 850Q

Too far for Laura to reach without Differentiation!

Laura 450Q
### Math Skills Database

**Laura’s Quantile Measure:** 450Q

Focus Skill to teach measures 850Q.
Go to the Knowledge Cluster of the Focus Skill.

<table>
<thead>
<tr>
<th>State Goal</th>
<th>QSC ID</th>
<th>QSC Description</th>
<th>Quantile Measure</th>
<th>Strand</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.EE.A.1</td>
<td>QSC220</td>
<td>Use exponential notation and repeated multiplication to describe and simplify exponential expressions.</td>
<td>600Q</td>
<td>Numerical Operations</td>
</tr>
<tr>
<td>6.EE.A.2.a</td>
<td>QSC218</td>
<td>Translate between models or verbal phrases and algebraic expressions</td>
<td>750Q</td>
<td>Algebra and Algebraic Thinking</td>
</tr>
<tr>
<td>6.EE.A.2.b</td>
<td>QSC1031</td>
<td>Identify parts of a numerical or algebraic expression</td>
<td>800Q</td>
<td>Algebra and Algebraic Thinking</td>
</tr>
<tr>
<td>6.EE.A.2.c</td>
<td>QSC236</td>
<td>Simplify numerical expressions that may contain exponents.</td>
<td>770Q</td>
<td>Numerical Operations</td>
</tr>
<tr>
<td>6.EE.A.2.c</td>
<td>QSC274</td>
<td>Evaluate algebraic expressions in number and word problems.</td>
<td>840Q</td>
<td>Algebra and Algebraic Thinking</td>
</tr>
<tr>
<td>6.SP.B.5.c</td>
<td>QSC214</td>
<td>Describe data using the mean.</td>
<td>850Q</td>
<td>Statistics, Data Analysis, and Probability</td>
</tr>
</tbody>
</table>

6.EE.B.5 | QSC1032 | Identify from a set of numbers which values satisfy a given equation or inequality. | 860Q | Algebra and Algebraic Thinking |
Knowledge Cluster: Quantile Skill and Concept Details

A Quantile Skill and Concept (QSC) is a skill or concept that has a Quantile measure. Learn More.

QSC214: Describe data using the mean.

These skills are still too high for Laura! Go to even lower prerequisite skills....
Laura’s Quantile Measure: 450Q

Using the Knowledge Cluster helps identify the point where Laura is ready to begin her instruction!
Steps to take in order to meet Laura’s needs:

Target Skill to teach: *Describe data using the mean (850 Q)*

Prerequisite Skill: *Estimate and solve division problems with 2 and 3 digit divisors (690Q)*

Prerequisite Skill: *Divide using single-digit divisors with and without remainders. (450Q)*

Laura’s Quantile Measure: 450Q

Laura’s Quantile measure indicated that her instruction needs to begin here before attempting the more advanced skill!
Let’s take a look at how the Quantile website can assist a teacher in meeting the needs of a roster of students in the classroom.
<table>
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<tr>
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<td>1290</td>
</tr>
</tbody>
</table>

**Activity:**

Consider QSC 263 (720Q)

Write a proportion to model a word problem; solve proportions.

*(Wyoming Standard 7.RP.3: Use proportional relationships to solve multistep ratio and percent problems.)*

With the QSC measuring 720Q which students are ready for this skill?
QSC263: Write a proportion to model a word problem; solve proportions.

- **QSC ID:** QSC263
- **Quantile Measure:** 720Q
- **Strand:** Numerical Operations
- **Description:** Write a proportion to model a word problem; solve proportions.

**Knowledge Cluster**

**Prerequisite Skills**

- **QSC208:** Solve one-step linear equations and inequalities and graph solutions of the inequalities on a number line in number and word problems. (650Q)
- **QSC654:** Write a ratio or rate to compare two quantities. (210Q)

**Supporting Skills**

- **QSC233:** Calculate unit rates in number and word problems, including comparison of unit rates. (830Q)
- **QSC258:** Convert measures of length, area, capacity, weight, and time expressed in a given unit to other units in the same measurement system in number and word problems. (820Q)
- **QSC287:** Determine and use scale factors to reduce and enlarge drawings on grids to produce dilations. (990Q)
- **QSC558:** Use proportional reasoning to solve problems related to similar polygons. (950Q)

**Impending Skills**

- **QSC362:** Write equations to represent direct variation and use direct variation to solve number and word problems. (890Q)
- **QSC558:** Use proportional reasoning to solve problems related to similar polygons. (950Q)
- **QSC264:** Calculate or estimate the percent of a number including discounts, taxes, commissions, and simple interest. (870Q)
- **QSC1065:** Find the coordinates of a point on a segment between given endpoints that partitions the segment by a given ratio. (1120Q)

---

**QSC for “on target” students!**

**The Knowledge Cluster offers insight to prerequisite skills for those not on target.**
Click on first prerequisite, **QSC 208**, to gain insight for students not ready for **QSC 263**

**QSC208: Solve one-step linear equations and inequalities and graph solutions of the inequalities on a number line in number and word problems.**

- **QSC ID:** QSC208
- **Quantile Measure:** 650Q
- **Strand:** Algebra and Algebraic Thinking
- **Description:** Solve one-step linear equations and inequalities and graph solutions of the inequalities on a number line in number and word problems.

### Knowledge Cluster

#### Prerequisite Skills

- **QSC97:** Locate points on a number line. (250Q)
- **QSC548:** Describe the meaning of an unknown in the context of a word problem. (430Q)
- **QSC604:** Graph or identify simple inequalities using symbol notation $>$, $<$, $\leq$, $\geq$, and $\neq$ in number and word problems. (550Q)
- **QSC605:** Find the value of a variable in a number sentence. (530Q)

#### Supporting Skills

- **QSC132:** Solve word problems using patterns. (490Q)
- **QSC180:** Construct or complete a table of values to solve problems associated with a given relationship. (630Q)
- **QSC218:** Translate between models or verbal phrases and algebraic expressions. (750Q)
- **QSC623:** Identify additive inverses (opposites) and multiplicative inverses (reciprocals, including zero) and use them to solve number and word problems. (780Q)

#### Impending Skills

- **QSC275:** Solve two-step linear equations and inequalities and graph solutions of the inequalities on a number line. (690Q)
- **QSC622:** Solve number and word problems using percent proportion, percent equation, or ratios. (820Q)
- **QSC210:** Write an equation to describe the algebraic relationship between two defined variables in number and word problems, including recognizing which variable is the constant and which is the variable. (850Q)
Mrs. Ashford’s Seventh Grade Class

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</table>

The lower prerequisites in the Knowledge Cluster provide teaching suggestions for students needing remediation.

QSC208: Solve one-step linear equations and inequalities on a number line in number and word form.

QSC ID: QSC208
Quantile Measure: 650Q
Strand: Algebra and Algebraic Thinking
Description: Solve one-step linear equations and inequalities and graph solutions on a number line.

Knowledge Cluster

Prerequisite Skills
- QSC97: Locate points on a number line. (250Q)
- QSC548: Describe the meaning of an unknown in the context of a word problem. (430Q)
- QSC604: Graph or identify simple inequalities using symbol notation >, <, ≤, ≥, and ≠ in number and word form.
- QSC605: Find the value of a variable in a number sentence. (530Q)

Supporting Skills
- QSC132: Solve word problems using patterns. (490Q)
- QSC180: Construct or complete a table of values to solve problems associated with a given function.
- QSC218: Translate between models or verbal phrases and algebraic expressions. (750Q)
- QSC623: Identify additive inverses (opposites) and multiplicative inverses (reciprocals, including 0).

Impending Skills
- QSC275: Solve two-step linear equations and inequalities and graph solutions of the inequality on a number line. (800Q)
- QSC622: Solve number and word problems using percent proportion, percent equation, or percent change.
- QSC210: Write an equation to describe the algebraic relationship between two defined variables.
Mrs. Ashford's Seventh Grade Class

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Supporting and Impending QSCs provide suggestions to add depth to instruction.

QSC263: Write a proportion to model a word problem

- **Quantile Measure:** 720Q
- **Strand:** Numerical Operations
- **Description:** Write a proportion to model a word problem; solve proportions.

Knowledge Cluster

**Prerequisite Skills**
- QSC208: Solve one-step linear equations and inequalities and graph solutions of the inequalities (1130Q)
- QSC654: Write a ratio or rate to compare two quantities. (210Q)

**Supporting Skills**
- QSC233: Calculate unit rates in number and word problems, including comparison of unit rates (820Q)
- QSC258: Convert measures of length, area, capacity, weight, and time expressed in a given unit to other units (820Q)
- QSC287: Determine and use scale factors to reduce and enlarge drawings on grids to produce similar drawings (210Q)
- QSC558: Use proportional reasoning to solve problems related to similar polygons. (950Q)

**Impending Skills**
- QSC362: Write equations to represent direct variation and use direct variation to solve number problems (1130Q)
- QSC558: Use proportional reasoning to solve problems related to similar polygons. (950Q)
- QSC264: Calculate or estimate the percent of a number including discounts, taxes, commissions, or gratuities (1130Q)
- QSC1065: Find the coordinates of a point on a segment between given endpoints that partitions the segment in a given ratio. (210Q)
In Summary...

The Quantile Framework places the mathematics curriculum, the materials to teach mathematics, and the students on the same scale.

Thus enabling the teacher to:

- target instruction
- forecast understanding and
- improve mathematics instruction and achievement.
Imagine...

...what if there was a means of determining student readiness to address various math concepts?

We call it a student’s Quantile Measure!

...what if there existed a tool that could drill a math concept all the way down to foundational knowledge?

We call it the Quantile Framework for Math!
CONTACT US

Jane Scott, Senior Educational Facilitator
Email: jscott@Lexile.com

For more information about Quantile measures, visit www.Quantiles.com.

For more information about MetaMetrics, visit www.MetaMetricsInc.com.

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Durham, North Carolina 27713

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Toll Free: 1.888.LEXILES (539-4537)
Email: feedback@Lexile.com