

Core to College Optional Activity Grant Initiative

Alignment Study of *Math 95* Scope and Sequence Statements and the Common Core State Standards

Prepared for:
Lane Community College (LCC), Math III Summit
December 5, 2013

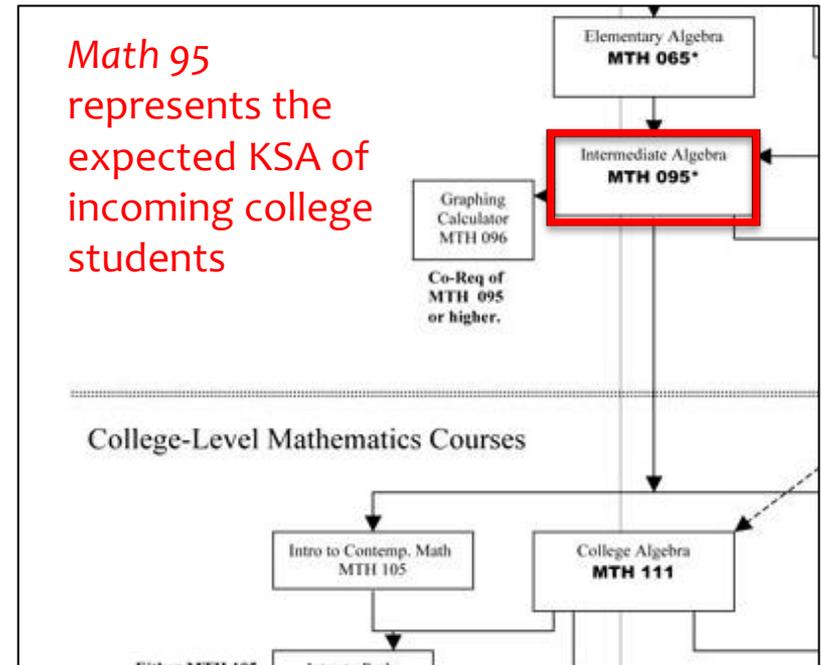
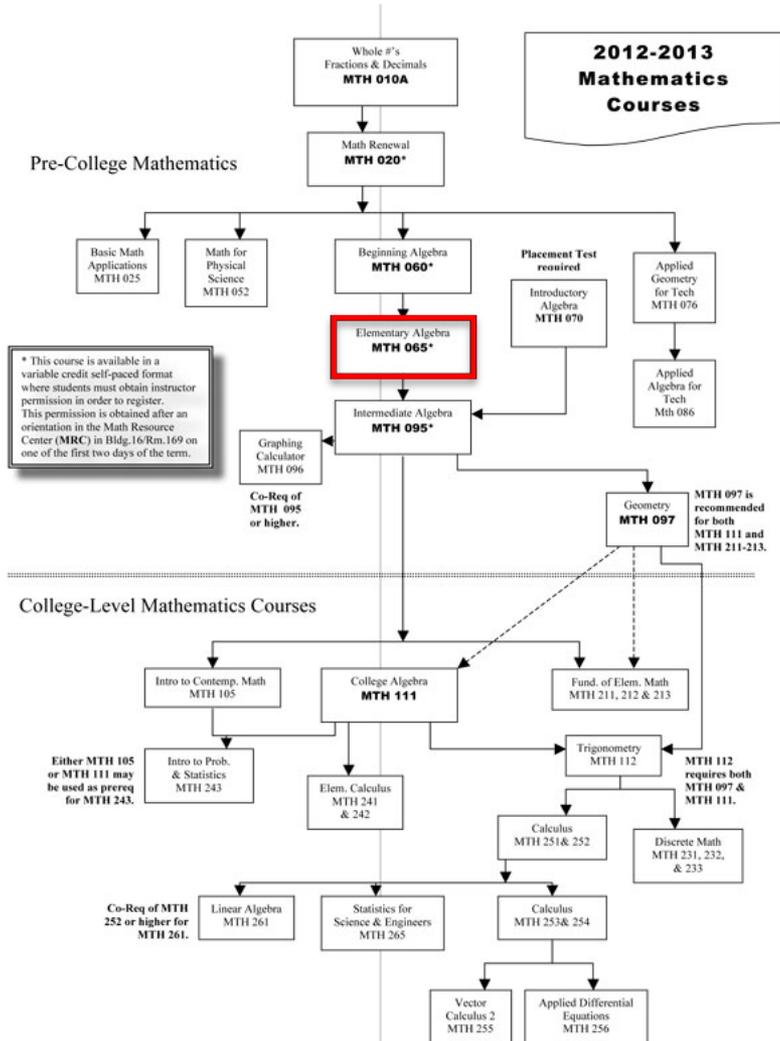
- EPIC is a nationally recognized leader in the field of College and Career Readiness founded by Dr. David Conley.
 - He is the author of several books and numerous articles on the topic of college and career readiness, including his most recent book, *Getting Ready for College, Careers and the Common Core: What Every Educator Needs to Know*.
- Our mission is to improve educational policy and practices that will increase student success, particularly for students historically underserved by public schools.
- Criterion-based, standards-referenced methods of course and document analysis to conduct research and develop tools to empower education organization to prepare students for success beyond high school.

Study Purpose and Research Questions

Purpose: To improve the number of students successfully matriculating into credit-bearing courses without remediation.

- ① How does the cognitive complexity of the *Math 95* Scope and Sequence statements compare to the Common Core State Standards (CCSS) in mathematics?
- ② To what extent are the knowledge and skills found in the *Math 95* Scope and Sequence statements the same as or different from (aligned) the CCSS in mathematics?

Why Math 95



Note: For each Math course, enrollment requires passing either the prerequisite course with a "C-" or better, or passing a placement test within the past 4 terms.

Why Math 95

- ① *Math 95* is the most frequently taken developmental math course before the credit-bearing 100-level courses.
- ① The content covered in *Math 95* is comparable to high school *Algebra II*, which is becoming a graduation requirement in many Oregon school districts.

The Process

Alignment Overview

What is alignment?

- The degree to which sets of learning expectations are in agreement
- The quality of the relationship between different sets of expectations (Scope & Sequence Statements and Standards)
- Alignment is the combination of linking (match between standards), and correspondence (comprised of depth and coverage)

How is it done?

- Content-specific experts use professional judgment to apply ratings.
- Different sets of standards can be analyzed and evaluated because they are judged using the same criteria.

Comparison Standards

Math 95 Scope and Sequence Statements

The Real Number System	13
Complex Numbers	15
System of Equations	9
Inequalities	12
Quadratic Equations	25
Rational Expressions and Equations	19
Radical Expressions and Equations	32
Exponential Logarithmic Exponents and Equations	33
Functions	17
Graphing and Coordinate Geometry	18
Linear Equations	29
Polynomials	21
Total Scope and Sequence Statements	243

CCSS for Mathematics

Standards for Mathematical Practices	8
Number and Quantity	27
Algebra	27
Functions	28
Geometry	43
Statistics and Probability	31
Total CCSS for Mathematics	164

<http://www.corestandards.org/>

Alignment Steps

Step 1: Expert reviewer selection and orientation

Step 2: Cognitive complexity (Depth of Knowledge) ratings

Step 3: Content match, relationship rating and rationale
(Alignment)

Step 2: Depth of Knowledge

- Measures the degree or depth of cognitive complexity that the standard requires from students.
- Show differences in distribution of cognitive complexity between two sets of standards.
- These differences can be used to further analyze the content alignment match between standards.

Step 2: Depth of Knowledge Scale

1
Recall

Recall of fact, information, or procedure.

2
Skill/Concept

Use information or conceptual knowledge, two or more steps, etc.

3
Strategic Thinking

Requires reasoning, developing plan or a sequence of steps, some complexity, more than one possible answer.

4
Extended Thinking

Requires an investigation, time to think and process multiple conditions of the problem

Step 3: Alignment

Common Core State Standard

Math 95 Scope and Sequence Statements

Algebra

Arithmetic with polynomials
and rational expressions

Perform arithmetic
operations on polynomials

A.ARP.1 - Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Polynomials
3 - Add and subtract
polynomials.

Polynomials
4 - Multiply a monomial by a
polynomial.

Polynomials
5 - Multiply a binomial by a
binomial.

Polynomials
6 - Multiply any polynomials.

Step 2: Alignment Scale

Complete Match

All content in the Common Core State Standard(s) fully align with the Scope and Sequence Statement.

Partial Match

Some of the content in the Common Core State Standard(s) partially aligns with some portion of the Scope and Sequence Statement.

No Match

None of the content in the CCSS aligns with any of the content in the Scope and Sequence Statements.

Step 2: Alignment Partial Rationale Statements

Scope and Sequence Statement content is prerequisite to the CCSS.

CCSS content is prerequisite to the Scope and Sequence Statement.

Part of the Scope and Sequence Statement Matches All of the CCSS.

Part of the CCSS matches all of the Scope and Sequence Statement

Part of the Scope and Sequence Statement matches part of the CCSS.

The Data

Number of Rated Statements

Math 95 Scope and Sequence Statements

The Real Number System	13
Complex Numbers	15
System of Equations	9
Inequalities	12
Quadratic Equations	25
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Statement Rating Level

Common Core State Standard

(Content area > Domain > Cluster > Standard)

Number and Quantity

Vector and Matrix Quantities

Perform operations on vectors

VM.B.4 – Add and subtract vectors.

VM.B.4.a - Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

VM.B.4b Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

VM.B.4c Understand vector subtraction $v - w$ as $v + (-w)$, where $-w$ is the additive inverse of w , with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

Math 95 Scope and Sequence Statements

(Content Areas > Statement)

Polynomials

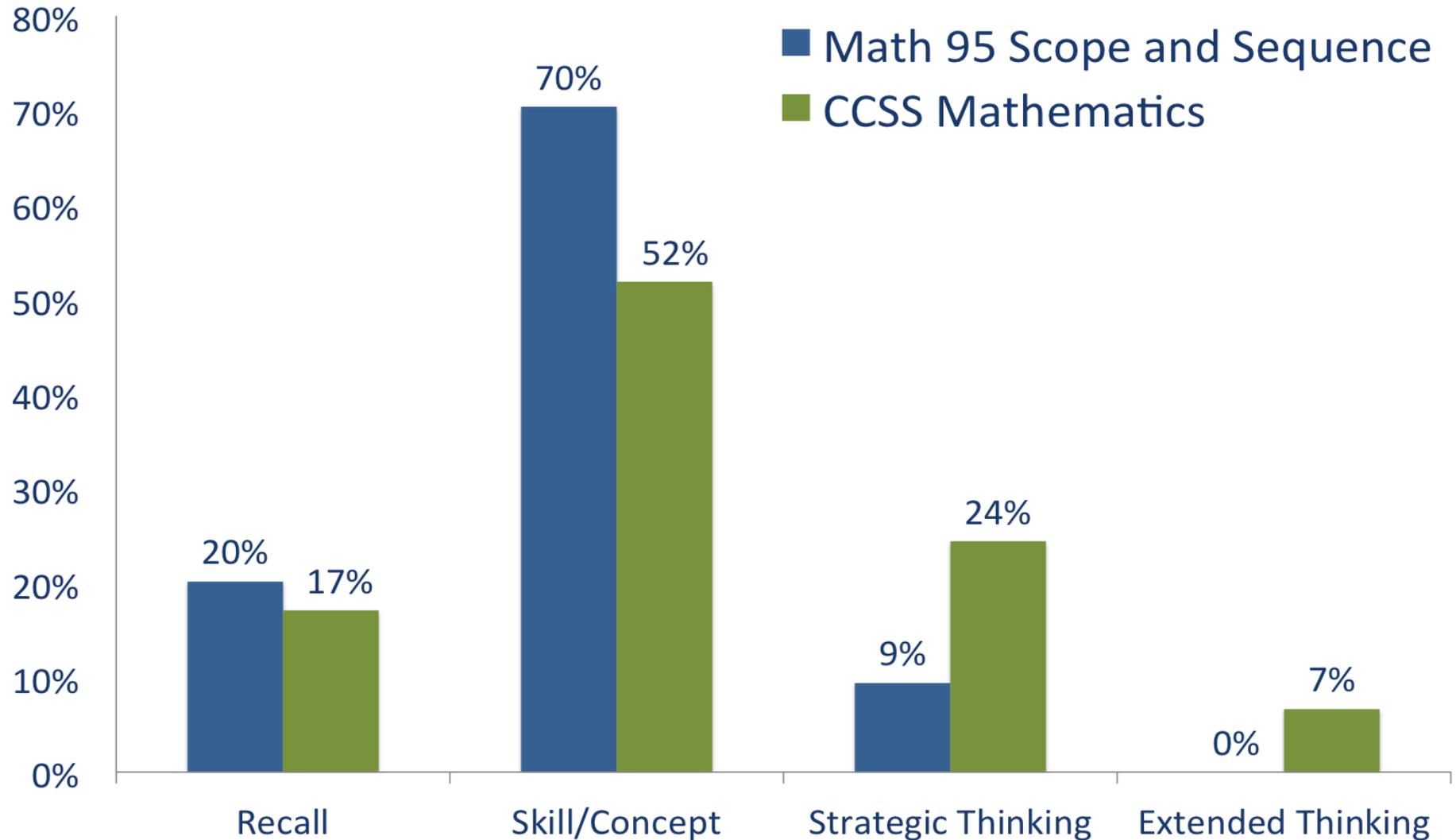
Add and subtract polynomials

The Findings

Summary of Findings

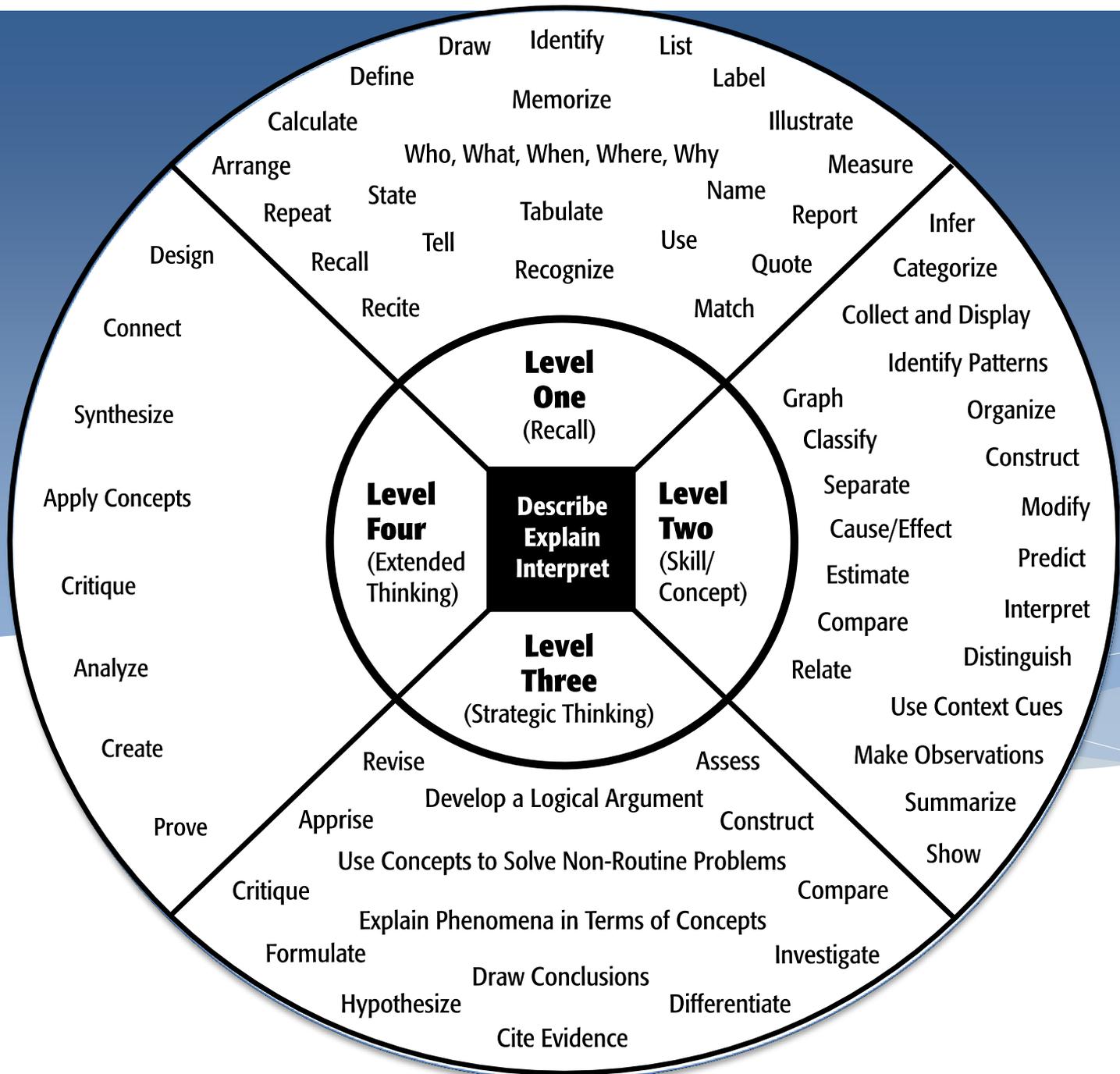
- Cognitive Complexity (Depth of Knowledge)
 - Comparison of the distribution of Depth of Knowledge between both sets of standards
- Alignment
 - Alignment matches and relationships
 - CCSS mapped onto the *Math 95* Scope and Sequence
 - *Math 95* Scope and Sequence mapped onto the CCSS
 - Alignment findings
 - Partial match alignment rationales
 - Example of one partial match

Cognitive Complexity (Depth of Knowledge)

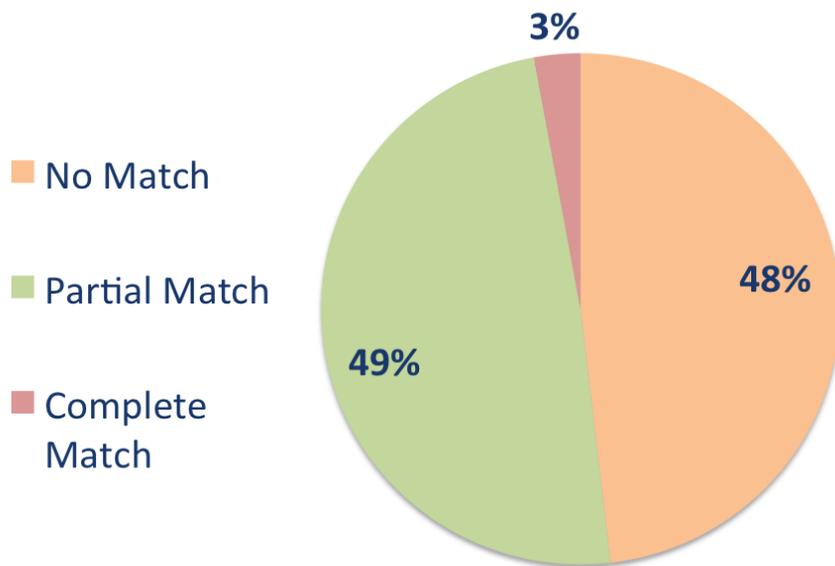


Cognitive Complexity (Depth of Knowledge)

- The *Math 95* Scope and Sequence statements are less cognitively complex than the CCSS.
 - The CCSS requires more strategic and extended thinking from students
 - Little difference in the distribution of cognitive complexity when comparing only those standards that were matched



Math 95 Scope and Sequence Matching Relationships



- 52% of the *Math 95* Scope and Sequence statements have matched CCSS
 - 3% are complete matches
 - 49% are partial match
- 48% of the *Math 95* Scope and Sequence statements have no matched CCSS

Alignment of *Math 95* Scope and Sequence

<i>Math 95</i> Scope and Sequence Statements	Total Number of S&S	Number of S&S Matched to CCSS	Percent of S&S Matched to CCSS
The Real Number System	13	4	30.77%
Complex Numbers	15	14	93.33%
System of Equations	9	9	100.00%
Inequalities	12	5	41.67%
Quadratic Equations	25	17	68.00%
Rational Expressions and Equations	19	9	47.37%
Radical Expressions and Equations	32	7	21.88%
Exponential Logarithmic Exponents and Equations	33	19	57.58%
Functions	17	15	88.24%
Graphing and Coordinate Geometry	18	3	16.67%
Linear Equations	29	11	37.93%
Polynomials	21	13	61.90%
Total	243	126	51.85%

Alignment of CCSS

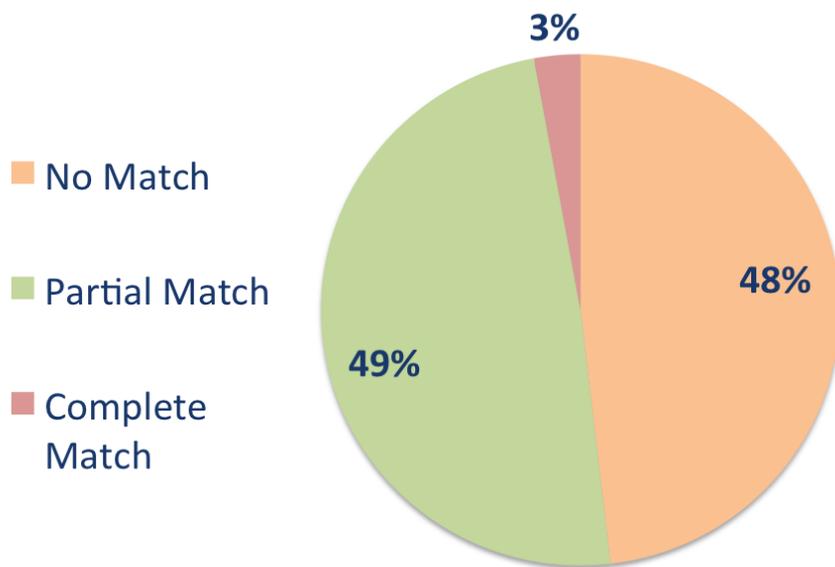
Common Core State Standard Mathematics	Total Number of CCSS	Number of CCSS Matched to S&S	Percent of CCSS Matched to S&S
Standards for Mathematical Practice	8	0	0.0%
Number and Quantity	27	9	33.3%
Algebra	27	16	59.3%
Functions	28	13	46.4%
Geometry	43	3	7.0%
Statistics and Probability	31	2	6.5%
Total	164	43	26.2%

- All 126 *Math 95* Scope and Sequence statements were covered by 43 CCSS
 - 7 of the 43 matched CCSS covered 50 of the 126 matched *Math 95* Scope and Sequence statements or approximately 40% of all matched *Math 95* Scope and Sequence statements
- No *Math 95* Scope and Sequence statements were matched to the Standards for Mathematical Practice
 - metacognitive processes that cannot be parsed into lists of discrete facts or formulas.
 - the connection between content knowledge mastery and conceptual understanding and learning.
 - generally employed during teaching as assessments that go beyond traditional homework, quizzes, and tests.

Math 95 Scope and Sequence Non-Matched Statements

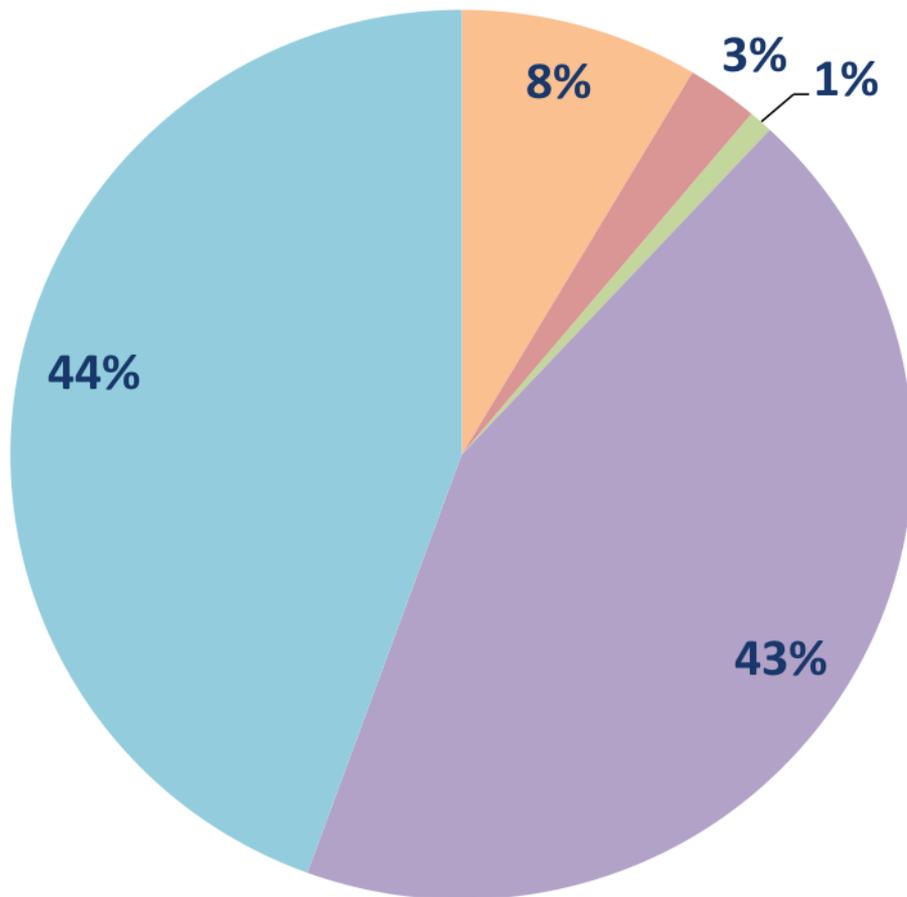
- The most common rationale for no matches
 - “This Scope and Sequence statement could be a prerequisite to *several CCSS*”.
 - “This Scope and Sequence statement could be considered a prerequisite *for all CCSS*”.
 - “This Scope and Sequence statement could be covered in a lower grade”.

Math 95 Scope and Sequence Matching Relationships



- 52% of the *Math 95* Scope and Sequence statements have matched CCSS
 - 3% are complete matches
 - 49% are partial match
- 48% of the *Math 95* Scope and Sequence statements have no matched CCSS

Math 95 Scope and Sequence Partial Match Rationales



- Scope and Sequence Statement content is prerequisite to the CCSS
- CCSS content is prerequisite to the Scope and Sequence Statement
- Part of the Scope and Sequence Statement Matches All of the CCSS
- Part of the CCSS matches all of the Scope and Sequence Statement*
- Part of the Scope and Sequence Statement matches part of the CCSS*

Example of Partially Matched Math 95 Scope and Sequence statements

Common Core State Standard

Math 95 Scope and Sequence Statements

Numbers and Quantity

The real number system

Use properties of rational and irrational numbers

N.RN.1 - Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

The Real Number System
5 – Define the rationals

The Real Number System
7 – Perform operations with integers and rationals

The Real Number System
8 – Define irrationales

The Real Number System
9 – Perform operations with irrationals

Research Questions

Cognitive Complexity (Depth of Knowledge) Findings

- ① How does the cognitive complexity of the *Math 95 Scope and Sequence* statements compare to the Common Core State Standards in mathematics?
 - The *Math 95 Scope and Sequence* statements are less cognitively complex than the CCSS.

- ② To what extent are the knowledge and skills found in the *Math 95 Scope and Sequence* statements the same as or different from (aligned) the Common Core State Standards in mathematics?
 - The CCSS covers mathematics more broadly than the *Math 95 Scope and Sequence Statements*.
 - *Math 95* is more content and skill specific
 - 26% of the CCSS covers 52% of the *Math 95 Scope and Sequence* statements
 - The CCSS uses more multifaceted verbs in its standards

- ② To what extent are the knowledge and skills found in the *Math 95 Scope and Sequence* statements the same as or different from (aligned) the Common Core State Standards in mathematics?
- Characteristics of *Math 95 Scope and Sequence* statements without CCSS matches.
 - More specific *Math 95* algebra skills statements not captured by CCSS.
 - More advanced algebra in CCSS is not captured by the *Math 95*
 - Lower level *Math 95* statements may be found in 8th grade level CCSS.

- ② To what extent are the knowledge and skills found in the *Math 95 Scope and Sequence* statements the same as or different from (aligned) the Common Core State Standards in mathematics?
 - No *Math 95 Scope and Sequence* statements were matched to the Standards for Mathematical Practice
 - Metacognitive skills that should be incorporated into course curriculum, teaching, and learning

For more information visit
epiconline.org