A Review of the Draft Arizona 2016 Standards for English Language Arts and Mathematics

Submitted by Achieve at the request of the State Board of Education
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Introduction

This report details a review of Arizona's draft 2016 English Language Arts (ELA) and Mathematics Standards ("ELA16" and "ADSM" respectively) to determine whether they are high-quality standards that prepare all students, over the course of their K–12 education, for success in credit-bearing college courses and quality, high-growth, jobs. Released in September 2016 for public review, the draft ELA16 standards and ADSM represent a revision of Arizona's 2010 standards. On August 3, 2016, the Arizona State Board of Education requested that Achieve perform a technical review of the draft standards. Achieve is an independent, nonpartisan, nonprofit education reform organization dedicated to working with states to ensure states develop and maintain high academic standards, raise graduation requirements, improve assessments, and strengthen accountability so that all students graduate from high school prepared for their next steps. Created in 1996 by a bipartisan group of governors and business leaders, Achieve is one of the nation's premier experts on K–12 academic standards in literacy, mathematics, and science.

Achieve evaluated the proposed draft standards in both subjects using criteria and procedures Achieve has developed and refined to evaluate academic standards for more than 30 states over nearly 20 years. Achieve has also used similar methods for comparing standards in 15 countries. When evaluating standards, Achieve uses six distinct criteria: rigor, focus, coherence, specificity, clarity/accessibility, and measurability. In addition, there is a set of accompanying side-by-side charts that show in detail Achieve's analysis of the ADSM against the Common Core State Standards (CCSS) and the ELA16 standards against the ELA10 standards. The ELA 10 standards, with a few noted exceptions, reflect the content and skills demands of the CCSS. The CCSS serve as a useful comparison set of standards since they are the K–12 college- and career-ready standards in ELA and mathematics in use by over 40 states.

Achieve is especially pleased to provide Arizona with this feedback given our long history of working with Arizona to improve the college and career readiness of its students. In 2006, Arizona joined Achieve's American Diploma Project Network, a network at that time of over half the states committed to graduating students from high school college and career ready. Arizona was specifically interested in raising standards and raising graduation requirements especially given that, in 2006, Arizona only had standards through the 10th grade level. Achieve was pleased to assist Arizona in raising its math standards, which were adopted in 2008. In 2007, Arizona increased its graduation requirements to a college and career ready level. In June 2010, Arizona adopted new college- and career-ready standards in both ELA and mathematics.

Arizona has made great strides in the last decade in orienting its K–12 education system toward ensuring that all students have the opportunity to graduate ready for the demands of college, career, and citizenship. Achieve has been honored to work with Arizona on improving its education system and pleased to submit this review as Arizona continues to seek improvements on behalf of its K–12 students.

Key Findings and Recommendations

The following findings summarize Achieve's evaluation of the draft ELA16 standards and ADSM. The recommendations, summarized below and throughout this report and the accompanying side-by sides in each subject, suggest improvements that should be considered before final submission of the ELA16 standards and the ADSM to the State Board of Education for adoption.

With respect to English Language Arts 16:

1. **The draft ELA16 standards lack direction with regard to the expected complexity levels of text, despite a series of standards dedicated to reading at particular text complexity grade levels.**

Text complexity is critical to preparing students for college and careers. The standards are recursive, and aim for depth of understanding rather than just breadth of content; as such, what puts students on track for college or the workplace is their ability to read increasingly complex text from grade to grade. In every grade, students read text and analyze it for essential elements including theme, central idea, vocabulary, structure, and characterization—those elements grow in sophistication; but also what must grow is the complexity of the text that students must apply to those elements. Arizona should provide clear direction on both quantitative ranges for the grade band and how to use qualitative measures for grade level placement within the band.

2. **The draft ELA16 standards prioritize vocabulary acquisition and development, building knowledge from text and relaying that knowledge, and using evidence from text, both literary and informational.**

The draft ELA16 standards make it clear that the three critical instructional shifts for college and career readiness, i.e., building knowledge, drawing evidence from texts, and developing academic vocabulary are valued. Scores of reading research point to vocabulary being a key component to text comprehension. Knowledge is how students build cognitive bridges from once concept to another. College and workplace reading and writing require the use of evidence in defense of inferences and ideas. Arizona has done an exceptional job in retaining these elements and clearly articulating their importance.

3. **The draft ELA16 standards include requirements for foundational writing skills that are not included in the draft ELA10 standards; they are a positive addition to the standards, overall.**

The draft ELA16 standards improve upon the ELA10 standards by including separate standards for K–3 that address foundational writing skills. This will go far in building writing automaticity and fluency in students.

4. **The draft ELA16 standards create meaningful progressions of expectations throughout the grade levels; however, there are occasions where the progression is unclear and could be improved.**

In most places the progression of expectations among standards is clear and meaningful, but as evidenced in RL.5, there are some places where the progression is weak. Additionally, the draft ELA16 standards do not identify language standards that need continued attention as students' progress through the grades, and encounter more complex reading and writing.

5. **The glossary that accompanies the draft ELA16 standards is meant to add clarity but too often it contains definitions that need more precision and clarity.**

The addition of a glossary which defines key concepts to an audience of educators is a positive one. However, the glossary in its current form has definitions that are unclear and imprecise. As the glossary, much like the standards, will be read by teachers individually or in small teams, it is critical that the glossary articulate clear, standard, easily understood, and focused definitions.

In summary, Achieve recommends the following:

- Arizona should clearly define expectations for text complexity in reading standard 10. This should include guidance for both a quantitative analysis by grade band and a process for a qualitative analysis to place text appropriately at a grade level within the grade band.
- Arizona should conduct a separate vertical articulation analysis of each standard to ensure that students do not experience gaps in expectations that create gaps in instruction.
- Arizona should re-read the standards with a focus on precision of language. During the reread, the committee should focus on a guiding question like "how might the language in this standard be misinterpreted by educators?"
- Arizona should consider re-inserting some parenthetical examples that serve to provide clarity to educators.
- Arizona should consult several research-based and academic publications when revising the glossary to ensure definitions are accurate, clear, and concise. Arizona should include citations to the sources of the definitions, so educators have the appropriate source to consult with questions.

With respect to Arizona Draft Standards for Mathematics:

1. **The ADSM are generally rigorous, coherent, and focused and with some revision will be on a par with other sets of college- and career-ready standards.**

The 2016 Arizona standards are well aligned to the CCSS, indicating, with a few exceptions, appropriate focus, coherence, and rigor. Details of those exceptions can be found in this report and in the side-by-side chart and commentary. In some cases, Arizona has improved clarity in ways that other states can learn from, but in other instances we recommend that additional clarity be considered for the final version.

2. **The Standards for Mathematical Practice are specifically defined for, and attached to, each grade level's content standards.**

The ADSM revised the language for each of the eight Standards for Mathematical Practice and have helpfully included the practices at each grade level. Positioning the Practices with each grade's content standards shows a commitment to their emphasis and serves as a reminder for teachers to attend to them. Achieve recommends adding grade-specific descriptors for each grade level to tailor the message for different grade levels or bands to make them clearer and more actionable for educators.

3. **There are a few places in the ADSM where standards were added or moved, causing a potential problem with the coding scheme.**

In some cases, the ADSM moved or modified standards in such a way that CCSS and ADSM codes refer to different mathematical concepts. This may cause problems for teachers who wish to use their existing materials or search nationally for materials aligned to ADSM codes. Consideration should be given to these changes to see if other alternatives are available. There are many examples of this in the accompanying side-by-side chart.[1]

4. **High school modeling and statistics seem to have a decreased emphasis in the ADSM.**

In many cases where the CCSS clearly indicate modeling, the Arizona counterpart instead has some version of the wording, "utilizing real-world context." This may obfuscate that modeling is in itself a conceptual category. In some instances, the connection of a standard to modeling has been altogether lost. The overall effect appears to be a reduced emphasis on modeling in the high school standards. This, along with the decreased emphasis on statistics, are opposite trends in mathematics education at higher levels, as explained in a recent report from the Mathematical Association of America:

> Data-driven science is reshaping the processes of discovery and learning in the 21st century. The current attention to big data and the demand for college graduates with data skills should prompt changes in our entry-level courses which result in students being better prepared for jobs requiring computational and statistical skills. Thus, there is a call to provide mathematically substantive options for students who are not headed to calculus. These entry courses should focus on problem solving, modeling, statistics, and applications.[2]

Achieve recommends revisiting the shifts in modeling and statistics.

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[1] See ASDM codes for: 1.MD.B.4 and 1.MD.C.5; 3.OA.C.7, 3.OA.C.8, 3.OA.D.9, and 3.OA.D.10; 3.NBT.A.2, 3.NBT.A.3, and 3.NBT.A.4; 3.MD.A.2, 3.MD.A.3, 3.MD.B.4, 3.MD.B.5, and 3.MD.C.6; 3.MD.C.8 and 3.MD.C.9; 5.NF.B.4b and 5.NF.4.B.4c; and 8SP.B.1.

[2] Saxe, K. and Braddy, L. (2015) A Common Vision for Undergraduate Mathematical Sciences Programs in 2025. Washington, DC: The Mathematical Association of America. p.13.

5. **The analysis has uncovered numerous issues of clarity in the ADSM.**

Throughout the ADSM content standards, there are changes in wording from the CCSS. In some cases, the changes make the standard's expectation more clear. [For example see commentary for 6.EE.B.5.] However, in many other cases, the changes resulted in a loss of clarity. There are also significant issues of precision and clarity in the glossary. For full details about issues with clarity in the ADSM, see the section on Clarity in this report as well as in the comments in the accompanying side-by-side chart. Achieve recommends that Arizona review these issues closely to ensure that clarity is improved in the final version.

6. **The purpose of the High School Plus standards is unclear.**

It is not clear from the format of the ASDM for high school whether the High School Plus standards are organized such that any course will use any or all of these standards. If Arizona intends to include these standards there should also be a clear rationale for their inclusion. At a minimum, Arizona should indicate which students will see which standards. This is particularly important since Arizona requires four years of mathematics for high school graduation.

Review of Arizona's Draft English Language Arts Standards

Both ELA10 and the draft ELA16 standards are unique in their design in that they have content strands, anchor standards, and grade specific articulations of the anchor standard. In ELA10 and ELA16, the content strands are Reading, Writing, Speaking and Listening, and Language. Each strand has anchor standards that are the same for K–12: Reading has 10 anchor standards; Writing has 10 anchor standards; Speaking and Listening has 6 anchor standards; Language has 6 anchor standards. The grade specific standards define a progression of expectations for each college- and career-readiness anchor standard. This design intends to ensure a tightly aligned ELA instructional experience K–12 that focuses on the more important aspects of reading and writing and minimizes potential gaps in thinking and learning.

As the content strands and anchor standards have not been revised in the ELA16 draft, Achieve focused its review on the proposed revisions to grade-specific standards. When evaluating standards, Achieve uses six distinct criteria: *rigor, focus, coherence, specificity, clarity/accessibility,* and *measurability*. For the purposes of this analysis, all six criteria[3] were used to evaluate the ELA16 standards and compared with the ELA10 standards. In addition, there is a set of accompanying side-by-side charts that show in detail Achieve's analysis of the draft ELA16 standards against the ELA10 standards. With the exception of a few additional standards added by Arizona, the ELA10 standards reflect the content of the Common Core State Standards (CCSS)[4]. Thus, they are a set of standards based on the college- and career-readiness research.

Rigor

Rigor is the hallmark of exemplary academic standards. Evaluating rigor requires analyzing whether or not the standards have the content and cognitive demand necessary to prepare students for success in credit-bearing college courses without remediation and in entry-level, quality, high-growth jobs. The analysis of the draft ELA16 standards reveal that Arizona has been largely exacting in its examination of the level of cognitive demand, drawing often upon the wording of its ELA10 standards, but there is one critical exception that must be addressed to ensure the standards prepare students for the reading demands of college and careers.

- ***The draft ELA16 standards lack adequate direction with regard to the expected complexity levels of text, despite a series of standards dedicated to students reading at particular text complexity grade levels. The final standards should address this issue fully and give educators specific quantitative measures.***

To be considered a set of college- and career-ready demands, standards must include a staircase of text complexity to ensure that students leave twelfth grade ready for postsecondary reading

[3] Descriptions for these criteria are found in the appendix.
[4] The ELA10 standards and the CCSS are very similar, but not a 100% match. No standards from the CCSS were deleted or revised, but Arizona did add a state specific standard for K–5 in Language, a state specific standard for grades K–12 in writing, and a state specific standard for reading informational text in grades K–12 in reading. For the purposes of this analysis, the ELA10 standards have parity with the CCSS.

demands. In 2006, research conducted by ACT, Inc. concluded that "performance on complex texts is the clearest differentiator in reading between students who are likely to be ready for college and those who are not."[5] As such, college- and career-ready standards must place an emphasis on students reading increasingly complex literary and informational text as they move through grades K–12. Arizona 's draft standards include language around quantitative and qualitative complexity in reading standard 10 from grades 2 to grades 12, however, reading standard 10 needs more definition:

1. While the draft ELA16 standards refer to students reading text that is quantitatively complex appropriate to the grade level, grade level complexities are *not* defined. Arizona needs to provide clear guidance to educators regarding text complexity for each grade level or each grade level band, such as the guidance included within the *Supplemental Information for Appendix A of the Common Core State Standards for English Language Arts and Literacy: New Research on Text Complexity.* (Quantitative complexity by grade bands was defined similarly within the ELA10 standards.)

2. The draft ELA16 reading standard 10 includes a requirement that teachers use qualitative measures in addition to quantitative measures to determine grade level complexity. As such, the challenge remains as to how Arizona expects teachers and other educators to best integrate quantitative measures with qualitative measures when selecting appropriate texts for a grade level. The two measures for determining text complexity are at once useful and imperfect. Both quantitative and qualitative measures of texts have their limitations: Quantitative measures are anchored in college and career readiness and use technology to measure dimensions of text complexity (e.g., word frequency and difficulty, sentence length, and text cohesion) that are difficult for a human reader to evaluate. On the other hand, while quantitative analyses can pretty accurately place a text within a text complexity grade band, it is less reliable in placing a text in a specific grade level. This is where a qualitative analysis is most helpful. While qualitative measures are neither anchored in college- and career-readiness levels, nor band or grade specific, they are enormously useful when determining the precise grade level placement of a text that is within a particular text complexity grade band. For example, a quantitative analysis can situate a text in the grades 6–8 text complexity band; a qualitative analysis then can determine if the text is better suited for grade 6 rather than grade 8 students. Currently, reading standard 10 asks for teachers to use both measures without any instruction about how they are to work together to lead to consistent complexity measures for all students.

3. A further complication in draft ELA16 is that Arizona does not differentiate between the text complexity expectations of grades 9 and 10 and grades 11 and 12. At grades 10 and 12, students should read at the high end of the text complexity band, and the standard should make that clear.

To maintain overall comparability in expectations and exposure for students, the overwhelming majority of texts that students read in a given year should fall within the quantitative range of grade

[5] ACT, Inc. (2006). Reading between the lines: What the ACT reveals about college readiness in reading. Iowa, City, IA: Author.

band complexity that will prepare them for college and career level reading by graduation. Without clear expectations for text complexity, educators in the same grade may select texts for their students that are at widely varying levels of complexity. That could result in some students not being provided with access to texts that will prepare them to meet college- and career-readiness expectations. Put simply, it is a matter of equity. In supporting documents, in addition to defining a staircase of specific quantitative measures, Arizona should also outline a set of recommendations about how the quantitative and qualitative measures work together. Achieve strongly recommends that Arizona considers these issues to ensure the critical complexity standards have meaning.

- ***The draft ELA16 standards retain vocabulary acquisition and development as clear priorities. Both are critical factors in building students' reading comprehension skills.***

Nearly a century's worth of research has identified vocabulary as one of the key factors that influence reading comprehension. A robust vocabulary is necessary for students to understand what they hear and read as well and for them to communicate clearly with others. In particular, students need to build strong academic vocabularies—words that are likely to appear in a variety of texts and content areas. The draft ELA16 standards include several standards across multiple strands that span grades K–12 that address vocabulary, signaling its ongoing importance. Vocabulary is directly addressed in standards for reading literature, reading informational text, and language. Attention is paid to determining the connotation, denotation, and technical meanings of words. The draft standards also ask for students to determine the impact of word choices on meaning and tone and pay attention to roots, affixes, word relationships, and the meaning of words in context, as well as a keen focus on academic vocabulary. The elementary grades are the years for students to acquire a large volume of vocabulary which will support their reading and comprehension for subsequent years. In the ELA16 draft standards, grades K–5 include an additional suite of standards in the reading foundational skills, which place added emphasis on vocabulary acquisition in standard 3. That standard calls for students to know and apply grade-level phonics and word analysis skills when decoding words. The draft ELA16 standards for vocabulary are strong and ensure that vocabulary remains a cornerstone of literacy development in grades K–12.

- ***The draft ELA16 standards place an important premium on students building knowledge from text and relaying that knowledge in written form.***

Research has shown that students' knowledge about a topic has a greater impact on their reading comprehension than their generalized reading ability does.[6] When students have knowledge about a topic, they are much more likely to learn and retain new information, as well as read more complex texts on that topic. Beginning in Kindergarten and extending through grade 12, the draft ELA16 standards require that students build knowledge from texts, and in particular, knowledge from content-rich texts.

The draft standards require students to demonstrate their knowledge through writing: two of the three writing modes require students to return to the text to provide solid backing for their claims, reasoning, and explanations. Moreover, there is a strong complement of standards in the Arizona

[6] Recht, D.R. & Leslie, L. (1988). Effect of prior knowledge on good and poor readers' memory of text. *Journal of Educational Psychology, 80(1), 16*

draft that require students to conduct research throughout their school careers, including shared research projects as early as Kindergarten. Multiple reading and writing draft ELA16 standards pertain to research, signaling its importance to educators. Beginning in grade 4, for example, reading standards 1, 7, 8, and 9 and writing standards 1, 2, 7, 8, and 9 all include direct (or implicit) references to research. The draft ELA16 reading standards expect students to interpret information about a topic from a single source and integrate information from multiple texts or sources on the same topic or subject matter, as well as evaluate sources. The draft ELA16 writing standards also call on students to gather relevant information from multiple sources and draw evidence from those literary or informational sources to support their findings. The inclusion of short research projects (in addition to more extended projects) beginning in grade 4 will ensure students have multiple opportunities to hone their research skills throughout the school year and over the grades.

- ***The draft ELA16 standards require that students draw evidence from text, both literary and informational, ensuring that students are primed for success in college or the workplace.***

The ability to find and use evidence appropriately in defense of an idea is a necessary skill for success in college and the workplace. As such, college- and career-ready standards should place a premium on students' ability to develop and hone their ability to call upon information from texts to provide support for their claims and conclusions when they write and speak. The Arizona standards accomplish this: Both reading literature and reading informational text strands of the draft ELA16 standards require students in all grades to locate textual evidence to support what the text says explicitly as well as in defense of inferences they draw from the text. Comparably, the writing standards require students in all grades to execute the skill of using evidence when writing arguments (or opinions) and informative/explanatory texts, explicitly calling upon students to provide reasons that are supported by facts and details (e.g., in grade 4) and to develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic (e.g., in grades 9–10).

- ***The draft ELA16 standards emphasize content-rich informational text, in addition to the wide reading of literature, ensuring students are prepared for the majority of reading they will complete post high school.***

Most of the reading students will do in college and in the workplace will be informational in structure and challenging in content. Moreover, informational texts are critical to building content knowledge, and in turn, strengthening reading comprehension. Thus, it is critical that students in K–12 are taught to comprehend, analyze, and evaluate rich informational text, as well as produce new information through the synthesis of complex ideas. While students should be expected to interact with informational text throughout the school day in history and science classes, etc., the ELA class is a prime time for students to read and write about informational texts and literary nonfiction in particular.

Much like ELA10, the draft ELA16 standards separate the reading strand into two sections: literature and informational text. Including two separate sections sends a clear message to educators that both types of reading are important and must be treated with instructional care. While students in the ELA class will (and should) continue to study and develop an appreciation for the rich language and narratives found in literature, they will also be expected to study and develop an appreciation for the content and structure of rich informational texts, including the reading of history/social studies, science and technological texts for study and review.

Focus

High-quality standards establish priorities about the concepts and skills that students should acquire by the time they graduate from high school. Choices should be based on the knowledge and skills essential for students to succeed in postsecondary education and the world of work. A sharpened focus also helps ensure that the cumulative knowledge and skills students are expected to learn—and teachers are expected to teach—are manageable. The draft ELA16 standards are clearly focused, and the additions to the standards are positive. The following are the results of analyzing the draft ELA16 standards against this criterion.

- ***The draft ELA16 standards reflect a commitment to integrating ELA skills across multiple modalities as indicated by the college- and career-ready research.***

Draft ELA16 reflects an appropriate balance between the study of literature and informational text and other important areas including, language study, foundational reading, foundational writing, and oral and written communications.

- ***The draft ELA16 standards include requirements for foundational writing skills some of which were not included in the draft ELA10 standards; overall, they are a positive addition to the standards.***

The draft standards in grades K–3 include a new section dedicated to foundational writing. It pulls some of the ELA10 requirements from the foundational reading standards and adds some requirements in the areas of sound-letter basics, handwriting (cursive), and spelling. Bringing together a host of standards under the heading of foundational writing skills will support emergent writers with developing automaticity for basic letter formation and other writing conventions. Achieve's only recommendation is for Arizona to make sure all of the foundational writing standards actually relate to writing. For example, K.WF.4 (Repeat multi-syllable words and pronounce the separate syllables) does not seem to fit with foundational writing and may be better placed with foundational reading standards.

Coherence

The way in which a state's college- and career-ready standards are categorized and broken out into supporting strands should reflect a coherent structure of the discipline and/or reveal significant relationships among the strands and how the study of one complements the study of another. If college- and career-ready standards suggest a progression, that progression should be meaningful and appropriate across the grades or grade spans. The following are the results of analyzing draft ELA16 against this criterion.

- ***The draft ELA16 standards are structured such that important topics are reinforced between strands; this reflects a thoughtful and tightly aligned system of standards.***

The draft ELA16 standards present a comprehensive vision of the ELA classroom that includes important knowledge and skills, not only in traditional areas of language, writing, and literature, but also in the areas of informational reading and media, which are critical for 21st century academic success.

The draft ELA16 has standards for reading, writing, speaking and listening, language, and foundational reading (K–5), as well as standards for foundational writing (K–3 only). The content of the standards reveals important relationships among the strands, highlighting how each strand can illuminate the study of another:

1. The writing standards refer to reading, requiring students to examine a topic and use details, facts, or examples, drawing evidence from text when writing.
2. The language standards require students to use the knowledge of conventions to support their reading and writing.
3. The speaking and listening standards require reference text when speaking about a topic. When speaking about a topic.

- ***The draft ELA16 standards create meaningful progressions of expectations throughout the grade levels; however, there are occasions where the progression is unclear and could be improved.***

The clear progression of expectations is a challenge in the ELA discipline. Students execute many of the same reading and writing skills across all grade levels, like determining the main idea or theme, determining the meaning of unknown words and phrases, writing clear and coherent pieces with a main idea and supporting details, and the use of standard English grammar and conventions. Though many of the skills are recursive, educators are expected to teach increasingly sophisticated techniques in the use of these skills as they are applied to increasingly complex texts.

While there is a dearth of research on the ideal sequence or progression for student expectations in ELA, there is research about the importance of reading tasks growing in rigor as students advance through the grades in order to be prepared to meet the demands of college and in the workplace.[7] For the most part, the draft ELA16 standards include meaningful progressions in every domain. For example, reading standards progress from recounting stories and determining their central message, lesson, or moral in grade 2 to determining a theme of a story, drama, or poem in grade 5, to determining a theme or central idea of a text and analyzing its development over the course of the text in grade 8 to determining two or more themes or central ideas of a text and analyzing their development over the course of a text, including how they interact and build on one another to produce a complex account in grades 11–12. Similarly, writing standards progress from writing opinion pieces in elementary school to crafting and developing evidence-supported arguments in the

[7] Perfetti, C.A., Landi, N., & Oakhill, J. (2005). "The Acquisition of Reading Comprehension Skill." In M.J. Snowling & C. Hulme (Eds.), *The Science of Reading: A Handbook.* (pp. 227-247); National Institute of Child Health and Human Development.

middle and high school grades. These patterns of progression reflect a commitment to meeting college- and career-ready expectations by the end of twelfth grade.

However, in some places, the progression seems less clear. For example, in AZ.L.4.1, students are asked to “write and organize one or more paragraphs that contain: an introduction of the topic, supporting details, and a conclusion that is appropriate to the writing task” and in AZ.L.5.1, students are asked to “write and organize one or more paragraphs that contain: a topic sentence, supporting details, and a conclusion that is appropriate to the writing task.” It is unclear how the “introduction of the topic” in grade 4 is substantively different from “topic sentence” in grade 5, and whether or not the grade 5 standard actually represents a more sophisticated challenge. If there is a difference, an example would be helpful in distinguishing the two.

Additionally, while the Language standards address new skills at each grade level, students will need to be cognizant of these language skills as their writing and reading becomes increasingly complex. For example, Language standard 1 in grade 3 addresses agreement, both subject-verb and pronoun-antecedent. At higher grade levels, more complex writing often calls for phrases or modifiers to be added between the subject and verb, making issues of agreement much more complicated—though still critical. In the next draft, Arizona should consider addressing how language skills will need continued attention throughout the grades as reading and writing becomes more complex.

Specificity

Quality standards are precise and provide sufficient detail to convey the level of performance expected without being overly prescriptive. Standards that maintain a relatively consistent level of precision are easier to understand and use. Those that are overly broad or vague leave too much open to interpretation, increasing the likelihood that students will be held to different levels of performance and create issues of equity, while atomistic standards encourage a checklist approach to instruction that undermines students’ overall understanding of the discipline. While some of the revisions in draft ELA16 make the standard more precise, there are other revisions in which specificity is lost. The following are the results of analyzing draft ELA16 against this criterion.

- ***Overall, the draft ELA16 standards simplify and clarify some expectations when compared to its ELA10 set of standards; there are, however, some cases in which the expectations have become less precise.***

Below are some examples of standards from draft ELA16 that would benefit from additional precision. The standards that deserve attention are rated in the side-by-side comparison charts that accompany this report with a rating of “2” (Partial match: there is a noticeable change, and the change may have made its interpretation more difficult for the user, e.g., when an important example was cut) or a “3” (Partial match: the revision weakens the standard, and important content may have been lost).

ELA10	Draft ELA16	Comments on Precision
2.RL.9: Compare and contrast two or more versions of the same story	**2.RL.9:** Compare and contrast the plot from two or more versions of the	The standard is narrowed to focus on comparing and contrasting only the plot of two versions of the

(e.g., Cinderella stories) by different authors or from different cultures.	same story (e.g., Cinderella stories) by different authors or from different cultures.	same story; however, this may be difficult to achieve. Is plot defined as the five elements (exposition, rising action, climax, falling action, resolution), or is plot also expanded to include information about character and setting? If plot is defined as the five elements, as written, it may be hard to find contrasting elements. Many versions of the same story follow the same plot, but differ in their setting, character, dialogue, etc.
8.L.1: Demonstrate command of the conventions of Standard English grammar and usage when writing or speaking. a. Explain the function of verbals (gerunds, participles, infinitives) in general and their function in particular sentences. b. Form and use verbs in the active and passive voice. c. Form and use verbs in the indicative, imperative, interrogative, conditional, and subjunctive mood. d. Recognize and correct inappropriate shifts in verb voice and mood.	**8.L.1:** Demonstrate command of the conventions of Standard English grammar and usage when writing or speaking. a. Explain the function of verbals (gerunds, participles, infinitives) in general and their function in particular sentences. b. Form and use verbs in the active and passive voice. c. Form and use verbs in the indicative, imperative, interrogative, conditional, and subjunctive mood. d. Recognize and correct inappropriate shifts in verb, voice, and mood.	The comma between verb and voice creates some confusion here. Was the intend to shift verb tense? Shifts between active and passive voice? Definitions for verb voice (active and passive) and verb mood (indicative, imperative, subjunctive) are clear whereas the meaning of "verb" as a standalone is unclear. This may create confusion for what teachers are expected to do—as well as what should be included in the assessments.
9-10.RL.6: Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.	**9-10.RL.6:** Analyze points of view or cultural experiences reflected in works of literature, drawing from a variety of literary texts.	The standard has been broadened from world literature to reading a variety of literary texts, presumably but not necessarily from both inside and outside the U.S. This could mean that students won't read any texts outside the US, which changes the intent (and students' experiences) drastically.
9-10.RI.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.	**9-10.RI.3:** Analyze how the author organizes an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.	"Organizes" speaks more directly to text structure, aligning better with standard 5. The rewording may result in teachers and assessment designers asking students to interpret text structure instead of focusing on how elements in a text interact, which is the intent of standard 3.

11-12.RL.4: Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (Include Shakespeare as well as other authors.)	**11-12.RL.4:** Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings, while analyzing the impact of specific choices on meaning and tone.	The change in wording means that every time students determine the meaning of words and phrases in a text they also will have to analyze the impact of specific choices on meaning and tone. The ELA10 standards treat these elements as separate concepts—i.e., in some instances students may determine the meaning of words and phrases; in other instances, they may analyze the impact of specific word choices on meaning and tone. Students should continue to determine the textual definition of multiple meaning words through 12th grade.

Clarity/Accessibility

The format should be easy to digest and standards should be written in clear, without jargon-laden prose, thereby communicating in language that can gain widespread acceptance not only from postsecondary faculty, but also from employers, teachers, parents, school boards, legislators, and others who have a stake in schooling. Most of the language in the draft ELA16 standards is clear and easily accessible; however, the omission of some parenthetical examples and the inclusion of a glossary mark examples where clarity has been lost. The following are the results of analyzing the draft ELA16 standards against this criterion.

- ***Overall, the format of the draft ELA16 makes it easy to recognize the expectations within a grade, but not progressions grade-to-grade.***

The format of the draft ELA16 standards has a progression of cognitive complexity from grade to grade. However, tracking that progression is difficult in the current format. Moving forward, it would be helpful for Arizona to offer the standards to educators in two formats: both by grade level and by standard progression, so it is easy for educators to identify how a standard evolves through the grades.

- ***The nomenclature and organization of the standards is clear and easy to follow.***

In the draft ELA16 standards, there are a set of anchor standards and grade level reading standards that consistently correspond to those anchor standards. For example, reading standard 1 always refers to drawing evidence from texts and standard 4 in the reading strand and language strand always address vocabulary throughout the grade levels. Moreover, in the lower grades, the reading foundational standards directly follow the reading standards and the writing foundational standards directly follow the writing standards, allowing for ease in locating information.

- ***In some instances, the draft ELA16 standards have honed the language and improved the clarity of statements from the ELA10 standards.***

The draft ELA16 standards clarify expectations for educators in some key areas. For example, writing standard 9 was consistently revised to include language that is now easier for users to understand. The new standard also does a fine job at reinforcing the use of text evidence in support of writing.

- ***The draft ELA16 standards intermittently omit parenthetical examples that had been included in the ELA10 standards, which sometimes results in making these expectations less clear to audiences.***

The draft ELA16 standards do retain some parenthetical examples from the ELA10 standards, but in some standards the fact that parentheticals were deleted from ELA10 has resulted in their being less clear. Following are some examples:

ELA10	Draft ELA16	Parenthetical Comments
4.RL.4: Determine the meaning of words and phrases as they are used in a text, including those that allude to significant characters found in mythology (e.g., Herculean).	**4.RL.4:** Determine the meaning of words, phrases, and figurative language found in stories, myths, and traditional literature from different cultures including those that allude to significant characters.	There are strengths to the Arizona revision (i.e., adds figurative language and literature from different cultures), however, defining text so precisely as the standard does, seems to concretely omit poetry (where a lot of figurative language can be found). How are “stories” different from traditional literature from different cultures? An example here about the goal would be very useful—without "Herculean," the standard loses some clarity.
4.RL.5: Explain major differences between poems, drama, and prose, and refer to the structural elements of poems (e.g., verse, rhythm, meter) and drama (e.g., casts of characters, settings, descriptions, dialogue, stage directions) when writing or speaking about a text.	**4.RL.5:** Explain the overall structure and major differences between poems, drama, and prose.	The omission of "when writing or speaking about a text" is important, as it focuses teachers’ attention on how students should respond. This revision reduces the standard to explaining how poems, drama and prose are different. A critical aspect of the standard (referring to the structural elements) has been lost. As written, the standard could be addressed with the question, "How is a poem different from a play?" In the ELA10 standards, students would have been expected to return back to the specific elements in poems, dramas, and prose they

		are reading when discussing the meaning of text.
6.RI.9: Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person).	**6.RI.9:** Compare and contrast one author's presentation of events with that of another author.	The elimination of the example may cause some confusion in the field. If the original example felt too narrow, Arizona should consider adding another one.
9-10.RL.7: Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment (e.g., Auden's "Muse des Beaux Arts" and Breughel's Landscape with the Fall of Icarus).	**9-10.RL.7:** Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment.	Deleting the example reduces clarity and does not provide any tangible expectations for an abstract concept to educators. Examples as defined in the glossary make it clear they are not mandatory; thus they will not impede local curricular decisions.
9-10.RI.4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).	**9.10-RI.4:** Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone.	Omitting the examples reduces clarity, and may reduce the rigor of the expectations.

- ***The glossary that accompanies the draft ELA16 standards is meant to add clarity but too often it contains definitions that need more precision and clarity.***

The glossary for the draft ELA16 standards would benefit from some additional attention (Appendix C). Below is a chart detailing some examples where more clarity and precision is needed:

Word	Definition	Comment
Aesthetic	The use of language as an artistic medium to create imagery that evokes sensory perception and is concerned with emotion, sensation, and a sense of beauty. Can be used in both literary and non-fiction texts.	This definition seems to move beyond the scope of the word. Does "aesthetic" refer to any emotion or sensation or more directly with beauty?
Argument: claim	An assertion in the face of possible contradiction. A debatable claim or thesis is an essential element of argument	Is "thesis" intended to be synonymous with claim? Usually "thesis" is connected with explanatory or informational writing. Here, the definition of claim is defined by using the word "claim," which could create further confusion.
Cite	(verb) To quote (a passage, book, or author) as evidence for or justification of an argument or statement, especially in a scholarly work	This may be too limiting, could a student not cite pictures, charts, or graphics? Shouldn't students also provide citations when they paraphrase an author?

Rhetorical situation	The context of a rhetorical construct which consists (at a minimum) a rhetor (the author), an issue, a medium, and an audience	This definition is hard to understand and needs more jargon-free words to articulate its meaning.

Measurability

In general, standards should focus on results rather than the process of teaching. Overall, the draft ELA16 standards present clearly measurable student outcomes that focus on results rather than a process which ends with instruction. The standards also make use of performance verbs that call for students to demonstrate knowledge and skills rather than those verbs that refer to learning activities (e.g., examine and explore) or cognitive processes (e.g., know or appreciate). With the exception of reading standard 10, the draft ELA16 standards are largely measurable. The following are the results of the analysis of the draft ELA16 standards against this criterion.

- ***The draft ELA16 standards are largely measurable. There is a singular, yet critical issue—a clear definition of grade level or grade band quantitative measures of text complexity—with measurability that will impact the state assessment system if it is not addressed.***

The issue of measurability centers around clear guidance and expectations for text complexity. As noted earlier, Arizona needs to include clear guidance about evaluating text quantitatively and qualitatively, and how the qualitative analysis of text should be used to complement the quantitative grade band placement. This will impact not only statewide assessment systems, but district and classroom expectations and assessments as well. Without clearly defined parameters for how to use both quantitative and qualitative measures of text complexity, teachers may take texts that are below grade level quantitatively and justify their instructional use by leaning too heavily on the qualitative measures, especially if they have been teaching those texts for years. In short, by not articulating clearly defined expectations for text complexity, students will be left unprotected and inequities will result—leaving some students on the path to college and career readiness, and others not. These measures and how they work together to identify appropriately complex text should be clearly defined and communicated.

Review of Arizona's Draft Standards for Mathematics

The purpose of this review is to examine the August 2016 Arizona Draft Standards for Mathematics (ADSM) to determine whether they are high-quality standards that prepare students, over the course of their K–12 education careers, for success in credit-bearing college courses and quality, high-growth jobs. Arizona has clearly done a great deal of work to thoughtfully produce a highly rigorous set of standards. The expectations intended for all students, up through Algebra 2, in the ADSM are very similar to other college- and career-ready sets of standards, such as the CCSS,[8] thus enabling educators to easily adapt existing instructional materials.

When evaluating standards, Achieve has historically used a set of six criteria: rigor, coherence, focus, clarity/accessibility, specificity, and measurability. For the purposes of this analysis, the ADSM were compared with the Common Core State Standards (CCSS) for Mathematics and analyzed with respect to these criteria.

Structure of the Arizona's Draft Standards for Mathematics

This report provides a review of the draft of the ADSM released in August 2016. The draft document provides grade-level standards for each of the grades from Kindergarten through Grade 8. In high school, course standards for the first three years are presented as Algebra 1, Algebra 2, and Geometry. The draft also includes High School Plus Standards that may be used in fourth-year courses. The ADSM are structured around domains, clusters, and content standards, with the high school standards also grouped by broader conceptual categories. The domains and categories are the same as those in the CCSS. The ADSM are aligned to progressions, as indicated in the table below.[9]

[8] The expectations after Algebra 2 are not clear at all, however.

[9] Arizona Draft Standards for Mathematics, August 2016, p. 7

<table>
<tr><th colspan="12">Grade Level or High School Course</th></tr>
<tr><th>K</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>Algebra 1</th><th>Geometry</th><th>Algebra 2</th></tr>
<tr><td colspan="12">Standards for Mathematical Practice</td></tr>
<tr><td>Counting & Cardinality</td><td colspan="5"></td><td colspan="2">Ratios & Proportional Relationships</td><td>Functions</td><td>Functions</td><td rowspan="2"></td><td>Functions</td></tr>
<tr><td colspan="6">Operations & Algebraic Thinking</td><td colspan="3">Expressions & Equations</td><td>Algebra</td><td>Algebra</td></tr>
<tr><td colspan="6">Number & Operations in Base Ten</td><td colspan="3" rowspan="2">The Number System</td><td rowspan="2">Number & Quantity</td><td rowspan="2">Number & Quantity</td><td rowspan="2">Number & Quantity</td></tr>
<tr><td colspan="3"></td><td colspan="3">Fractions</td></tr>
<tr><td colspan="6">Geometry</td><td colspan="3">Geometry</td><td></td><td>Geometry</td><td></td></tr>
<tr><td colspan="6">Measurement & Data</td><td colspan="3">Statistics & Probability</td><td>Statistics & Probability</td><td></td><td>Statistics & Probability</td></tr>
<tr><td colspan="9"></td><td colspan="3">Modeling</td></tr>
<tr><th colspan="9">Domains</th><th colspan="3">Conceptual Categories</th></tr>
</table>

The ADSM include the same eight Standards for Mathematical Practice as those found in the CCSS, although the descriptions vary somewhat from those of the CCSS. The ADSM version of the Math Practices are placed alongside the content standards for every grade. We commend Arizona for providing this added emphasis to the Practices as including them with the content standards will strengthen student understanding of both. However, in many cases the CCSS provide examples which were removed in the ADSM version. It would be helpful to include grade-specific descriptors to tailor the message for different grade levels or bands and to make them clearer and more actionable for educators.

Analysis of content using Achieve's Criteria for Quality Standards

Accompanying this report is a side-by-side chart that provides full alignment and commentary of the ADSM content standards as compared to the CCSS through the Algebra 1, Algebra 2, Geometry, and the High School Plus Standards. The chart uses the CCSS as the organizing structure in the left column. Each Arizona K–8 standard is used in the alignment chart in the column directly to the right of the CCSS column. The ADSM high school course standards can be found in the four columns directly to the right of the CCSS column, with one column for each course. Commentary on the alignment is in the column on the far right. The side-by-side chart includes comprehensive commentary and suggestions beyond what is found in this report.

The ADSM include standards beyond Algebra 2, called the High School Plus Standards (designated with a P) that closely match the CCSS (+) standards. The purpose of these standards in the ADSM, however, is unclear. [10] These standards "are intended to be included in honors, accelerated, advanced courses, fourth credit courses, as well as extensions of the regular courses" (Intro, p.11) and are not intended to serve as a course on their own. As such, there is no requirement that any courses use any or all of these standards. The ADSM (P) standards include topics in Discrete

[10] Specific differences are detailed in the accompanying side-by-side chart.

Mathematics, for example, but it is unclear if a fourth-year course in Discrete Mathematics would be expected to use those standards. The purpose of the (P) standards should be clearer.

The discussion below highlights key findings and recommendations based on the comparison of the ADSM and CCSS content standards using Achieve's Criteria for Quality Standards: rigor, coherence, focus, clarity/accessibility, and measurability.

Rigor

Rigor refers to the intellectual demand of the standards. It is the measure of how closely a set of standards represents the content and cognitive demand necessary for students to succeed in credit-bearing college courses without remediation and in entry-level, quality, high-growth jobs. Rigorous standards should reflect, with appropriate balance, conceptual understanding, procedural skill and fluency, and applications. For Achieve's purposes, the CCSS represent the appropriate threshold of rigor.

In most respects, the ADSM and the CCSS are very similar. As such the emphasis on the three components of rigor, conceptual understanding, procedural skill and fluency, and application in the ADSM has a balance similar to that of the CCSS. We do see a few instances, however, where the ADSM shifted an understanding, fluency, or application from a given CCSS standard.

The ADSM *almost* always changes the expectation of "recognize" to "understand." Changing an expectation to "understand" tends to increase rigor, but it may not do so in all cases. While the CCSS indicate modeling standards using an asterisk, the ADSM remove that notation. Instead, in the ADSM, modeling standards are only recognized by adding the phrase, "utilizing a real-world context" (Intro, p.18). A.CED.1 provides an example of this change:

CCSS Standard	ADSM Standard
A.CED.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*	A2.A-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on equations and inequalities arising from linear, quadratic, rational, and exponential functions with real exponents.

A significant concern, however, is that many of the ADSM standards that correspond to modeling standards in the CCSS do not include the additional phrase, "utilizing real-world context."[11] As such, several AZ standards, like the following, have unfortunately lost the connection to modeling:

CCSS Standard	ADSM Standard

[11] The definition of modeling in the introduction should appropriately reference the 2016 report *Guidelines for Assessment & Instruction in Mathematical Modeling Education* (GAIMME) by the Consortium for Mathematics and its applications (COMAP).

N.Q.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*	A1.N-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
A.CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*	A1.A-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*	A1.F-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Functions include linear, exponential with integer exponents, quadratic, and piecewise-defined functions.
F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*	A1.F-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input-output pairs.

While fluency, also an aspect of rigor, is not defined in the CCSS, the ADSM introduction helpfully clarifies the meaning of fluency and clearly outlines the expectations for fluency in the introduction to the standards. Both sets of standards include similar progressions for Grade K through Grade 7 that incorporate fluency, computations, algorithms, and/or knowing from memory, but Arizona, in the introduction, helpfully provides a tabular version of these progressions. The most noteworthy difference is that the ADSM postpone adding and subtracting within 100 until Grade 3. The postponement will temporarily put students behind their counterparts in CCSS states, as by the end of Grade 4 students using the ADSM or CCSS standards will be adding or subtracting multi-digit numbers.

The ADSM, however, apply fluency to other algebra and geometry topics:

ADSM Fluencies
Grade 6: Write, read, and evaluate algebraic expressions
Grade 8: Solve linear equations and inequalities in one variable.
Algebra 1: Perform arithmetic operations on polynomials; Interpret complicated expressions by viewing one or more of their parts as a single entity
Geometry: Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing a real-world context; use coordinates to prove simple geometric theorems algebraically; make geometric constructions

Algebra 2: Use the structure of an expression to identify ways to rewrite it; Build new functions from existing functions

It is important to note here that the standards and clusters referenced in these fluencies have similar matches in the CCSS (though the CCSS do not include inequalities in Grade 8), yet neither the ADSM nor CCSS explicitly mention fluency as a goal in the clusters or the standards themselves. As such, teachers will only recognize these as fluency topics if they read the introduction to the standards. This shifted intention should be made explicit.

There is a need, however, to revisit the referencing of some of these as fluency standards. While defining fluency through producing answers efficiently, accurately, flexibly, and appropriately is helpful and will work with most of the standards tagged for fluency, it becomes problematic when held against some of the ADSM fluencies from algebra and geometry. Does Arizona intend that students be able to make geometric constructions using multiple approaches? What might it mean for students to fluently interpret complicated expressions? In the introduction, Arizona draws a distinction between procedural skills and fluencies. Is it possible that some of these are procedural skills, rather than fluencies? Arizona has an opportunity to delineate these terms more clearly.

Coherence

Coherence refers to how well a set of standards conveys a unified vision of the discipline, establishing connections among the major areas of study and showing a meaningful progression of content across the grades, grade spans, and courses.

Given the close match between the CCSS and the ADSM, the coherence of the ADSM is very similar to that found in the CCSS. There are a few subtle differences between the two sets, however. Below are examples of potential coherence issues in the ADSM:

CCSS Standard	ADSM Standard	Comments
	3.MD.A.2 Solve word problems involving money through $20.00, using symbols $, ₵, and "." as a distinction between dollars and cents.	AZ added this standard addressing problems involving money. This is addressed in Grade 2 in the CCSS but without the $20 limit and without the reference to the decimal point. Since students at this grade have not been introduced to decimal numbers, requiring the use of a decimal point in their notation is beyond the reach of students in this grade level.
6.EE.7. Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which *p, q* and *x* are all nonnegative rational numbers.	6.EE.B.7 Solve mathematical problems and problems in a real-world context by writing and solving equations of the form $x + p = q$, $x - p = q$, $px = q$, and $p/x = q$ for cases in which p, *q* and *x* are all non-negative rational numbers.	AZ added two variations on the CCSS equations. However, p/x = q would not be appropriate at this level since students have not been introduced to rational expressions. It is likely that this is a typo and it should be $x/p = q$. Indiana, as referenced in the technical

		notes, includes *x/p = q* but not *p/x = q* in their standard 6.AF.5.
G.SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	G.G-SRT.C.8 Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles in applied problems.	Inverse functions are an Alg 2 topic in AZ, possibly putting this requirement out of order. It is not clear whether the Geometry course typically comes before or after Alg 2 in AZ. While this is an identified modeling standard in the CCSS, the AZ version does not include the phrase, "utilizing a real-world context" per the ADSM introduction (see page 18).

Arizona should consider these issues in the final draft.

Focus

High-quality standards establish priorities about the concepts and skills that should be acquired by students. A sharpened focus helps ensure that the knowledge and skills students are expected to learn are important and manageable in any given grade or course.

There are a number of ways that focus can be affected in a set of state mathematics standards. Using the CCSS as our model, a state might delete or add concepts or alter the wording of a standard to change meaning or emphasis. In the case of the ADSM, there are a few instances of all of these. There are four ADSM with no CCSS counterpart, four CCSS that have no match in the ADSM, and five CCSS that are intended for all students (non-(+) standards) that are only addressed in the ADSM Plus (P) course standards.

Below are examples and commentary of ADSM standards that have no CCSS counterpart:

ADSM Standard	Comment
K.NBT.B Use place value understanding and properties of operations to add and subtract. K.NBT.B.2 Demonstrate conceptual understanding of addition and subtraction through 10 using a variety of strategies.	This Grade K header and standard have no counterpart in the CCSS at this grade level. These, however, seem redundant to K.OA.2, 3, and 4.
1.MD.B.4 Identify coins by name and value (pennies, nickels, dimes and quarters).	AZ added requirements to *identify* coins.
3.MD.A.2 Solve word problems involving money through $20.00, using symbols $, ₵, and "." as a distinction between dollars and cents.	AZ added this standard addressing problems involving money. (See the accompanying side-by-side chart for other issues with this standard.)
A2.S-ID.C Interpret models. A2.S-ID.C.10 Interpret parameters of exponential models.	This high school AZ header and standard is not included in the CCSS requirements, but this addition provides a nice parallel to S-ID.C.7.

In addition, there are four CCSS with no match in the ADSM, but, with the exception of F-BF.4a, the Arizona technical notes provide a reasonable rationale for not including them. The four missing CCSS are as follows:

- **1.OA.5** Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
- **3.MD.6** Measure areas by counting unit squares (square cm, square m, square in, square ft., and improvised units).
- **F.BF.4a** Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2 x^3 or f(x) = (x+1)/(x–1) for x ≠ 1*
- **S.ID.6c** Fit a linear function for a scatter plot that suggests a linear association.

There are five high school non-(+) CCSS that are only matched in ADSM Plus standards, all but one of which (G.GPE.2) are related to statistics. This de-emphasis in statistics runs counter to trends in higher education and the increasing importance of statistics in the 21st century. It is not clear why Arizona chose to reduce the emphasis on statistics for all students, and no explanations are provided in the technical notes. These differences are concerning given that all students may not be exposed to these concepts if they opt for a fourth-year course that does not address them.

There are a few other differences in focus between the CCSS and the ADSM. One example is that the ADSM moves probability of compound events from Grade 7 to Grade 8. This change should be relatively easy for teachers to implement:

CCSS Standard	ADSM Standard	Comment
7.SP.8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.	8.SP.B.1 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.	AZ moved probabilities of compound events from Grade 7 to Grade 8. [There are four separate CCSS associated with this concept.]

Two other noteworthy shifts in focus happen in Grade 8:

CCSS Standard	ADSM Standard	Comment
8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form *x*^2 = *p* and *x*^3 = *p*, where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.	8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x^2 = p and x^3 = p, where p is a positive rational number. a. Evaluate square roots of perfect squares less than or equal to 225, and rewrite non-perfect squares in equivalent form. b. Evaluate cube roots of perfect cubes less than or equal to 625, and rewrite non-perfect cubes in equivalent form.	In addition to other changes, AZ includes “rewrite non-perfect squares in equivalent form” and “rewrite non-perfect cubes in equivalent form.” The intention here is not mathematically clear. For example, what are students expected to do with $\sqrt{7}$? This appears to overlap with A2.N-RN.A.2 and will be a time-consuming addition to the standard. The technical notes indicate this is “a foundational concept that is part of the progression to Algebra” but such a claim is far from apparent.

Analyze and solve linear equations and pairs of simultaneous linear equations.	**8.EE.C Analyze and solve linear equations, inequalities, and pairs of simultaneous linear equations.**	AZ added inequalities to the 8.EE.C cluster. This is a time-consuming change and it is not clear why this needs to happen here rather than in Algebra 1.

Finally, there are occasional inconsistencies between the changes in the standards and the changes listed in the technical notes. It is unclear in these instances which information reflects the latest intention of the reviewers. Standard 8.NS.A.1, for example, removed converting decimal expansions, yet that change was not mentioned in the notes. It is not clear if the change is a mistake or intentional. The notes in standard 2.OA.C.4 mention the addition of parentheses to the standard, though that change did not happen. Arizona should review the notes and changes for consistency.

Clarity/Accessibility

High-quality standards are clearly written and presented in an error-free, legible, easy-to-use format that is accessible to the general public.

The ADSM are generally clear and accessible. It is evident that the writers of the ADSM have carefully considered the wording of the standards and have subsequently rephrased many standards in an effort to add clarity. This is evidenced in the thoughtful comments in the technical review and analysis that explains the reasoning behind all changes to the CCSS. There are, however, a few potential issues of clarity for Arizona to consider before finalizing the standards.

- On page 18 of the ADSM Introduction, there is an explanation for how modeling with mathematics is handled in the AZ standards. The Introduction states that modeling standards (indicated with an asterisk in the CCSS) will include the phrase, "utilizing a real-world context." However, in every case the included statement is, "utilizing real-world context," with the article missing. This appears to be a global typo that needs correcting.
- Throughout the ADSM, there are examples where wording of the CCSS was deleted, added, or revised. Below are examples of some cases where the result was less clear:

CCSS	ADSM	Comments
2.NBT.2. Count within 1000; skip-count by 5s, 10s, and 100s.	2.NBT.A.2 Count to 1000 by 1's, 5's, 10's, and 100's from different starting points.	AZ changed "within 1000" to "to 1000." The latter would mean that the requirement is to always count up to 1000 from different starting places but not necessarily to different end places. The CCSS expects counting to different numbers that fall within 1000. AZ also added the requirement to start at different points. Do "points" mean "numbers?" This should be clarified. Note: The AZ technical review states, "parenthesis [sic] were added to clarify that students should skip count starting

		at different numbers." However, none are here.
3.OA.5. Apply properties of operations as strategies to multiply and divide.* Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.) [Students need not use formal terms for these properties.]	3.OA.B.5 Apply properties of operations as strategies to multiply and divide. This includes use of known facts to solve unknown facts through the application of the commutative, associative, and distributive properties of multiplication. (Students do not need to use the formal terms for these properties.)	It is not clear what "use of known facts to solve unknown facts" means. There may be a word missing.
3.NF.1. Understand a fraction *1/b* as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size *1/b*.	3.NF.A.1 Understand a unit fraction (1/b) as the quantity formed by one part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts 1/b.	Removing "of size" may lead to misunderstanding the quantitative reasoning used in the CCSS, and therefore, some - if not all - of the need for recognizing fractions as numbers, with the denominator used to indicate the size of the part. The expression "a parts *1/b*" is not clear.
3.NF.2a Represent a fraction *1/b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size *1/b* and that the endpoint of the part based at 0 locates the number *1/b* on the number line.	a. Represent a unit fraction (*1/b*) on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it from 0 into b equal parts.	Partitioning "from zero" does not make sense.
3.NF.2b Represent a fraction *a*/*b* on a number line diagram by marking off *a* lengths 1/*b* from 0. Recognize that the resulting interval has size *a*/*b* and that its endpoint locates the number *a*/*b* on the number line.	b. Represent a fraction *a/b* on a number line diagram by marking off *a* lengths of unit fractions *1/b* from 0. Understand that the resulting interval has size a/b and that its endpoint locates the number *a/b* on the number line including values greater than 1.	The "including values…" reads as if the number line should include values greater than 1. In its current form, it is grammatically awkward and mathematically unnecessary. If the intent is for *a/b* to include values greater than 1, It might be that a comma is needed after "number line." However, it would be more clear to clearly state, "including values for *a/b* that are greater than 1," or "including values where *a* > *b*."
4.NBT.1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.*	4.NBT.A.1 Apply concepts of place value, multiplication, and division to understand that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right.	How a student would "apply concepts" in order "to understand" is unclear, as is how a teacher would measure the understanding of place value through application of place value and operations.

4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a “one-degree angle,” and can be used to measure angles. b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees.	4.MD.C.5 Understand angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays. An angle that turns through 1/360 of a circle is called a “one-degree angle,” and can be used to measure angles. b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees.	AZ deleted the defining statement for angle measurement. Without that statement the next sentence, about a commonly misunderstood concept, is less clear. The technical notes indicate that the statement was removed because it was, "all the how... and not appropriate for wording in standards." The deleted statement, however, is not about "how" but is rather a key part of the understanding of what one should attend to when measuring an angle.
5.NF.4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.	5.NF.B.4 Apply and extend previous understandings of multiplication to multiply a fraction by a whole number and by a fraction.	Attention to clarity is needed here. There is a slight word order change in the stem part of the standard (5.NF.4): The required operations "whole number by a fraction" is changed to "fraction by a whole number." The difference is subtle but not insignificant. In this case, part a asks for a fraction by a whole number, which is the reverse of the AZ stem standard. It should be noted that in other AZ standards (e.g. 5.NF.B.7) the difference between the two orders is attended to by including both.
5.G.1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).	5.G.A.1 Understand and describe a coordinate system as perpendicular number lines that intersect at the origin (0 , 0). Identify a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number (x) indicates the distance traveled on the horizontal axis, and the second number (y) indicates the distance traveled on the vertical axis.	By including the example as part of this standard, AZ specifically identifies the variables as x and y, making it less likely that students would use other variables more appropriate to a real world context. The CCSS makes the effort to allow for any variable and uses x and y only in a parenthetical example.
6.NS.1. Interpret and compute quotients of fractions, and solve word	6.NS.A.1 Interpret and compute quotients of fractions to solve	Removing the "e.g." in this CCSS gives the impression that only visual models

problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?*	mathematical problems and problems in a real-world context involving division of fractions by fractions using visual fraction models and equations to represent the problem. (In general, (*a*/*b*) ÷ (*c*/*d*) = *ad*/*bc*.)	and equations are required. AZ removed the CCSS specific example but kept the general one.
6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.	6.G.A.1 Find the area of polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques to solve mathematical problems and problems in a real-world context.	The CCSS provides more detail about some of the specific polygons required. Unfortunately, the AZ modification, apparently meant to remove redundancy, loses the parallel language found in critical area 5 of the front matter in the Grade 6 standards.
F.BF.4. Find inverse functions.	A2.F-BF.B.4 Find inverse functions. a. Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, recognizing that functions f and g are inverse functions if and only if *f(x) = y* and *g(y) = x* for all values of x in the domain of *f* and all values of *y* in the domain of *g*. b. Understand that if a function contains a point (*a, b*), then the graph of the inverse relation of the function contains the point (*b, a*); the inverse is a reflection over the line *y = x*.	There is a problematic mathematical issue in part b. The statement, "the inverse is a reflection over the line *y*=*x*" will only be true if the *x*-axis and *y*-axis quantities mean the same thing simultaneously, which would never happen in context. See the article "Inverse Functions: What Our Teachers Didn't Tell Us" written by Arizona educators.[12] There is also a need to improve precision in part b in that a GRAPH of the function, and not the function itself, contains the point (*a, b*)..."
G.GPE.4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, $\sqrt{3}$) lies*	G.G-GPE.B.4 Use coordinates to prove or disprove simple geometric theorems algebraically. Theorems include: proving or disproving geometric figures given specific points in the coordinate plane; and	This standard is mathematically problematic. This standard adds, "disprove simple geometric theorems" and "disproving geometric figures." By the definition, a "theorem" cannot be disproved and disproving a figure

[12] Wilson, F. C., Adamson, S., Cox, T., and O'Bryan, A. (2011). Inverse Functions: What Our Teachers Didn't Tell Us. *Mathematics Teacher*, 104(7), 500–507.

on the circle centered at the origin and containing the point (0, 2).	proving or disproving if a specific point lies on a given circle.	makes no sense. In the CCSS, the examples ask that a theorem be used to disprove a condition or attribute. This is different from "disproving" the theorem. Also, the AZ version of the CCSS example may be construed to mean that only those two theorems are included. In the AZ final example, "disproving if..." should probably be "disproving that..."
S.ID.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	A1.S-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets (dot plots, histograms, and box plots), accounting for possible effects of extreme data points (outliers).	The purpose of the AZ addition is not clear here. The placement of the parentheses makes it appear in the AZ version that "data sets" are equivalent to the three types of plots. Also, it is not clear why they have included these three types of representations in this interpretation requirement. Are these the only displays included in the requirement? Why would a visual display be required at all?

- In several ADSM high school standards there are other more global issues of clarity:
  - Standards for all three required high school courses are identical. The limitations for each course are not clear. See the side-by-side commentary for the following: N.Q.1, N.Q.2, N.Q.3,
  - Several Algebra 1 standards related to exponential functions limit exponential functions to integer exponents. Since exponents are variable in exponential functions, it is not clear whether the intention is to limit the calculations students are asked to do or whether continuous functions are not allowed. See commentary for the following: A-REI.D.11, F-IF.4, F-IF.5, F-IF.6, F-IF.7e, F-IF.9, F-BF.1
  - In at least one case, A.APR.3, it appears that the Algebra 2 expectation is lower than the Algebra 1 expectation.
  - There are instances where it appears that a typo made it into this draft of the ASDM. See commentary for the following: F-TF.4, G.GMD.3, S-IC.2

While the ADSM aimed to remove instructional aspects for teaching, some standards, perhaps inadvertently, include verbs such as *focus* or *extend* that are aimed at teachers rather than at what students should be able to understand or do. These issues of clarity, as provided in the examples below, should be addressed. (See also A.REI.1, A.REI.11, and S-ID.6)

CCSS Standard	ADSM	Issue
A.SSE.2. Use the structure of an expression to identify ways to rewrite it. For example, see x^4 – y^4 as (x^2)^2 – (y^2)^2, thus recognizing it as a difference of squares that can be factored as (x^2 – y^2)(x^2 + y^2).	A2.A-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. Extend polynomial expressions to multivariable expressions. Focus on rational or exponential expressions seeing that $(x^2 + 4)/(x^2 + 3)$ as $((x^2+3) + 1)/(x^2+3)$, thus recognizing an opportunity to write it as $1 + 1/(x^2 + 3)$.	"Extend" can read as a connector for a teacher reading from Alg 1 to Alg 2, but it can also mean that students are able to "extend" polynomial expressions. In this case it appears to be instruction for the teacher, rather than what the student should know or do. Similarly, "focus" seems to be an instruction for the teacher.
F.BF.3. Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	A2.F-BF.B.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. Extend from linear, quadratic and exponential with integer exponents to include polynomial, radical, logarithmic, rational, piecewise-defined, sine, cosine, and exponential functions with real exponents.	The "extend" here is clearly about what the teacher, not the student, should do.

In addition to the issues of clarity in the draft standards, there are numerous issues of clarity in the Glossary. The entries in the Glossary are important as they serve to define specific terms that may be often misunderstood. Arizona should review the entire Glossary to ensure that the appropriate terms are included and that each entry is mathematically precise. Each entry should be consistent with other entries, as well as with the terms used in the standards.

It is not clear why certain terms were included or excluded in the Glossary. Terms such as *empirical rule,* found nowhere in the standards, and *positive association*, which was deleted from the standards, may be removed from the glossary. There is a definition for *irrational number* yet none for *rational number*. Beyond these, there are many other glossary issues that need attention. These include:

- The terms *quantity*, *amount*, *value*, and *size* are used in the glossary yet not clearly defined. Are they the same? If not, how are they different? The entry for *ratio*, for example, includes the words quantity, amount, and size implying a difference between these terms.
- The definition for *addition* implies that the result is actually more than one quantity.
- The associative property is a property of operations; it is not an action of "changing." The glossary elsewhere defines *properties of operations* as principles, for example.

- The definition for *complex fractions* does not need the example. Consider that the first mention of *complex fractions* is in Grade 7 and this example is beyond that level.
- The entry for *descriptive modeling* tells what it does, but not what it is. "Describes the phenomena" is far too general.
- The entry for *equation* should be reconsidered. It seems potentially confusing to use "divided by" in this definition. This entry also is vague in the use of the "two values" – which two values are intended?
- Why does the entry for *expression* use the word "certain?"
- The definition of *focus* is problematic as it is inconsistent with the use of the term in an ellipse or hyperbola. The entry simply describes the center of a circle or sphere.
- Why not simply use the definition of *function* as given in 8.F.A.1? To say a function is "a rule that assigns to each input exactly one output" matches the standard, is more concise, and clarifies the assignment of the input to the output.
- The entry for *interquartile range* is ambiguous.
- *Mathematical argument* is defined through sound reasoning. *Reasoning (mathematical)* is defined through mathematical arguments. The definitions are nearly the same except for this bit of circularity. What do these terms really mean?
- The entry for *mean absolute deviation* is too general and lacks defining the actual measure. It is problematic to say this is a "simplified measure" when there is no other measure for comparison.
- It would be more precise to say *rectilinear polygon* rather than *rectilinear figure* given that the entry focuses only on polygons.
- *Representation* is presented as a verb. It is never a verb.
- A *scale factor* is a number, not a ratio.
- *Subtraction* is defined as an operation, but *addition* is not.
- A *translation* works with a figure yet a *rotation* works with an object or coordinate system. This is inconsistent.
- For *zeros of a function* it is not clear if the "points" are locations on a graph or inputs that lead to an output of zero. The language should be precise. "Roots" (of this sort) and "solutions for a function" are not found in the standards.
- *Trapezoid* is defined here as a quadrilateral with exactly one pair of parallel sides. This is known as the *exclusive* definition. The *inclusive* definition, in contrast, defines a trapezoid to be a quadrilateral with at least one pair of parallel sides. The Progressions Documents helps to clarify this issue (http://commoncoretools.me/wp-content/uploads/2014/12/ccss_progression_gk6_2014_12_27.pdf, p.3):

  > Note that in the U.S., that the term "trapezoid" may have two different meanings. In their study *The Classification of Quadrilaterals* (Information Age Publishing, 2008), Usiskin et al. call these the exclusive and inclusive definitions:
  >
  > T(E): a trapezoid is a quadrilateral with exactly one pair of parallel sides.
  >
  > T(I): a trapezoid is a quadrilateral with at least one pair of parallel sides.
  >
  > These different meanings result in different classifications at the analytic level. According to T(E), a parallelogram is not a trapezoid; according to T(I), a parallelogram is a trapezoid.

> Both definitions are legitimate. However, Usiskin et al. conclude, “The preponderance of advantages to the inclusive definition of trapezoid has caused all the articles we could find on the subject, and most college-bound geometry books, to favor the inclusive definition.”

In addition to the above issues indicating a lack of clarity, Arizona might also consider the opportunity to add clarity based on research. Recent research from Pat Thompson and Marilyn Carlson, mathematics faculty at Arizona State University, has served to increase knowledge of how students think about functions. There is now clear evidence that the development of covariational reasoning is foundational to having a profound understanding of functions. Covariational reasoning, while not contradicted in the ADSM and CCSS, is not explicit in either set of standards. Arizona State University Professors Pat Thompson and Marilyn Carlson[13] have summarized the research on covariation and explained how it fits with the CCSS. They point out that while covariation is evident in the example of CCSS 6.EE.9 (this example was removed from this draft of the ADSM), and in the introduction to Grade 8, the connections to covariation need to be much clearer:

> From the perspective of a mathematician or a mathematics education researcher, it is easy to see covariation in such statements. However, research tells us that students and teachers typically do not. (p.61)

The original authors of the CCSS, they claim, did “not convey to readers a coherent picture of the robust practice of variational and covariational reasoning about quantities.” (p. 60) Arizona is uniquely positioned to address this issue in the next draft of the standards.

Specificity

Quality standards are precise and provide sufficient detail to convey the level of performance expected without being overly prescriptive. Those that maintain a relatively consistent level of precision are easier to understand and use. Those that are overly broad or vague leave too much open to interpretation, while atomistic standards encourage a checklist approach to teaching and learning.

The ADSM are generally specific and are not overly broad or vague. There are a few potential issues of specificity to consider. For example:

- To imply a closed interval, the ADSM have changed every limiting statement in Grades K–3, from, for example, “within 100” to “through 100.” It is not clear that this actually improves specificity in all cases. See comments for the following alignments: K.OA.2, K.OA.5, 1.OA.1, 1.OA.6, 1.NBT.4, 2.OA.1, 2.OA.2, 2.NBT.5, 2.NBT.7, 2.MD.5, 2.MD.6, 3.OA.3, 3.OA.7, and 3.NBT.2.

CCSS	ADSM	Comments

[13] Thompson, P. W., & Carlson, M. P. (in press). Variation, covariation, and functions: Foundational ways of thinking mathematically. In J. Cai (Ed.), *Compendium for research in mathematics education*. Reston, VA: National Council of Teachers of Mathematics. Retrieved September 23, 2016 from http://www.pat-thompson.net/Publications.html.

1.NBT.4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.	1.NBT.C.4 Add through 100 using models and/or strategies based on place value, properties of operations, and the relationship between addition and subtraction.	AZ replaced "within" with "through" to imply a closed interval. It is not clear whether "add through 100" means that the sum cannot be more than 100 or that any two 2-digit numbers are fair game. Would the sum, 78 + 54 be included in the AZ translation? If so, the requirements are different from the CCSS counterpart.
3.OA.2. Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.*	3.OA.A.2 Interpret quotients of whole numbers by: •determining the number of objects in each share when a total number of objects are partitioned into a given number of equal shares. •determining the number of shares when the total number of objects and the size of each share is given. Describe a context in which division can be used to find the numbers of objects in each share or the number of shares. (See Table 2)	AZ does not specify if the quotients are also whole numbers.
6.NS.7d Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.*	d. Distinguish comparisons of absolute value from statements about order, especially when considering values in context.	The word "especially" in a standard is awkward. If the intent is that students be able to work with the comparisons both in and out of context, it should be clearly stated.
8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two dimensions and three dimensions (in regards to slant height).	The inclusion of the parenthetical statement, "(in regard[s] to slant height)," lacks specificity. Are the three-dimensional applications limited to slant height?

Measurability

Standards should focus on results rather than the processes of teaching and learning. They should make use of performance verbs that call for students to demonstrate knowledge and skills, with each standard being measurable, observable, or verifiable in some way.

The ADSM reflect a comparable level of measurability to that of the CCSS with a few exceptions. One exception is that the requirement to “recognize,” “find,” “describe,” or operations such as “add, subtract, multiply, and/or divide” in the CCSS for Grades 2, 3, 4, 5, 6, and 8 were frequently changed in the ASDM to another verb, most often “understand” or “demonstrate understanding.” The effect of this was often an increase in rigor while at the same time possibly making the AZ standard more difficult to measure. Overall there are more standards in the ADSM with “understanding” as the requirement than in the CCSS. For specific examples see commentary for the following: 2.NBT.5, 2.NBT.7, 2.MD.2, 2.G.1, 3.NBT.2, 3.NF.2b, 3.NF.3b, 3.NF.3c, 3.NF.3d, 3.MD.5, 3.MD.7d, the header for 3.MD.8, 4.OA.4, 4.NBT.1, 4.NBT.5, 4.NBT.6, 4.NF.1, 4.NF.2, 4.NF.7, 4.MD.5, 4.MD.7, 4.G.2, 4.G.3, 5.MD.5c, 6.NS.4, 8.EE.1, and 8.G.9.

Here a few of these examples with comments:

CCSS Standard	ADSM	Issue
3.NF.3c Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.*	c. Express whole numbers as fractions, and understand fractions that are equivalent to whole numbers.	The AZ decision to replace the verb "recognize" with "understand" in the AZ standards sometimes causes reduced clarity and sometimes increases the rigor. In this case it is less correct/clear to say, "understand fractions that are equivalent to whole numbers." Here using "recognize" is more accurate, more measurable, and more clear.
6.NS.4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 (9 + 2).*	6.NS.B.4 Understand the greatest common factor, understand the least common multiple, and use the distributive property. a. Find the greatest common factor of two whole numbers less than or equal to 100. b. Find the least common multiple of two whole numbers less than or equal to 12. c. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor.	AZ split this CCSS into four parts, the stem and three sub-parts, and removed the example. The change from "find" to "understand" in the AZ stem for this standard represents an increase in rigor but is more difficult to measure. The sub-parts for this AZ standard return to the more easily measured performances of "find" and "use."

Appendix A: The Criteria Used for the Evaluation of College- and Career-Ready Standards in English Language Arts and Mathematics

Criteria	Description
Rigor: What is the intellectual demand of the standards?	Rigor is the quintessential hallmark of exemplary standards. It is the measure of how closely a set of standards represents the content and cognitive demand necessary for students to succeed in credit-bearing college courses without remediation and in entry-level, quality, high- growth jobs. For Achieve's purposes, the Common Core State Standards represent the appropriate threshold of rigor.
Coherence: Do the standards convey a unified vision of the discipline, do they establish connections among the major areas of study, and do they show a meaningful progression of content across the grades?	The way in which a state's college- and career-ready standards are categorized and broken out into supporting strands should reflect a coherent structure of the discipline and/or reveal significant relationships among the strands and how the study of one complements the study of another. If college- and career-ready standards suggest a progression, that progression should be meaningful and appropriate across the grades or grade spans.
Focus: Have choices been made about what is most important for students to learn, and is the amount of content manageable?	High-quality standards establish priorities about the concepts and skills that should be acquired by graduation from high school. Choices should be based on the knowledge and skills essential for students to succeed in postsecondary education and the world of work. For example, in mathematics, choices should exhibit an appropriate balance of conceptual understanding, procedural knowledge, and problem-solving skills, with an emphasis on application. In English language arts, standards should reflect an appropriate balance between literature and other important areas, such as informational text, oral communication, logic, and research. A sharpened focus also helps ensure that the cumulative knowledge and skills that students are expected to learn are manageable.
Specificity: Are the standards specific enough to convey the level of performance expected of students?	Quality standards are precise and provide sufficient detail to convey the level of performance expected without being overly prescriptive. Standards that maintain a relatively consistent level of precision ("grain size") are easier to understand and use. Those standards that are overly broad or vague leave too much open to interpretation, increasing the likelihood that students will be held to different levels of performance, while atomistic standards encourage a checklist approach to teaching and learning that undermines students' overall understanding of the discipline. Also, standards that contain multiple expectations may be hard to translate into specific performances.
Clarity/Accessibility: Are the standards clearly written and presented in an error-free, legible, easy-to-use format that is accessible to the general public?	Clarity requires more than just plain and jargon-free prose that is also free of errors. College- and career-ready standards also must be communicated in language that can gain widespread acceptance not only from postsecondary faculty but also from employers, teachers, parents, school boards, legislators, and others who have a stake in schooling. A straightforward, functional format facilitates user access.
Measurability: Is each standard measurable, observable, or verifiable in some way?	In general, standards should focus on results rather than the processes of teaching and learning. College- and career-ready standards should make use of performance verbs that call for students to demonstrate knowledge and skills and should avoid using those verbs that refer to learning activities — such as "examine," "investigate," and "explore" — or to cognitive processes, such as "appreciate."

Achieve Match Rating	Explanation
0	No changes
1	Very close match or the revision strengthens the standard or makes it clearer
2	Partial match: there is a noticeable change, and the change may have made its interpretation more difficult for the user (e.g., an important example has been cut).
3	Partial match: the revision weakens the standard, and important content may have been lost.
4	No match: ELA10 has a standard, but AZ has eliminated it, and the elimination of the standard is a weakness.
5	No match: AZ eliminated a CCSS, but the elimination does not weaken the suite of standards.
6	No match: AZ has added a standard that does not have a match in the CCSS, and the addition is a strength (e.g., cursive writing, foundational writing).
7	No Match: AZ has expectation, and Achieve cautions against it (because it is confusing, unnecessary, unmeasurable, or otherwise problematic).
8	No Match: AZ has expectation which does not appear in CCSS; Achieve sees this as neither a strength nor a weakness.

Appendix B: Draft ELA16 Standards Glossary with Reviewer Comments

Word	Definition	Comment
Aesthetic	The use of language as an artistic medium to create imagery that evokes sensory perception and is concerned with emotion, sensation, and a sense of beauty. Can be used in both literary and non-fiction texts.	This definition moves beyond the scope of the word. Does aesthetic refer to any emotion or sensation? Aesthetic deals with beauty.
Argument: claim	An assertion in the face of possible contradiction. A debatable claim or thesis is an essential element of argument	Is "thesis" intended to be synonymous with claim? Usually thesis is connected with explanatory or informational writing. Here, the definition of claim is defined by using the word "claim," creating confusion.
Cite	(verb) To quote (a passage, book, or author) as evidence for or justification of an argument or statement, especially in a scholarly work	This definition may be too limiting: should a student not also cite pictures, charts, or graphics?
Citation	(noun) A quotation from or reference to a book, paper, or author, especially in a scholarly work	This definition is too limiting—what about paraphrases that need citations as well?
Evidence	Facts, figures, details, quotations, or other sources of data and information that provide support for claims and can be evaluated by others. Different disciplines use and value different types of evidence according to the task, purpose, and audience of the text	Claims are defined as a part of argumentation. This definition may unintentionally leave out informative/explanatory texts that also use evidence, but do not have a claim.
Examples (e.g./i.e)	The abbreviation i.e. is short for the Latin phrase *id est,* meaning "that is." When used in Arizona's English Language Arts Standards, the examples following i.e. are for further clarification or explanation.	Suggest dropping the words "the examples," as they are confusing in this definition. Additionally, this definition is lacking in specificity—what follows an i.e. is the definition, and thus required.
Informational text	A broad category of nonfiction resources, including: Biographies; autobiographies; books about history, social studies, science, and the arts; functional texts; technical texts (including how-to books and procedural books); and literary nonfiction.	"Books" is too limiting in this definition, as there are other types of informational texts that do not appear in book format, like newspaper articles. Consider referencing the CCSS definition at grades 6–12 which includes essays, speeches, opinion pieces, journalism, etc.

Medium	A particular form or system of communication	It is unclear what is meant by "A particular form." Does artistic medium fit here? The language is not precise enough to be meaningful for educators to use. This is a definition that would benefit from some examples.
Narrative writing	Narrative writing conveys experience, either real or imaginary, and uses time as its foundational structure. It can be used for many purposes, such as to inform, instruct, persuade, or entertain. It is often blended with other types of writing, such as informational or argumentative	It is possible to tell a narrative that does not use time as its foundational structure—Baldwin's "Go Tell it on the Mountain" uses character development and characterization as the main structure, and while time in Beloved and the Bluest eye by Morrison is important, it is argued that time is not the primary structure—those are also driven my characters and/or stream of consciousness. Consider altering the definition so that "foundational" is not the descriptor for time.
Print or digital sources	Interchangeable terms to express the format in which text or visual information is presented	Print or digital are not interchangeable terms. They are both terms used to express the format.
Recount	The oral presentation of essential elements aligned with the sequence of a story's events.	These definitions are very similar except that retelling requires memorization and recounting does not. What is the difference between "essential elements" and "essential details?" That is not clear form the definitions. Additionally, the definition of retell isn't completely accurate. The CCSS intended for retelling to be oral and more informational and recounting can be oral or written and more formal. It is suggested that these definitions be tightened and additional reference material on the definitions consulted.
Retell	The oral presentation of essential details of a story that a student recalls from memory.	
Rhetorical situation	The context of a rhetorical construct which consists (at a minimum) a rhetor(the author), an issue, a medium, and an audience	This definition has issues of clarity and specificity. It is unclear what this definition is intended to mean.
Text complexity	Quantitative measures refer to those aspects of text complexity such as word length or frequency, sentence length, and text cohesion that are difficult for a human reader to evaluate efficiently….	The definition needs additional material defining appropriate ranges for grade bands.
	Text difficulty is determined by the reader. What might be difficult for one person might not be difficult for another. Teachers need to consider textual features that could present challenges for a variety of students and approach the text accordingly with appropriate scaffolds and support.	It is confusing why text difficulty is included with text complexity. How is text difficult measured and accounted for? It is recommended that text difficulty be included on its own line, separate from text complexity
Text	A source of information, print or non-print, that provides meaning to the reader. Text may be read, viewed, or heard.	It is strongly suggested that examples are included with this definition.
Tier two words	General academic words that are for more likely to appear in written texts than in speech, often representing	Tier two words can be challenging for educators to understand without appropriate professional learning. However, as most assessments will place a premium on these words, it is highly recommended that there are

	subtle or precise ways to say relatively simple things—saunter instead of walk, for example.	examples in the definitions of all word tiers so teachers can immediately see some of the differences.