



Executive Summary: McREL Alignment Study

Mathematics

Donlynn Rice, Administrator, Curriculum and Instruction Team and
Deborah Romanek, Mathematics Director

9/6/2013

Introduction to the Nebraska Standards Alignment Study

The Nebraska State Board of Education's Number One Goal is to "Improve achievement outcomes for all students". One way to do this is to ensure that all Nebraska students graduate from high school being fully prepared for college and career. To accomplish this it is imperative that Nebraska has rigorous K-12 academic standards in place that prepare students to do just that. In addition, State Statute Section 79.760.01 requires that academic content standards be reviewed every five years. It is now time to begin looking at Nebraska's Language Arts and Mathematics standards which were adopted in 2009. Since the development of the Nebraska Standards, the National Governor's Association and the Council of Chief State School Officers released a set of Common Core State Standards in Language Arts and Mathematics. These standards have been adopted by a majority of the states around the country.

As a part of Nebraska's review process the State Board authorized an alignment study between the Common Core State Standards and the Nebraska Standards for each grade level in March of 2013. The results of this study will be used to assist the Board in the review of Nebraska standards as they work to ensure that all students meeting the Nebraska Standards are ready for a successful transition to college or career.

The results of the Mathematics Section of this study are listed in the following documents:

The Executive Summary – This report highlights the key points in the Mathematics section of the study. It also gives specific information for each grade level. The report notes the degree of match that exists; strong, partial, or weak. Where a partial match is identified, the nature of the difference is defined; specificity, scope, emphasis, phrasing. These results are exemplified in a series of charts followed by a brief narrative explaining the differences. Note: The Nebraska Standards and the Common Core standards are organized differently resulting in a high number of partial matches (i.e., it may take three Common Core Standards to exemplify what is listed in one Nebraska standard or vice versa.)

The McREL Alignment Study – The results of the study are shown in two different ways: Nebraska standards as the anchor showing how the Common Core Standards compare; Common Core Standards as the anchor showing how Nebraska standards compare. The comparisons are done at the "example indicator level" level of specificity in the Nebraska Standards. Again, because the two sets of standards are organized differently the results will differ between the two.

Nebraska contracted with McREL (Mid-Continent Research for Education and Learning) to do this study. They have conducted validation studies on Nebraska's Language Arts, Mathematics and Social Studies Standards in the past. Their work has always been of the highest caliber. McREL provided national experts in the specific content areas for this work. They have conducted similar studies for several other states including North Dakota and Wyoming.

Common Core Standards Addressed by Nebraska Mathematics Standards

Kindergarten Overview

Very few topics in the Common Core Mathematics Standards are not also addressed by the Nebraska Standards for Mathematics. The topics not found in the Nebraska standards are related to specific aspects of counting forward from a given number, making ten from any number, describing objects in the environment with shape names, and forming larger shapes from smaller ones. The majority of the topics are fully addressed; only two standards received a weak alignment rating. These two standards are related to specific aspects of measurement and three-dimensional shapes. Most of the content related to simple counting, comparing numbers, addition and/or subtraction are fully covered in the Nebraska standards. The majority of partial alignments are due to emphasis and phrasing or specificity; meaning that the Nebraska standards are not as specific as Common Core or there are notable differences in emphasis and phrasing. In general, the Common Core standards often highlight different aspects of content found in the Nebraska standards, either through phrasing or by adding specific knowledge and skills to the standard. Examples of differences include that the Common Core identifies the kinds of arrangements of objects (a line, a rectangular array, etc.) students should use when counting, or that students should “decompose numbers into pairs,” (Common Core phrasing), while the Nebraska standards simply state that students should identify equivalent representations of objects. In regards to rigor, the Common Core standards were found to require some expectations at an earlier grade level than the Nebraska standards, for example, expectations related to writing equations for addition and subtraction problems, and naming the parts of shapes.

Of the 22 rated standards in the Common Core for kindergarten, 19 are addressed and only 3 are not addressed by the Nebraska Standards. Of those addressed, 5 are strong alignments, 11 are partial alignments, and 3 are weak alignments.

Grade 1 Overview

Nearly all of the topics found in the Common Core Mathematics Standards are addressed by the Nebraska Standards for Mathematics. The topics not found in the Nebraska standards are all specific aspects of standards that are at least partially addressed. These standards were rated as Partial (scope), or Weak. These topics include determining if equations are true or false, relating problem-solving strategies to a written method and explaining reasoning, and composing shapes to make more complex shapes. Most of the content related to solving word problems with addition and/or subtraction, determining unknown numbers, and counting to 120 are fully covered in the Nebraska standards and received strong ratings. The majority of partial alignments are due to emphasis and phrasing or specificity; meaning that the Nebraska standards are not as specific as Common Core or there are notable differences in emphasis and phrasing. In general, the Common Core State Standards often highlight different aspects of content that is found in the Nebraska standards, either through phrasing or by adding specific knowledge and skills to the standard. For example, the Common Core emphasizes using the properties as strategies to add and subtract, while Nebraska emphasizes using representations of the properties. An example of a specificity difference includes Common Core specifying

two-digit numbers based on meanings of the tens and ones digits. In regards to rigor, the Common Core standards were found to require a few expectations at an earlier grade level than the Nebraska standards, for example, expectations related to applying properties of operations as strategies to add and subtract. Even though these expectations are for 1st grade in Common Core, they are not found until 5th grade for Nebraska's standards or indicators.

Of the 21 rated standards in the Common Core for 1st grade, all are addressed by the Nebraska Standards. Of the 21 alignments, 4 are strong, 16 are partial alignments, and 1 is weak.

Grade 2 Overview

All except one of the Common Core Mathematics Standards are addressed by the Nebraska Standards for Mathematics. The topic of the standard not addressed is specific content related to comparing units of length. Most of the content related to solving word problems with addition and/or subtraction; counting, reading, writing, and comparing three-digit numbers; and measurement of objects are fully covered in the Nebraska standards and received strong ratings. The majority of partial alignments are due to specificity; meaning that the Nebraska standards are not as specific as Common Core. For example, while both documents include modeling situations involving addition and subtraction, the Common Core standards included the detail that students should use modeling situations involving lengths. It is unclear from the Nebraska standard whether students must address the same details as specified in the Common Core. In regards to rigor, the majority of the standards were found to be at the same level of rigor as the Common Core standards. For the standards that did show a grade discrepancy, the majority of standards were within one grade (e.g., Nebraska content is in grade 3; Common Core content is in grade 2). Topics that were two or more grades apart include estimation of length, the concept of odd and even, and line plots.

Of the 25 rated standards in the Common Core for 2nd grade, all except 1 are addressed by the Nebraska Standards. Of those addressed, 12 are strong, 12 are partial, and none are weak alignments.

Grade 3 Overview

All of the Common Core *Mathematics* Standards are addressed by the Nebraska Standards for Mathematics. A few of the topics related to interpreting products of whole numbers, determining the unknown whole number in multiplication or division equations, fluently multiplying and dividing within 100, and using appropriate place value to perform multi-digit operations are fully covered in the Nebraska standards. The majority of partial alignments were due to specificity; meaning that the Nebraska standards are not as specific as Common Core. An example of a specificity difference includes Common Core specifying measuring areas by counting unit squares. In regards to rigor, most of the Common Core standards were found to require expectations at an earlier grade level than the Nebraska standards. For example, expectations related to understanding fractions as numbers is expected in 3rd grade for Common core, but is not an expectation until 4th or 5th grade for

Nebraska standards or indicators. The majority of the rigor ratings were due to a difference of only one or two grade level expectations. One rigor issue was due to a difference of five grade levels—students are expected to find the perimeter of polygons in 3rd grade for Common Core standards, but they are not expected to master this skill until 8th grade in the Nebraska standards.

Of the 25 rated standards in the Common Core for 3rd grade, all are addressed by the Nebraska Standards. Of the 25 alignments, 5 are strong, 19 are partial, and 1 is weak.

Grade 4 Overview

All of the Common Core *Mathematics* Standards are addressed by the Nebraska Standards for Mathematics. A few of the topics related to comparing fractions and decimals; measuring angles in degrees; and drawing points, lines, line segments, rays, and angles are fully covered in the Nebraska standards. The majority of partial alignments were due to emphasis and phrasing, and specificity. The Common Core standards place a different emphasis than Nebraska on some content, for example, the Common Core emphasizes relative sizes of measurement units, while NE emphasizes converting between units. In addition, some of the Nebraska standards are not as specific as Common Core. For example, Common Core specifies real world and mathematical problems, while Nebraska standards do not. With regards to rigor, a majority of the Common Core standards were found to require expectations at an earlier grade level than the Nebraska standards. For example, understanding fractions as multiples of another fraction is expected in 4th grade for Common Core, but is not an expectation until 7th grade for Nebraska standards or indicators. The majority of the rigor ratings were due to a difference of only one or two grade level expectations.

Of the 28 rated standards in the Common Core for 4th grade, all are addressed by the Nebraska Standards. Of the 28 alignments, 5 are strong, 23 are partial, and none are weak.

Grade 5 Overview

All of the Common Core Mathematics Standards are addressed by the Nebraska Standards for Mathematics. Only one standard received a weak alignment rating for content related to the expectation that students be able interpret multiplication as scaling (sizing). Some of the Common Core standards are fully addressed within the Nebraska standards, reflecting a strong alignment. The majority of partial alignments are due to emphasis and phrasing or specificity; meaning that the Nebraska standards are not as specific as Common Core or there are notable differences in emphasis and phrasing and specificity. For example, Common Core standards emphasize classifying figures in a hierarchy based on properties, while Nebraska indicators emphasize classifying two-dimensional shapes and three-dimensional objects. An example of specificity includes Common Core stating that students should understand the relationship between addition and subtraction. In regards to rigor, the Common Core standards were found to require many expectations at an earlier grade level than the Nebraska standards;

a few Nebraska indicators required expectations at an earlier grade level than the Common Core standards. Most of the rigor ratings were due to a grade level discrepancy of only one or two grades. However, one of the Common Core standards relating to converting among different-sized standard measurement units within a given measurement system was aligned to a Nebraska high school indicator.

Of the 26 rated standards in the Common Core for Grade 5, all are addressed by the Nebraska Standards. Of the 25 aligned standards, 8 are strong, 17 are partial, and 1 is a weak alignment.

Grade 6 Overview

Very few topics in the Common Core Mathematics Standards are not also addressed by the Nebraska Standards for Mathematics. The topics not found in the Nebraska standards are all specific details about topics that are otherwise at least partially addressed. These standards were rated as Partial (scope), or Weak. In general, the specific aspect not addressed in the Nebraska standards was related to real-world problem solving. Some topics in the Common Core standards are minimally addressed in the standards, receiving a weak alignment rating. In general, this was due to the large amount of specific detail included in the Common Core standards that is not found in the Nebraska standards. For example, within one standard Common Core includes the concept of independent and dependent variables, analyzing the relationship between variables, and relating the relationship between the independent and dependent variables to the equation. That amount of detail is not present in the Nebraska standards. Instead, the related Nebraska standard includes using a variable to describe a situation with an equation. In terms of expectations for students, the majority of standards were within one grade of each other (e.g., Nebraska content is in grade 6; Common Core content is in grade 5). A few topics were found two or more grades apart. In those cases, differences in rigor were found regarding specific detail within a standard, while other aspects of the standard were found to be at the same level of rigor. For example, both Common Core and Nebraska address many aspects of rational numbers in 6th grade. However, Common Core addresses the absolute value of integers in grade 6, while Nebraska does not address that concept until grade 8. All of the topics that were found two or more grades apart were those found in earlier grades in the Common Core.

Of the 29 rated standards in the Common Core for Grade 6, all 29 are addressed. Of those addressed, 6 are strong alignments, 16 are partial alignments, and 7 are weak alignments.

Grade 7 Overview

Only one topic in the Common Core Standards, unit rates, is not also addressed by the Nebraska Standards for Mathematics. Topics that were only partially addressed or weakly addressed include giving an informal derivation of the relationship between circumference and area, describing the two-dimensional figures that result from slicing three-dimensional figures, understanding that rewriting an expression can shed light on problems, specific aspects of ratio and proportional problems, and specifics regarding real-world problem solving and

situations. In general, content related to problem solving with rational numbers, geometric concepts such as area and volume, and probability were fully addressed. The Common Core standard is more specific than the Nebraska indicator in a few cases, and so it is unclear whether students must address the same details as specified in the Common Core. For example, while both Common Core and Nebraska include scaling shapes, Common Core specifies computing actual lengths and areas and reproducing drawings at different scales. In regards to rigor, the majority of the standards were found to be at the same level of rigor as the Common Core standards. Some of the Common Core standards were found to require expectations at an earlier grade level than the Nebraska standards. The majority of standards were within one grade of each other (e.g., Nebraska content is in grade 6; Common Core content is in grade 7). A few topics were found two or more grades apart. In those cases, differences in rigor were found regarding one detail of a standard, while other aspects of the standard were found to be at the same level of rigor. For example, both Common Core and Nebraska address algebraic expressions in 7th grade. However, Common Core addresses working with rational coefficients in grade 7, while Nebraska does not address that concept until high school. The majority of the topics that were found two grades apart were in earlier Common Core grades. A large number of standards related to probability models were found to be in earlier grades in Nebraska.

Of the 24 rated standards in the Common Core for grade 7, 23 are addressed and only 1 is not addressed by the Nebraska Standards. Of those addressed, 8 are strong alignments, 11 are partial alignments, and 4 are weak alignments.

Grade 8 Overview

Very few topics in the Common Core Standards are not also addressed by the Nebraska Standards for Mathematics. The topics not found in the Nebraska standards are all specific aspects of standards that are at least partially addressed. These standards were rated as Partial (scope), or Weak. The topics not found in the Nebraska standards are related to cube roots, adding and subtracting using scientific notation, deriving the equation $y=mx + b$, and explaining a proof of the Pythagorean Theorem. The majority of partial alignments are due to emphasis and phrasing or specificity; meaning that the Nebraska standards have notable differences in emphasis and phrasing or are not as specific as Common Core. An example of a difference in emphasis and phrasing is that the Common Core emphasizes an informal understanding of rational and irrational numbers, while Nebraska emphasizes classifying numbers as rational or irrational. When the Nebraska indicator is more specific, it is unclear whether students must address the same details within the Common Core. For example, Common Core includes specific aspects of analyzing a functional relationship, including how they should conduct that analysis, while the Nebraska standards do not include that level of detail. In regards to rigor, many of the standards were found to be at the same level of rigor as the Common Core standards. For the standards that did have a grade discrepancy, the majority of standards were within one grade of each other (e.g., Nebraska content is in high school; Common Core content is in grade 8). Further, two of the Common Core standards require the same essential skills as Nebraska, but with higher levels of cognitive difficulty. For example, both Common Core and Nebraska standards address the topic of representing numbers in scientific notation. However, the Common Core emphasizes the use of scientific notation in estimation

and to express how many times larger or smaller a number is from another number, while Nebraska emphasizes the representation of the numbers.

Of the 27 rated standards in the Common Core for Grade 8, all 27 are addressed. Of those addressed, 5 are strong alignments, 20 are partial alignments, and 2 are weak alignments.

High School Overview

Many topics in the Common Core *Mathematics* Standards are not also addressed by the Nebraska Standards for mathematics. However, most topics not found in the Nebraska standards are those present in Common Core standards marked with a “+”, indicating that they are considered standards that students should master who are focused on advanced mathematics courses. Within the appendix to the Common Core, the majority of these standards are found in an optional fourth year course, though a few are found in the courses intended for all students. For McREL’s analysis in the pie charts below, the standards indicated with a “+” are grouped separately from the courses, even when the Appendix included them in the course, in order to more easily identify them. Some of the topics found in these “+” standards include vectors, matrices, complex numbers, and polar coordinates. The majority of partial alignments are due to specificity; meaning that the Nebraska standards are not as specific as Common Core. It is sometimes unclear whether students must address skills to the same level of detail as found within the Common Core. For example, the Common Core specifies that students should solve quadratic equations that have complex solutions. The Nebraska standards require that students solve quadratic equations, but do not specify that these equations should have complex solutions. A few standards are marked as partial alignments due to scope; meaning that the Nebraska standards include some, but not all of the content found in the Common Core standards. Examples of scope differences include instances in which the Common core standards address specific concepts, such as understanding that polynomials form a system analogous to integers, and then specify skills that students will use related to that understanding, such as performing operations on polynomials. Often, the Nebraska standards will address the skills, but will not include the associated conceptual understanding. In regards to rigor, the majority of the standards were found to be at the same level of rigor as the Common Core standards. For the standards that did have a grade discrepancy, the majority of standards were within one grade of each other (e.g., Nebraska content is in grade 8; Common Core content is in high school).

Of the 156 standards or indicators in the Common Core Mathematics Standards for high school, 95 are addressed and 61 are not addressed by the Nebraska State Standards. Of those addressed, 18 are strong alignments, 59 are partial alignments, and 18 are weak alignments.

Note: High School Common Core standards are shown in the analysis as they are in the main standards document – as Conceptual Categories. The “Conceptual Categories” structure in the Common Core documents is designed to encompass four years of high school mathematics. Recognizing the desire for schools to have standards grouped by course, the writers of the Common Core standards included an Appendix A, which shows model courses. In order to provide more precise information about the content alignment between Nebraska state mathematics

standards and the Common Core standards, McREL has created graphs that show the matches between Nebraska state standards and the standards found in each of the courses. In cases where the Common Core appendix indicates that a given standard is to be addressed in both Algebra 1 and Algebra 2, data on those standards was reflected in both graphs. For example, Appendix A places HS.A-SSE.1 in both the Algebra 1 and Algebra 2 courses; this content was rated as Weak in alignment to Nebraska standards. The rating was reflected in both the Algebra 1 and Algebra 2 charts and counts.

Algebra I Overview

A few topics in the Common Core Mathematics Standards are not also addressed or are weakly addressed by the Nebraska State Standards for mathematics. The topics found to be missing in the Nebraska standards include specific content related to systems of equations and graphs, defining quantities for modeling, understanding sequences as functions, and inverse functions. Alignments are rated as partial in a few cases when the standards in each document differ in their emphasis and phrasing. Common Core emphasizes determining a recursive process from a context, for example, while Nebraska emphasizes deriving and using formulas for the general term and summation of finite series. In a few cases, the Common Core standards identify specifics about a topic that the Nebraska standards do not. For example, the Common Core standards include expectations related to developing proofs about linear and exponential growth functions that are not specified in Nebraska.

Of the 47 standards or indicators identified by Common Core Appendix A as being in the Mathematics Standards for Algebra 1, 39 are addressed and 8 are not addressed by the Nebraska. Of those addressed, 10 are strong alignments, 23 are partial alignments, and 6 are weak alignments. (Please see the high school graph and overview for information on rigor.)

Geometry Overview

A few topics in the Common Core Mathematics Standards are not also addressed or are weakly addressed by the Nebraska Standards for mathematics. The topics found to be missing in the Nebraska standards relate to specific proofs and derivations, and trigonometric concepts. In many cases, the Common Core standards are more specific than the Nebraska indicators, and so it is unclear whether students must address the same details as specified in the Common Core. For example, the Common Core asks that students know the precise definitions of angle, perpendicular line, parallel line, and line segment. Nebraska does not specify these definitions, but does ask that students identify and give examples of definitions.

Of the 34 standards or indicators identified by Common Core Appendix A as being in the Mathematics Standards for Geometry, 30 are addressed and 4 are not addressed by the Nebraska State Standards. Of those addressed, 6 are strong alignments, 19 are partial alignments, and 5 are weak alignments. (Please see the high school graph and overview for information on rigor.)

Algebra 2 Overview

A few topics in the Common Core Mathematics Standards are not also addressed or are weakly addressed by the Nebraska Standards for mathematics. The topics found to be missing in the Nebraska standards relate to the Remainder theorem, identifying and using the zeros of polynomials, polynomial identities, trigonometric functions and identities, and making specific inferences from experimental data. A few partial alignments are due to scope; meaning, the Nebraska standards include some, but not all of the content found in the Common Core. Examples of scope differences include instances in which the Common Core addresses particular aspects of functions (e.g., sketching key features, relating the domain to the quantitative relationship it describes) that are not found in the Nebraska standards.

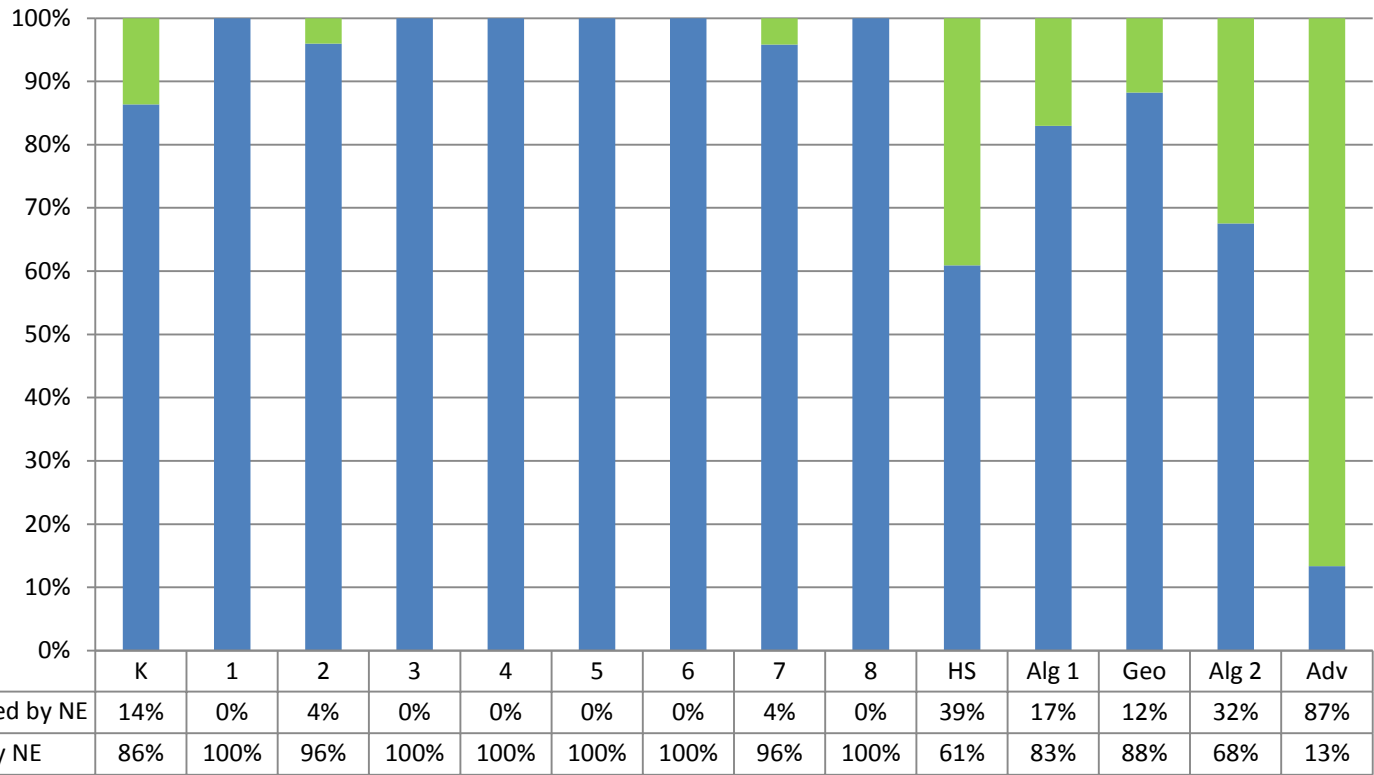
Of the 37 standards or standards identified by Common Core Appendix A as being in the Mathematics Standards for Algebra 2, 25 are addressed and 12 are not addressed by the Nebraska State Standards. Of those addressed, 6 are strong alignments, 11 are partial alignments, and 8 are weak alignments. (Please see the high school graph and overview for information on rigor.)

Additional Mathematics Standards for Advanced Courses (+)

Nearly all of advanced topics in the Common Core Mathematics Standards are not also addressed or are weakly addressed by the Nebraska Standards for Mathematics. The topics found to be missing in the Nebraska standards relate to complex numbers, complex conjugates, vectors, matrices, polynomial identities, trigonometric functions and identities, the derivation of specific equations and formulas, and some advanced probability concepts. All partial and weak alignments include problems due to scope; meaning, the Nebraska standards include some, but not all of the content found in the Common Core. For example, the Common Core standard regarding inverse functions includes verifying by composition that one function is the inverse of another, while the Nebraska standards do not ask students to do that.

Of the 45 standards or indicators identified by Common Core Appendix A as being in the Mathematics Standards for an advanced course, 6 are addressed and 39 are not addressed by the Nebraska State Standards. Of those addressed, 1 is a strong alignment, 1 is a partial alignment, and 4 are weak alignments. (Please see the high school graph and overview for information on rigor.)

% of CCSS Addressed by NE Math Standards



CCSS Math	K	1	2	3	4	5	6	7	8	HS	Alg 1	Geo	Alg 2	Adv	Total
# Standards	22	21	25	25	28	26	29	24	27	156	47	34	37	45	546
Addressed by NE	19	21	24	25	28	26	29	23	27	95	39	30	25	6	417
Not Addressed by NE	3	0	1	0	0	0	0	1	0	61	8	4	12	39	129

Both sets of standards outline the skills and content that should be mastered from kindergarten through high school.

The chief differences between the two sets of standards can be categorized in several ways:

- Organization/Placement of concepts or content
- Specificity
- In addition, found in Common Core are:
 - (+) Standards are considered to be additional mathematics that students should master who are focused on advanced mathematics courses or careers in the STEM fields
 - The eight Mathematical Practices reflect the characteristics of a good mathematician.
 1. Make sense of problems and persevere in solving them.
 2. Reason abstractly and quantitatively.
 3. Construct viable arguments and critique the reasoning of others.
 4. Model with mathematics.
 5. Use appropriate tools strategically.
 6. Attend to precision.
 7. Look for and make use of structure.
 8. Look for and express regularity in repeated reasoning.