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THE STATE OF THE SUNSHINE STATE STANDARDS:

Florida's B.E.S.T. Edition

By Solomon Friedberg,
Tim Shanahan, Francis (Skip) Fennell,
Douglas Fisher, and Roger Howe

Foreword by Amber M. Northern
and Michael J. Petrilli

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Foreword

By Amber M. Northern and Michael J. Petrilli

It's no secret that the Common Core State Standards ushered in much higher-quality academic expectations for K–12 students across the nation. It's also no secret that their arrival in 2010 unleashed a national melee that is still, a decade later, playing out in political theatre at the state and local levels. Arguably, nowhere is that drama more visible than in the Sunshine State, where Governor Ron DeSantis, who had campaigned on eradicating the standards, issued an executive order upon taking office to "eliminate the Common Core from Florida schools."

Following this announcement, the Florida Department of Education pressed the pedal to the metal. Within one year, new standards would be drafted, shared with stakeholders, presented at public hearings, revised several times, and presented to the State Board for approval. It was a very tall order on an accelerated timeline but, by all accounts, the Department approached it with the seriousness and sweat equity that such a challenge demanded. After all, Florida has long been viewed as a pioneering education-reform state that had produced historically high growth for Hispanic students and (more recently) outsize gains for fourth graders, who outperformed the national average in reading and math. The stakes were high.

In mid-February, almost right on schedule, the state unveiled the Florida's B.E.S.T. (Benchmarks for Excellent Student Thinking) Standards in English language arts (ELA) and mathematics. Governor DeSantis boasted that "Florida has officially eliminated Common Core. I truly think this is a great next step for students, teachers, and parents...Florida's B.E.S.T. Standards were made by Florida teachers for Florida students, and I know they will be a model for the rest of the nation."

That last part got our attention; we at Fordham have long supported model standards that could be emulated and adopted by states nationwide. Heck, that's why we were such big supporters of Common Core in the first place—once we reviewed it and found the standards worthy of emulation and adoption. When policymakers contend that their standards deserve to be replicated, especially when those policymakers lead big, highly regarded states like Florida, we think their claims merit a closer look.

Hence this report.

As many know, the Thomas B. Fordham Institute has been evaluating state academic standards since the late 1990s. Typically, we allow five to ten years to pass between reviews of particular subjects, depending on state activity and interest. Our most recent review of ELA and mathematics standards, *The State of State Standards Post-Common Core*, was published in August 2018. Ordinarily, that means we would wait several more years before again examining standards in these two core subjects.

But this was a special case. In fact, as the news of Florida's elimination and replacement of Common Core spread, other states became even more interested in how it had gone about this and what it had come up with. That reinforced our sense that an off-cycle, one-off review of the Sunshine State's new standards was in order.

It was important, however, to use the same expert reviewers and criteria that we'd used in our 2018 report so that we'd have an apple-to-apples comparison with our most recent multistate reviews. Had Florida chosen to adopt its B.E.S.T. Standards a couple of years earlier, they would have been reviewed in that cycle.

Once the Florida B.E.S.T. Standards were released, we asked our expert reviewers to evaluate them. The mathematics team was led by Solomon Friedberg of Boston College, and the ELA team was led by Tim Shanahan of the University of Illinois at Chicago. They were ably assisted by several other reviewers, including Francis (Skip) Fennell of McDaniel College and Roger Howe of Yale and Texas A&M for mathematics and Douglas Fisher of San Diego State University for ELA. See *Appendix B* for their full bios.

Each team used the criteria they had developed for the 2018 report (see *Appendix C* for the entire ELA criteria and *Appendix D* for the entire math criteria, respectively). They also used the same scoring system and format.

You'll find both teams' detailed evaluations in the pages that follow, and we encourage you to read them in their entirety. That said, the bottom line is that each team, working independently, awarded the B.E.S.T. Standards for ELA and math a score of six out of ten, which equates to "weak." By our scoring rubric (see Appendix Tables C-1 and D-1), that means reviewers recommend "significant and immediate revisions" and that the Florida's "standards are not suitable until and unless these revisions occur."

Our reviewers find several key strengths but also many weaknesses.

On ELA, major strengths include reasonably clear learning progressions for several components of the subject that put the focus on college and career readiness; effective development of the ability to read and interpret literary and informational texts in grades K–12; and clear definitions and expectations relating to the reading and understanding of complex texts, including useful examples of what constitutes appropriate texts and lots of well-chosen sample texts for possible use in teaching particular reading standards.

In several other respects, however, Florida's new ELA standards either fail to address important aspects of the subject or do so in such general and repetitive ways as to be of little value. For instance, the B.E.S.T. Standards ignore disciplinary literacy (the specialized ability to read history, science, or technical materials in appropriate and sophisticated ways). And although they require

that students learn to make formal oral presentations and use technological or multimedia supports in doing so, the development of listening abilities and participation in discussions is absent altogether, as are any standards for the interpretation of multimedia information.

When it comes to individual standards that were fully developed, reviewers generally liked what they saw. But often, that's not what they found, prompting them to say that the "job is unfinished." During Florida's rushed schedule for standards development, is it possible that the writers simply ran out of time?

With respect to math, our reviewers praise the detailed, topic-by-topic treatment of the subject. In the standards for both the elementary and middle grades, they think the amount of time devoted to major content strands is generally appropriate. The standards rightly emphasize numbers and operations in the early grades; ratio, proportion, and linearity in the middle grades; and algebra and geometry in high school. Data and probability are also properly developed.

The big problem in math is that conceptual understanding is sacrificed on the altar of procedural fluency. High-quality standards should strive for a balance across conceptual understanding, procedural fluency, and application. Although Florida's math standards reference conceptual understanding, its discussion serves primarily as prelude to the goal of procedural fluency. Indeed, the vast majority of the benchmarks about topics in arithmetic are procedural. Yet conceptual understanding in mathematics is as critical as procedural fluency, as it lays the groundwork for one's ability to use math, to reason, and to handle new mathematical situations.

We're in no way dismissing the necessity of procedural fluency. Many of the pre-2010 state standards in mathematics were weak on that front, with some going so far as to allow students to use calculators in the early grades. So we applaud Florida's clear expectation that students will use basic arithmetic facts and algorithms with "automaticity." Yet there's such a thing as going too far and thereby downplaying conceptual understanding to the extent that students will lack the capacity to transfer what they are able to do into other contexts.

On top of that, reviewers spotted many technical and language errors throughout the math standards—so many that we chose not to itemize them all in the review (but will make them available to interested readers).

Florida's total score of six breaks down—in each of the two subjects—to the sum scores of four out of seven for content and rigor and two out of three for clarity and specificity. How do those scores line up with those for other states and the Common Core in our 2018 review (again, using the same reviewers and criteria)?

Table 1. State standards ratings: English language arts				
	Content & rigor (out of 7)	Clarity & specificity (out of 3)	Total score (out of 10)	Overall rating
Common Core ELA	6	3	9	Strong
Indiana	6	2	8	Good
Kansas	6	1	7	Good
New York	5	2	7	Good
North Carolina	5	2	7	Good
Oklahoma	4	3	7	Good
Pennsylvania	4	3	7	Good
West Virginia	5	2	7	Good
Arizona	4	2	6	Weak
FLORIDA	**4**	**2**	**6**	**WEAK**
South Carolina	4	2	6	Weak
Texas	5	1	6	Weak
Nebraska	3	2	5	Weak
Tennessee	4	1	5	Weak
Missouri	3	1	4	Inadequate
Virginia	2	2	4	Inadequate

Per Table 1, it puts the Florida ELA standards on par with those in Arizona, South Carolina, and Texas. Still, of the fourteen states we last reviewed in ELA, half fared better, including Indiana, Kansas, New York, North Carolina, Oklahoma, Pennsylvania, and West Virginia. And yes, the original Common Core standards fared better, too.

Table 2. State standards ratings: Mathematics				
	Content & rigor* (out of 7)	Clarity & specificity (out of 3)	Total score (out of 10)	Overall rating
Common Core math	7	2	9	Strong
Texas	7	2	9	Strong
Indiana	5	2	7	Good
Tennessee	5	2	7	Good
Virginia	4	3	7	Good
FLORIDA	**4**	**2**	**6**	**WEAK**
Minnesota	4	2	6	Weak
North Carolina	5	1	6	Weak
Missouri	4	1	5	Weak
Nebraska	3	2	5	Weak
Oklahoma	3	2	5	Weak
Pennsylvania	3	1	4	Inadequate

Referred to more broadly as Content and Communication in the mathematics review.

Per Table 2, we find Florida's new math standards on par with those in Minnesota and North Carolina. But, again, several states fared better, including Texas, Indiana, Tennessee, and Virginia. Ditto the Common Core.

Before COVID-19 hit, Florida was moving ahead aggressively to adopt instructional materials in ELA and prepare professional development for teachers in both subjects in 2020-2021. It is unclear (to us at least) how that timeline is now impacted. Still, it's evident that the state is serious—and not likely to go back to the drawing board anytime soon. Developing standards is extremely difficult, not to mention exhausting—especially under the gun of an expedited timeline so that a new governor can make good on a campaign promise.

We empathize, then, with what the standards writers had to do. But we won't empathize with policymakers who decline to make needed improvements to the standards on the grounds that they're now "finished." If our ELA review is any indication, that's not the right word to describe them. And if our math review is any indication, there are loads of fixes that ought to be made.

As for other states, they should indeed look for model standards, but they won't find them in Florida. Look instead to Indiana (for ELA) or Texas (for math) or to smart improvements that Massachusetts and California made several years ago to the Common Core.

At Fordham, we'll likely wait a few years to review state ELA and math standards again, but Floridians shouldn't wait that long to improve what they've recently been given.

Review of the Florida's B.E.S.T. English Language Arts Standards

Document reviewed:
Florida's B.E.S.T. (Benchmarks for Excellent Student Thinking) Standards: English Language Arts

Overall rating:
Content and rigor: **4/7**
Clarity and specificity: **2/3**
Total: **6/10** (weak). Recommend significant and immediate revisions. Standards are not suitable until and unless these revisions occur.

Overview

The Florida Benchmarks for Excellent Student Thinking (B.E.S.T.) Standards for English language arts (ELA) are generally coherent and rigorous. Major strengths include clear definitions and expectations relative to teaching students to read complex texts, including useful examples of what constitutes appropriate texts and reasonably clear "learning progressions" for foundational skills and for the comprehension/analysis/interpretation of reading and writing that, if accomplished, should assure college and career readiness in these abilities by the time students complete high school.

Basically, the Florida standards require that students meet appropriate intellectual demands, emphasize appropriate learning priorities, are sufficiently specific to guide practice, and are clear, accessible, and measurable. **Nevertheless, the standards either fail to address important aspects of ELA or address key priorities so generally or repetitively as to be of little value.** For instance, the standards require that Florida students learn to make formal oral presentations and to use technological or multimedia supports in doing so, but the development of listening abilities or of the ability to take part in discussions are omitted altogether, as are any standards for the interpretation of multimedia information. Likewise, the Florida standards ignore disciplinary literacy (e.g., the unique or specialized abilities to read history, science, or technical materials in appropriate and sophisticated ways).

When the standards are fully developed, they are quite good—as rigorous and coherent as any. Yet it is evident that in several sections, the job is unfinished. A more fully realized set of standards would provide a better educational pathway for Florida's students. As it stands, these standards are markedly incomplete.

General organization

The Florida B.E.S.T. Standards for ELA are organized into four strands: foundations, reading, communication, and vocabulary. Each of these strands is further divided into additional categories. For instance, the reading strand includes reading prose and poetry, reading informational text, and reading across genres. Furthermore, the standards contain clarifications, designed to help educators understand the language of the standard and provide additional detail not included in the standard.

Content and rigor

Strengths

The Florida B.E.S.T. Standards have notable content strengths. First, they make clear that college and career readiness is a fundamental goal of education. **One innovation is to present standards progressions for each component area within ELA.** Thus, in the section Reading Prose and Poetry: Literary Elements, there is a list of all the standards that emphasize the interpretation of literary elements from Kindergarten through grade 12, allowing users to see all that students are to learn about literary elements for reading and how this knowledge and ability develops over time. Importantly, and uniquely, these lists of progressions go from grade 12 to Kindergarten, not the reverse; hence, the approach starts with the ultimate goal and then works backward through the grades to show how to get there.

Second, the standards do a fine job of emphasizing the development of the ability to read and interpret literary and informational texts in grades K–12. These reading standards are divided into three sets: one aimed at the reading of literary prose and poetry, one at the reading of informational texts, and a third at reading across genres (either addressing abilities that are evident in both literary and informational reading or comparative reading that may involve more than a single genre). Each set addresses multiple topics; thus, the set on reading prose and poetry includes learning progressions for literary elements, theme, perspectives and point of view, and poetry. The poetry progression is particularly specific and well developed. Likewise, reading of informational texts emphasizes text structure, the central idea, the author' purpose and perspective, and argument. Moreover, the front matter provides a unifying explanation of reading development and the important role that a reader's knowledge plays in reading comprehension.

Third, the Florida B.E.S.T. Standards establish clear guidelines regarding the level of text complexity that students are expected to be able to handle at each grade level. The standards state that students are required to learn to read "grade-level texts" (and instructional suggestions also prompt educators to encourage students to "wrestle with" texts at a higher grade level when they deem it appropriate). **The oft-repeated general statement that students must learn to read grade-level texts is bolstered by specific and up-to-date information concerning quantitative and qualitative expectations of reading performance across the grades.** The standards also include

sample lists of both literature and civics texts that are either required readings or examples of the types of texts that students should be working with in their ELA curricula (more below).

Fourth, **the standards do a good job of emphasizing the teaching of foundational skills in reading and writing,** though at times they perseverate on these a bit beyond what research may suggest is useful. Students are required to develop specific print awareness, phonological awareness, phonics/decoding, oral reading fluency, and handwriting skills. These skills are described specifically and, for the most part, thoroughly (though it might be useful to provide a complete list of the decoding skills to be learned in an appendix), and specific evaluation tools are provided so that teachers should be able to monitor their students' progress toward the standards (for example, Appendix E provides words lists, oral reading fluency norms and evaluation rubrics, and secondary-learner profiles). The inclusion of handwriting and phonics standards all the way through the elementary grades may be overdoing it a bit (research doesn't support either of these for nonremedial instruction), but there is no question that such skills are valuable and should be taught.

Weaknesses

Although many content strengths are evident in the Florida standards, there are also important omissions and several areas that could be improved.

First, **the standards fail to include any disciplinary literacy requirements.** Research has shown that reading and writing in science, mathematics, history, and literature are unique or highly specialized in their purposes, skills or strategies, linguistic demands, text formatting, and other features. Accordingly, college- and career-ready students must be able to do more than exhibit the general reading skills enumerated in the Florida standards. Although these standards provide a reasonable delineation of literary reading (particularly with regard to poetry) and of general informational text reading, they omit entirely the idea of developing any of the specialized reading skills for dealing with texts in science, mathematics, and history or of any of their subspecialties such as biology or geography. **The theory underlying these standards seems to be that readers should be able to make sense of any kind of text equally well, ignoring the burgeoning research showing important differences across disciplines.** These standards do not aspire to train students to read like historians, scientists, mathematicians, or literacy critics. For instance, students are taught to identify an author's evidence in grade 2 (ELA.2.R.2.4, "Explain an author's opinions and supporting evidence"), but at no grade level are they taught to recognize what constitutes acceptable evidentiary support in the various disciplines.

On the plus side, the standards require or suggest (the verbiage is unclear) the reading of K–12 sample lists of literary texts and texts with a civics emphasis—an innovative inclusion—but then fail to provide any kinds of learning goals that would enable students to engage successfully in the specialized demands of such reading. Though the thoroughness of the civics recommendations is

refreshing, this serves to highlight the lack of attention to scientific texts or texts drawn from the other humanities.

Second, in other ways as well, the Florida standards often seem to provide an incomplete vision of the ELA. For instance, in keeping with the strong K–12 progression for this standard, students are expected to know how to make formal presentations, and the standards do include specific rubrics for evaluating presentation skills. But other aspects of oral language development are totally ignored or omitted at all grade levels. Thus, Florida students will be expected to make oral presentations but not to develop the skills to contribute to a conversation, discussion, or debate. **Even more puzzling is the omission of any standards for the ability to listen effectively or critically.** Similar omissions riddle these standards: Students will certainly learn to comprehend what they read, but any kind of critical or evaluative analysis of what they read is barely apparent (there is a bit of this under reading arguments, but—of course—readers need to be able to read other kinds of texts critically, as well). Unlike for reading and speaking, the standards provide no guidance as to how to determine whether students are meeting the writing standards.

Likewise, in some cases, it appears that the standards include placeholders rather than actual progressions of learning and development. For example, students are to learn to conduct research, but the list of research skills shows little change from grade to grade, and unlike the reading and writing standards, the research standards lack specificity. The same can be said for the use of multimedia. Florida students are to know how to use multimedia and other technological resources to support or extend their oral and written presentations (and that is beneficial), but **there are no comparable standards requiring that they be able to interpret multimedia, digital, or technology-based information,** either as a reader or a listener. Students will be taught to use content and morphology to make sense of word meanings, and there is a good deal of specific information supporting teachers in accomplishing this goal. However, nowhere do we find the requirement that students learn to use references (such as dictionaries or thesauruses) to figure out word meanings in the elementary grades or more specialized kinds of references (such as science dictionaries or atlases) in the upper grades.

More apparent examples of incompleteness are the six learning "expectations" presented for all students, no matter their grade level. For example, students are to "cite evidence to explain and justify reasoning." Although this is a reasonable requirement, one wonders why it is not presented with any of the grade-level adjustments evident for the other standards. What is acceptable in the use of evidence for a first grader should not pass for a high schooler.

Even in the standards that appear to be fully realized (with differing, specific requirements at each grade level), weaknesses appear in the progressions, with artificial demarcations of content. For example, grade 3 students are to learn how to negotiate chronology, comparison, and cause/effect text structures, while grade 4 students will learn problem/solution, sequence, and descriptions. This sequence has a basis neither in research nor in common sense; description is likely the easiest of

these, so why would it be mastered later in the sequence? There is a similarly questionable progression evident with figurative language, and often particular abilities are included in multiple grade levels (students in grades 6–12 all are aimed at the same standards for paraphrasing and summarizing, and students in grades 3–7 all have the same writing expectations). **Such flawed or nonexistent progressions make it look as if the standards developers simply ran out of time** and tried to make their work appear complete either by arbitrarily (and somewhat randomly) dividing standards among grade levels or simply fleshing out the progressions by repeating certain standards over and over again.

The standards claim that the "reading and writing standards have been written in such a way that they progress together and students are able to use the texts they are reading as accompanying texts for their writing." This is a worthy ambition, given the relationships between reading and writing that research has identified, but it is not accomplished satisfactorily, despite the rhetoric. The connections between the standards fail to provide any kind of equivalent or parallel emphasis on particular skills or text features. For instance, students are to be taught to identify central ideas through the reading of texts, but the communication of central ideas through writing is not a goal. One exception is in the nature of reading and writing arguments, which are more closely allied. For example, ELA.5.R.2.4 requires that fifth-grade students learn to "track the development of an argument, identifying the specific claim(s), evidence, and reasoning," and ELA.5.C.1.3 states that students should be taught to "write to make a claim supporting a perspective with logical reasons, relevant evidence from sources, elaboration, and an organizational structure with varied transitions." However, as is evident in these examples, even these connections could be made more explicit.

One innovation in the Florida standards is the inclusion of a series of tables throughout that show that sample texts could or should be used to teach particular reading standards. The idea that these are also the ideal texts to serve as models for students' writing work is encouraging, yet none of the tables reference any connections between the texts and the writing standards.

Clarity and specificity

Strengths

In many ways, the Florida standards are reasonably clear, specific, and well organized, though there are some important flaws in their presentation that will be described in the next section. Nevertheless, the overall organization of the standards contributes to their comprehensibility both within and across grades, and the front and back matter provide useful information that should help educators and parents to understand and use the standards appropriately. Major content omissions aside, the standards that are presented are accessible, with minimal jargon. **The backwards presentation of the standards in progressions that start with the twelfth-grade goals and then work back to Kindergarten is both innovative and effective.** The various supporting documents, tables, and charts provide a plethora of useful information that should buttress the standards and aid

in their interpretation, including norms for evaluating oral reading fluency, quantitative readability standards for determining the grade appropriateness of text, a qualitative text analysis guide, text exemplars, oral presentation evaluation rubrics, and so on. Throughout the standards document, there are "clarifications" that should help teachers address them successfully in their instruction.

Weaknesses

Despite these strengths, the Florida ELA standards also evidence some disturbing flaws in clarity and specificity. Often, the standards present information about the instructional means that teachers are to use to accomplish learning rather than what it is that the students are supposed to learn. Specifically, **the writing standards sometimes emphasize writing processes or instructional activities rather than measurable learning outcomes.** For example, third-grade standard ELA.3.C.1.5 reads, "Improve writing as needed by planning, revising, and editing with guidance and support from adults and feedback from peers." Similarly, the standards on technology in communication sometimes specify activities but not outcomes (for instance, ELA.3.C.5.2 states, "Use digital writing tools individually or collaboratively to plan, draft, and revise writing").

The standards document is difficult to follow at times because of the amount of instructional guidance it provides. **Instead of focusing on presenting educational standards clearly so that teachers and parents will have an unambiguous understanding of what students are to learn, it often devolves into how teachers should present the material.** This information, if needed at all, would be better placed in an appendix or separate document altogether. Take, for example, the fourth-grade standards on pages 60–68. On the first page, there is an introductory quote from Dr. Seuss, a paragraph describing how fourth-grade ELA differs from the earlier grades, and two standards, each accompanied by a paragraph clarifying what the standard says. On the following pages, each standard is accompanied by additional clarifying statements, some of these directing readers to other parts of the guide for explanatory information about concepts presented and others providing quite specific instructional and assessment advice (such as how to teach a specific standard to a child with a speech impediment). Finally, there are three pages of advice (or perhaps requirements[1]) on which standards are to be taught with which books drawn from the sample text lists. With this much extraneous instructional information, it can be difficult to follow the standards presentation at all.

This lack of clarity carries over to the sample lists of literary classics and civics-oriented texts, both fine lists comprising excellent reading material. **However, the functional purposes of these lists are not clear** (though the documents state that both should build students' "background knowledge"). One functional possibility is that these books are required reading for students in Florida, and the other is that the lists are only meant to provide examples aimed at illustrating the quality, complexity, and content of texts that students are expected to learn to read at the various

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[1] The standards document is unclear as to whether this instructional information is meant to be helpful guidance or required practices that all classroom teachers are expected to adopt.

grade levels (such lists of text examples are common in the standards of many states, but no other state has established a required-reading list of this kind in literature or any other subject).

Adding to the confusion, the standards refer to the civics-focused texts as "*the* source" (emphasis added) of building background knowledge and vocabulary "designed to reinforce civics instruction by providing quality texts" (page 168). The "sample book list" is supposed to serve as a "guide for teachers, curriculum developers, and test makers as they prepare their instructional units and materials for Florida students" and is "not intended to be exhaustive but to serve as a foundation" (page 151). If the texts are to serve as a guide for *test makers*, it is not hard to see why teachers might view them as required.

If they are required, they represent excellent choices, but they are also breathtakingly ambitious and probably not very realistic.[2] High standards are valuable, but they must also be attainable. That it is impossible to determine the educational requirements in Florida helps illustrate the clarity problems inherent in this document.

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[2] For example, eleventh graders would be expected to read Dante's *Inferno*, *Jane Eyre*, *The Confessions of St. Augustine* (including the details of his sexual dalliances), Emerson's *Nature*, Thucydides's *History of the Peloponnesian Wars, Book IV*, the Federalist Papers, *The Dreamer*, *Walden*, Locke's *Two Treatises on Government*, and Montesquieu's *The Spirit of Laws*, along with more than twenty shorter works (poems, plays, and parts of books). Such a requirement would require students to master about twenty-five pages per day, every school day, all year long of such challenging material.

Recommendations

1. Add disciplinary literacy standards aimed at grades 6–12 to ensure that students learn to engage successfully in the specialized reading demands of history, science, and mathematics and their subdisciplines.
2. Add fully realized oral language standards, including listening standards, and expand the speaking standards to include a wider array of presentation skills, including discussion and debate.
3. Add standards for critical or evaluative reading to supplement the reading-comprehension standards already included. It is essential that students be able to critically analyze information and misinformation, rather than just understanding it.
4. Add standards aimed at fostering students' ability to make sense of multimedia, digital information, and technology-based information.
5. Provide guidance as to how to determine whether students are meeting the writing standards (similar to those in place for reading and speaking).
6. Develop learning progressions in those categories that currently include only repetitive placeholders (e.g., improving writing, researching and using information, multimedia, academic vocabulary, morphology, context, and connotation).
7. Reduce or remove the instructional guidance to focus more clearly on the learning standards that are required.
8. Clarify whether the sample text lists are requirements or examples and whether teachers need to match standards to texts as indicated. If the text lists are requirements, then they should be trimmed to reflect more manageable expectations.

Bottom Line: Recommend significant and immediate revisions. Standards are not suitable until and unless these revisions occur.

Review of the Florida's B.E.S.T. Math Standards

Document reviewed: *Florida's B.E.S.T. (Benchmarks for Excellent Student Thinking) Standards: Mathematics*

Overall rating:
Content: **4/7**
Communication: **2/3**
Total: **6/10** (weak). Recommend significant and immediate revisions. Standards are not suitable until and unless these revisions occur.

Overview

Florida's B.E.S.T. Standards for mathematics provide a detailed, topic-by-topic treatment of K–12 mathematics. **For the most part, the standards are rigorous, thorough, and develop topics logically across grade levels; however, they fall short on some important topics,** particularly at the elementary (K–5) level. Moreover, they provide only minimal information for teachers on what is most important in each grade level, have a "strand" structure (more below) that distributes related mathematical topics in a grade across multiple strands without addressing coherence, and are thin regarding mathematical understanding and reasoning, with most benchmarks focusing on procedure. The Florida B.E.S.T. Standards include mathematical thinking and reasoning (MTR) standards, but there is little integration of these standards with the content standards. There are also many technical and language errors throughout the document.

General organization

The Florida B.E.S.T. Standards: Mathematics are substantial, at 211 pages. There are content standards for each grade, K–8, and for the 9–12 grade band, with some of the latter standards assigned to Algebra I and Geometry courses. The content standards include a list of areas of emphasis for each grade K-8 and for the Algebra I and Geometry courses.

Content standards are organized by strand: number sense and operation (grades K–12), fractions (1–5), algebraic reasoning (K–12), measurement (K–5), geometric reasoning (K–12), data analysis and probability (K–12), functions (8–12), and financial literacy, trigonometry, logic and theory, and calculus (all 9–12). Each strand includes standards (e.g., MA.5.AR.1, which states, "Solve problems involving the four operations with whole numbers and fractions") and benchmarks for the standards that specify what students are to know or be able to do (e.g., MA.5.AR.1.2, "Solve real-world

problems involving the addition, subtraction or multiplication of fractions, including mixed numbers and fractions greater than 1").

Almost every benchmark for grades K–8 and the two high school courses includes "benchmark clarifications" that either provide additional detail, limit the scope of the benchmark, or offer brief instructional suggestions. Stand-alone MTR standards are also included, but there is almost no integration of the MTR standards with the rest of the document. The Florida B.E.S.T. Standards also include a section on developing fluency with arithmetic and several appendices, including an extensive glossary that is organized by grade bands (K–5 and 6–12).

Content and rigor

The Florida B.E.S.T. Standards include all necessary mathematics content. Though some of the standards mention understanding, the benchmarks are mostly procedural, and it is not clear how seriously understanding is to be considered. There are also many specific content issues.

Strengths

The Florida B.E.S.T. Standards appropriately emphasize numbers and operations in the early grades; ratio, proportion, and linearity in the middle grades; and algebra and geometry in high school. Data and probability are also developed properly.

The standards recognize the importance of place value. Their development of this topic begins in Kindergarten, including the key standard MA.K.AR.1.1, which states "for any number from 1 to 9, find the number that makes 10 when added to the given number." By fourth grade, students are to "understand place value for multi-digit numbers" (MA.4.NSO.1). The standards also recognize the importance of the development of computational fluency, with a three-stage process—exploration, procedural reliability, and procedural fluency—that includes the expectation that students will be able to use basic arithmetic facts with automaticity and be able to carry out computations using a standard algorithm. In third grade, students are expected to "add and subtract multi-digit whole numbers including using a standard algorithm with procedural fluency" (MA.3.NSO.2.1), and in sixth grade, they are expected to "extend previous understanding of multiplication and division to compute products and quotients of positive fractions by positive fractions, including mixed numbers, with procedural fluency" (MA.6.NSO.2.2).

The standards develop fractions thoroughly from third grade on (with some minor earlier work in K–2). They use number lines regularly and emphasize the equal sign. At the elementary level, B.E.S.T. develops topics in geometry and measurement and data, albeit occasionally at a faster pace than is common.

In the middle grades (6–8), the standards complete the arithmetic of the rational numbers. They treat algebraic concepts appropriately: They develop rates and ratios in grade 6, proportional relationships in grade 7, and linear equations and linear relationships in grade 8. The standards also emphasize geometry and data analysis/probability and initiates the study of functions in grade 8. **In both the elementary and middle grades, the amount of time devoted to the major content strands within the Florida B.E.S.T. Standards is generally appropriate.**

The standards for high school appear in two parts. First, there are specific benchmarks for courses in Algebra I and Geometry, and then there are a list of high school topics by strand. The Algebra I and Geometry courses are high school graduation requirements for all students. The Algebra I course content is very ambitious, including benchmarks on linear, quadratic, and exponential functions, polynomial arithmetic, systems of linear equations and inequalities, financial literacy (e.g., standard MA.912.FL.1.3, "Explain the relationship between simple interest and linear growth"), and data analysis and probability. The Geometry course content is strong and includes theorems in Euclidean geometry; rigid transformations, congruence, and similarity; work with the Cartesian plane; equations of circles; volumes; and trigonometric functions via right triangles. Students are introduced to mathematical reasoning and proofs in the context of geometry. **Those who master the topics in these two courses with understanding as well as procedural skill will have a good foundation for further study in quantitative domains.**

The Algebra I and Geometry courses are two of the four math courses that Florida students must complete in high school. Instead of providing standards for additional courses that might fulfill the remaining two requirements, the Florida B.E.S.T. Standards provide a list of mathematical topics, organized by strand. For example, the strand on number sense and operations includes standards on complex numbers, vectors, and matrices; the strand on algebraic reasoning includes work with absolute values, logarithms, rational functions, and systems of linear equations; and the strand on functions includes work with inverse functions. **Proper selection from these strands and standards would make the core of a good Algebra II course.** There are also additional standards on financial literacy (e.g., standard MA.912.FL.3, "Develop personal financial skills and describe the advantages and disadvantages of financial and investment plans"), geometry (conic sections), trigonometry (trigonometric functions for general angles, trigonometric identities, and polar coordinates), data analysis and probability (conditional probability, drawing inferences from data, and probability distributions), logic and theory (recursive methods, graph theory, election theory, propositional logic, and set theory), and calculus (with topics comparable to those covered on the AP Calculus AB examination). Many of these topics are necessary and appropriate for students who are considering pursuing a STEM major, some are atypical but of high value (e.g., linear programming), and others are of value but not frequently taught at the high school level (e.g., decision trees, bin-packing techniques, and election theory).

Weaknesses

The Florida standards exhibit both structural and specific content weaknesses. They sometimes lack coherence, due to different strands having overlapping content. For example, in grade 5, one of the five emphases is "adding and subtracting fractions and decimals with procedural fluency [and] developing an understanding of multiplication of fractions and decimals." However, operations with decimals are mentioned in the strand on number sense and operations, while the fractions strand includes multiplication of fractions but makes almost no connection to working with decimals. Then, the strand on algebraic reasoning lists arithmetic operations with fractions and mentions decimals in some of the benchmark clarifications but not in the benchmarks themselves. **In general, the standards provide no specific information concerning the connection between the stated emphases for a grade and the standards and the benchmarks that follow.**

Specific content standards are sometimes imprecise and overly broad (e.g., the second-grade standard MA.2.FR.1 says "develop an understanding of fractions" and the fourth-grade standard MA.4.M.2 says "solve problems involving time and money"). In addition, there are occasional gaps between a standard and its benchmarks. For example, standard MA.8.GR.2 states, "Understand similarity and congruence using models and transformations," while the three associated benchmarks about transformations do not mention either similarity or congruence (these are relegated to benchmark clarifications). Standard MA.8.AR.4 states, "Develop an understanding of two-variable systems of equations," but all of its related benchmarks are limited to two-variable linear equations.

Place value (base-ten structure) is a critical and foundational concept in elementary school mathematics. However, its treatment in the Florida B.E.S.T. Standards is not always coherent. For example, in first grade, there is no benchmark that specifically indicates that students should understand that a number such as 75 is made up of seven tens and five ones. Students are expected to identify a number that is ten less or more than a given number (MA.1.NSO.2.3) but not to explain how to do so using concepts of place value. Rather, this is a benchmark for a standard about addition and subtraction, and the example does not mention place value (similarly, second-grade benchmark MA.2.NSO.2.2 concerns place value but is not attached to the standard about this topic).

In grade 2, benchmark MA.2.NSO.1.2 expects students to "compose and decompose three-digit numbers in multiple ways using hundreds, tens, and ones," and an example states that "the number 241 can be expressed as 2 hundreds + 4 tens + 1 one or as 24 tens + 1 one or as 241 ones." This benchmark conflates three related but fundamentally distinct ideas: the meaning of digits in base ten, the foundational fact that a hundred is ten tens, and the concept of decomposing a number in different ways. **This makes it more likely that some teachers may fail to make these distinctions in practice** (some of the same criticisms apply to benchmark MA.1.NSO.1.3). In grade 3, standard MA.3.NSO.1 extends place-value concepts from three-digit whole numbers (treated in grade 2) to four-digit whole numbers. If students understand place value, this extension should be

straightforward. Adding one more digit does not require significant new concepts or skills. Place value should be emphasized as the primary way to compare two numbers, rather than as coequal with using a number line, as suggested by the benchmark clarifications for MA.1.NSO.1.4, MA.2.NSO.1.3, and MA.3.NSO.1.3. Place value should also be explicitly connected to the standard algorithm for each operation (+, −, ×, and ÷).

Another key weakness is that conceptual understanding appears to suffer at the hands of procedural fluency. The first stage of learning, the Explore standards,[3] reference building understanding, but they are only a preparation for computing reliably and then fluently. This view of understanding as merely a prelude to the ultimate goal of procedural fluency is delineated on pages 5–6 and reflected in the K–8 standards throughout. Reflecting this hierarchy, the vast majority of the benchmarks about topics in arithmetic are procedural. Yet conceptual understanding in mathematics is as critical as procedural fluency because it supports long-term retention and future learning. Though understanding is mentioned in the emphases and standards, the abundance of procedural benchmarks overwhelms these references.

Moreover, though the Florida B.E.S.T. Standards do ask students to explain mathematics, what they are supposed to explain is often procedural in nature rather than conceptual. For instance, first-grade benchmark MA.1.AR.2.2 states, "Determine and explain if equations involving addition or subtraction are true or false." Variations of this benchmark also appear in grades 2–5. The following is an example from the grade 5 benchmark MA.5.AR.2.3: "The equation $2.5 + (6 × 2) = 16 − 1.5$ can be determined to be true because the expression on both sides of the equal sign are equivalent to 14.5." It is a long way from simple statements based on procedures such as this to the MTR standard requiring students to "Justify results by explaining methods and processes" (MA.K12.MTR.4.1). **In short, there is little to no connection between this important MTR standard and the content benchmarks.**

Strong computational skills also require flexibility, the ability to select the most appropriate approach to a given problem. Unfortunately, this ability is not emphasized in the Florida standards, which specify building from procedural reliability to procedural fluency. Indeed, when benchmarks require procedural reliability, "instruction focuses on helping a student choose a method they can use reliably" (this benchmark clarification appears six times, beginning with MA.K.NSO.3.2), so flexibility is not a goal at this stage. The benchmarks that call for procedural fluency typically mention a standard algorithm (e.g., MA.3.NSO.2.1: "Add and subtract multi-digit whole numbers using a standard algorithm with procedural fluency"). **The effect is to underemphasize the importance of teaching students to compute flexibly.** To be sure, mathematical fluency, as described in the MTR standards (MA.K12.MTR.3.1), does include such flexibility; however, this goal is not articulated and supported in the actual content standards.

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[3] Explore standards for arithmetic appear in the strands on number sense and operations and fractions.

The concept of procedural reliability is not common in mathematics education, and the envisioned approach is not always coherent. For example, when children learn the addition and related subtraction facts (the Explore stage), strategies such as "making tens," "doubles," and "doubles plus one" are often helpful. It is unclear whether such strategies are to be jettisoned in the name of procedural reliability (ditto for strategies pertaining to number facts in multiplication). Further, the connection between procedural reliability and procedural fluency is blurry. For example, the second-grade benchmark MA.2.NSO.2.3 recommends using a number line and "jumping up" (counting on) to add as a possible strategy for procedural reliability. Students are then expected to move from reliability to fluency (MA.3.NSO.2.1). But there is no explanation of the pathway from the counting-on approach to procedural fluency with the standard algorithm, which is based on place value.

Other general concerns are related to computation, real-word problems, and mathematical reasoning. The standards mention "a standard algorithm" (e.g., emphases in grade 3) rather than "the standard algorithm." It is important that students learn *the* standard algorithm for integer addition, subtraction, multiplication, and division.

The phrase "mathematical and real-world problems" is used throughout the Florida B.E.S.T. Standards. Its repetition is not only tedious but appears to encourage educators to teach each mathematical standard and their related benchmarks with a word problem immediately at hand. **This approach risks a curriculum filled with forced and fabricated contexts for each small topic, at the expense of mathematical modeling (varied representations) and coherence.**

The MTR standards describe mathematical reasoning in the context of problem solving. They are thin regarding abstract reasoning and proof and regarding understanding mathematical concepts. They do not include any examples, and there is little specific integration of these standards with the content standards and benchmarks. The statement that "students can use them as self-monitoring tools" (page 8) seems like wishful thinking.

In a number of places, the Florida B.E.S.T. Standards in K–5 are faster paced than most other state standards for mathematics (though this does not result in more advanced content coverage by the end of grade 8). **There is a danger that this pacing will lead back to a "mile-wide and inch-deep" implementation, in which conceptual understanding and mathematical reasoning are given short shrift.**

Also, there are no pre-K standards. It would be helpful to develop them, particularly given the aggressive pacing of the Kindergarten standards.

Selected grade-specific weaknesses for grades K–8 appear in *Appendix A*.

High school–specific concerns

It is difficult to know what different schools and districts will do with the high school standards, which are comprehensive but sometimes tedious and overly procedural and which are not (except for Algebra I and Geometry) directly associated with specific high school classes. Although the standards for Algebra I and Geometry are clear, **the standards for grades 9–12 that encompass the last two years of high school are not by themselves sufficient, providing a large list of topics organized by strand from which courses must be created.**

There are several structural concerns. The Algebra I course is so full that it will be very challenging to teach it with suitable conceptual understanding. The standards for high school algebraic reasoning contain pages of "solve-and-graph" standards for different types of functions, which is both inefficient and tedious and risks an implementation that is focused on rote. The standards for financial literacy that are not in Algebra I are often not specifically connected to the mathematics content in other strands. There are no formal standards about mathematical modeling.

Selected topic-specific weaknesses for grades 9–12 appear in *Appendix A*.

Glossary and appendices

There are multiple mistakes in the glossary. The description of the area model presented there is too limited because, for example, it is also crucial to modeling the multiplication of two fractions and valuable for finding common denominators and explaining division of fractions. The first circle shown under "circle" is actually a disk (a circle plus its interior). The definition of polygon is wrong (as written, a closed figure made from three line segments and a semicircle, such as part of a basketball court, would qualify). The entry for angle insists angles be measured in degrees, but they may also be measured in radians. Under cylinder, a net should include the interiors of the parallelogram and the disks rather than circles that are part of its boundary. For intercept, the x-intercept is mislabeled (it should be (x,0)). For principal square root, the real number mentioned in the definition must be positive. For scientific notation, "a number between 1 and 10" should be "a number that is at least 1 and less than 10."

Appendix B, titled "Fluency and Recall with Automaticity Chart," includes measurement as well as the topic of the title. This unwisely conflates two different topics: the development of number skills and the development of measurement skills. Also, in Appendix D, "Properties of Operations, Equality and Inequality," it would be helpful to list the distributive property (b + c) × a = b × a + c × a. And in the Law of Exponents (Properties of Exponents would be better), it is not clear why the "and conversely" statements are presented. All of them are immediate consequences of the symmetry property of equality ("if a = b then b = a"). In Appendix E, the formula for the surface area of a hemisphere is not accurate.

Communication: clarity, specificity, and access

Overall, the Florida B.E.S.T. Standards are clear about which mathematical topics are to be covered. However, specific standards are often broad, sometimes overly so, with the related benchmarks being more narrow and these in turn modified by benchmark clarifications so that stakeholders cannot know what is expected by just reading the content standards or even the benchmarks. The content standards include examples, but they are often of little use.

Strengths

Together, the standards, benchmarks, and benchmark clarifications for each grade level are detailed, providing a precise list of the topics to be covered. The benchmarks are, for the most part, specific and can be assessed. Many of the benchmark clarifications provide useful additions about the scope of topics and sometimes indicate suggestions for how they are to be taught. The appendices give helpful information on some specific topics and include a glossary (albeit with some errors).

Weaknesses

Grade-level topics of emphasis are terse and sometimes vague or overly general. For example, in grade 6, one of the emphases is "extending understanding of statistical thinking." This phrase offers little information, and there is no additional introduction to the grade 6 standards to provide more detail. Some standards, when read literally, are unrealistic. For instance, students in the second grade are expected to "develop an understanding of fractions" (MA.2.FR.1), an expectation fortunately limited in scope by subsequent benchmark clarifications.

The standards and their benchmarks also do not adequately communicate explicit expectations for understanding and mathematical reasoning, and it is important that they do so.

The standards sometimes use odd language. Second graders are asked to "understand the place value of three-digit numbers" (MA.2.NSO.1), rather than to understand place value in the context of three-digit numbers. An algebraic reasoning standard for grades 9–12 (MA.912.AR.10) states, "Write and solve sequence and series equations, functions and inequalities in one and two variables." But one does not solve a function $f(x)$; rather, one looks for roots of a function by solving the equation $f(x) = 0$. And the benchmark MA.912.C.2.5, "Prove the rules for finding derivatives of constant, multiple and power," is certainly misedited.

The standards contain examples, but they are often not helpful. Many are for the easiest benchmarks to understand. The example for a fifth-grade benchmark (MA.5.AR.2.1) states, "The expression 4.5 + (3 × 2) in word form is four and five tenths plus the quantity 3 times 2."[4] In other

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[4] Also, 3 × 2 is not a quantity—that is, an amount of something—but a number.

places, an example is not provided where it would be especially helpful—for example, to enhance grade 9–12 benchmark MA.912.AR.2.1, which reads, "Given a real-world context, write and solve one-variable multi-step linear equations." Some examples are not good illustrations of the concepts, such as this example for grade 6 benchmark (MA.6.NSO.1.4): "Michael has a lemonade stand which costs $10 to start up. If he makes $5 the first day, he can determine whether he made a profit so far by comparing |–10| and |5|." **Several examples provide "real-world problems" but do a poor job of illustrating anything real world.** The example for grade 7 benchmark MA.7.AR.4.5, in which students are to calculate how many tanks of gas it takes to drive a car from Florida to Maine, implicitly assumes that the driver drives until his tank is empty and never leaves the road and ignores the issue of significant digits.

Many examples use the word "equivalent" instead of "equal" when two expressions evaluate to the same number. An example for first-grade benchmark MA.1.AR.2.2 states, "9 – 1 = 7 can be determined to be false" rather than "is false." The example for fifth-grade benchmark MA.5.FR.1.1, which is about fractions, includes converting from gallons to ounces, which is not part of this benchmark. Other examples include erroneous grammar (e.g., eighth-grade benchmark MA.8.NSO.1.4 uses "times bigger than" instead of "times as large as" for a multiplicative comparison between two numbers).

Recommendations

1. Provide a clear linkage between the emphases for each grade and the standards that are associated with each topic. Enhance the grade level/course introductions so that they provide more guidance for teachers about the main content of each grade level.
2. Revise the MTR standards to provide a greater emphasis on mathematical reasoning and proof. Integrate these standards with the content standards and benchmarks. In particular, add benchmarks requiring students to explain their reasoning.
3. Add increased emphasis on conceptual understanding in the benchmarks at all grade levels, as a complement to procedural fluency.
4. Add benchmarks that call for students to compute flexibly, selecting the best approach to each specific problem.
5. Replace "a standard algorithm" with "the standard algorithm."
6. Organize the high school standards beyond Algebra I and Geometry into courses.
7. Address the specific problems noted by the reviewers. In particular, improve the treatment of place value.[5] Also, revise the examples in the present document and add many additional examples that are more carefully constructed.
8. Consider developing pre-K math standards.
9. Consider developing a document that shows connections between different mathematical topics and across grade levels, which will promote coherence.

Bottom line: Significant revisions recommended. Standards should not be implemented until and unless these revisions are made.

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[5] The standards and their benchmarks should emphasize the conceptual structure of place-value notation: that a base-ten numeral expresses a number as a sum of copies of base-ten units, each digit indicating the number of copies of the corresponding unit, and that the base-ten unit corresponding to each place is ten times the unit for the next place to the right and one-tenth of the unit for the next place to the left. This structure should be tied to procedures for addition, subtraction, multiplication, and division for whole numbers and for decimals.

Appendix A: Additional Grade-Level Weaknesses in Mathematics

Selected grade-specific weaknesses, grades K–8

In general, the Florida B.E.S.T. Standards are sometimes fast paced at the elementary level. In Kindergarten, students are asked to "Locate, order, and compare numbers from 0 to 20 using the number line and terms less than, equal to or greater than" (MA.K.NSO.2.3) and to add and subtract within ten with procedural reliability (MA.K.NSO.3.2). Lines of symmetry and the perimeter of polygons are both topics at the second-grade level. Standards and benchmarks related to the mean, median, and mode of a data set are found in grade 4 (MA.4.DP.1) and grade 5 (MA.5.DP.1). Care should be taken to ensure that what is perceived to be advancing the placement of particular topics/standards does not occur at the expense of a decreased emphasis on understanding.

In Kindergarten, the standards introduce the number line. Although the number line is a valuable representational tool, understanding it properly requires the concept of linear measurement. In the early grades, teachers should work with a displayed number sequence instead of a number line and with rows of manipulative materials (e.g., unifix cubes) to develop connections between numbers and lengths before introducing the number line formally in grade 2. Similarly, while supporting understanding of the equal sign is important, it is not necessary to start this in Kindergarten (standard MA.K.AR.2), beyond conceptual explorations with equality (e.g., same number).

In grade 2, adding a standard about partitioning a rectangular array into rows and columns would help set the stage for early work with multiplication and complement the work with arrays in MA.2.AR.3.2. Additionally, the standards do not mention regrouping ones and decomposing tens in the context of addition with sums up to one hundred and related subtraction problems (MA.2.NSO.2.3).

The distributive property is an important topic that is first discussed in third grade (MA.3.AR.1.1) and that also appears in the higher grades (e.g., MA.4.NSO.2.2 and MA.6.NSO.3.2). Students must understand it as well as be able to use it. However, developing understanding by connecting it to the area model is suggested solely (and incompletely) in the definition of "area model" in the glossary.

In treating fractions in grade 3, an example suggests interpreting fractions as parts of a pie but not interpreting them as parts of a rectangle. The latter is much more useful in later work with fractions—for example, when using the area model to understand the multiplication of fractions. A similar issue appears in grade 4 (the examples provided for MA.4.FR.2.4). In third grade, it would be helpful to identify whole numbers as fractions with the denominator one. It is also difficult to see

why grade 3 benchmark MA.3.FR.1.3, "Read and write fractions, including fractions greater than one, using standard form, numeral-word form and word form," is needed and how it is related to the goals laid out in Benchmark Clarification 1 (e.g., "to support algebraic thinking in later grades"). Fourth-grade benchmark MA.4.NSO.2.4 requires understanding the relationship between division and fractions ("Represent remainders as fractional parts of the divisor"), but this content is not presented until fifth grade (MA.5.FR.1).

Fourth-grade benchmark MA.4.AR.2.1, Clarification 1, specifies "whole number factors within 12." This is unclear. It presumably means "products of two whole numbers, each at most 12." Similar language is found in Appendix B (page 170). Clarification 1 to benchmark MA.4.GR.2.2 mentions "the conceptual understanding of the relationship between perimeter and area." It is unclear what relationship is intended.

In grade 6, students are to learn how to divide integers, including negative integers, with procedural fluency (MA.6.NSO.4.2). However, there is no indication as to how the formulas in Clarification 2 will be justified or explained. For example, Clarification 1 mentions "the inverse relationship between multiplication and division." However, using this inverse relationship to check the computation $2 \div (-5) = -(2/5)$ requires computing $(-5) \times (-2/5)$. Multiplication involving negative rational numbers is a topic in grade 7, not grade 6.

In grade 8, standard MA.8.F.1 mentions evaluating functions but this topic is not explicitly included in any of its associated benchmarks (the standards do address this topic in grade 9 in benchmark MA.912.F.1.2). The standards do not mention a proof of the Pythagorean theorem or its converse. In the grade 8 standard MA.8.NSO.1, which specifies "extend[ing] the understanding of rational numbers to irrational numbers," it is not clear what students are expected to know about irrational numbers. For instance, should they know why $\sqrt{2}$ is irrational?

Selected topic-specific weaknesses, grades 9–12

In high school Geometry, there is a standard concerning geometric constructions (MA.912.GR.5) but its benchmarks do not specify the tools that are to be included. No benchmark for standard MA.912.NSO.4 mentions the noncommutativity of matrix multiplication. Benchmark MA.912.AR.1.10 does address the binomial theorem, but there is no mention of Pascal's triangle or of combinations.

Grade 9–12 benchmark MA.912.F.1.4 is in the functions strand, but it requires knowledge of calculus. It would be helpful if benchmark MA.912.T.3.6 ("Verify that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed") mentioned the inverse trigonometric functions by name. In benchmark MA.912.C.2.13 ("Define and apply the Mean Value Theorem"), the Mean Value Theorem is not a definition.

Appendix B: Author Biographies

English Language Arts

Timothy Shanahan (lead reviewer) is Distinguished Professor Emeritus at the University of Illinois at Chicago, where he was founding director of the UIC Center for Literacy. Previously, he was director of reading for the Chicago Public Schools. He is author/editor of more than two hundred publications, and his research emphasizes the connections between reading and writing, literacy in the disciplines, and improving reading achievement. Professor Shanahan is past president of the International Literacy Association. He served as a member of the Advisory Board of the National Institute for Literacy under Presidents George W. Bush and Barack Obama, and he helped lead the National Reading Panel, convened at the request of Congress to evaluate research on the teaching reading—a major influence on reading education. He chaired two other federal research review panels: the National Literacy Panel for Language Minority Children and Youth, and the National Early Literacy Panel, making him the only scholar to serve on all three national literacy research panels. Professor Shanahan helped write the Common Core State Standards. He was inducted into the Reading Hall of Fame in 2007, and is a former first-grade teacher.

Douglas Fisher is professor of Educational Leadership at San Diego State University, where he previously served in the Department of Teacher Education since 1998, and is a teacher and administrator at Health Sciences High and Middle College. He is a board member of the International Reading Association and a past board member of the Literacy Research Association. He has served as a teacher, language development specialist, and administrator in public schools and nonprofit organizations, including eight years as the director of professional development for the City Heights Collaborative, a time of increased student achievement in some of San Diego's urban schools. Dr. Fisher is a member of the California Reading Hall of Fame and the recipient of an International Reading Association Celebrate Literacy Award and a Christa McAuliffe award for excellence in teacher education, and was a co-recipient (with Nancy Frey) of the 2004 Kate and Paul Farmer award from the National Council of Teachers of English. In 2011, his book Implementing RTI with English Learners won the innovation award from the Academy of Educational Publishers. He has published widely on school improvement and has written several books on the topic.

Mathematics

Solomon Friedberg (lead reviewer) is James P. McIntyre Professor of Mathematics at Boston College. A well-known researcher in number theory and representation theory and a Fellow of the American Mathematical Society, Dr. Friedberg served as chair of the BC Mathematics Department for nine years and led the development of a new and highly regarded doctoral program. Dr. Friedberg has been involved in pre-collegiate mathematics education since the 1990s. He has been an editor of

the CBMS book series Issues in Mathematics Education from 2006 on and is vice chair of the National Academy of Science's U.S National Commission on Mathematics Instruction. He also received an award for Distinguished College or University Teaching from the Mathematical Association of America in 2009, and is chair of the AMSMAA Joint Committee on TAs and Part-Time Instructors. He is co-principal investigator for a current National Science Foundation-funded project, "Exemplary Mathematics Educators for High-need Schools," through which Boston College partners with M*f*A Boston in support of teaching fellows.

Francis (Skip) Fennell is the L. Stanley Bowlsbey Professor of Education and Graduate and Professional Studies at McDaniel College in Maryland. A mathematics educator who has experience as a classroom teacher, principal, and supervisor of instruction, he is a past president of the National Council of Teachers of Mathematics (NCTM) and the Association of Mathematics Teacher Education (AMTE). Dr. Fennell is widely published in professional journals and textbooks related to elementary and middle grade mathematics education and has played key leadership roles in the Research Council for Mathematics Learning, the Mathematical Sciences Education Board, the National Science Foundation, the Maryland Mathematics Commission, the United States National Commission for Mathematics Instruction, the Association for Mathematics Teacher Educators, and the National Mathematics Advisory Panel. He was a writer for the Common Core State Standards in Mathematics. He has received numerous honors and awards, including Maryland's Outstanding Mathematics Educator (1990), McDaniel College's Professor of the Year (1997), the Glenn Gilbert National Leadership Award from the National Council of Supervisors of Mathematics, the CASE-Carnegie Foundation Professor of the Year – Maryland (1997) and the AMTE Distinguished Outstanding Teacher Educator Award for Excellence in Service (2010).

Roger Howe is the Curtis D. Roberts Professor of Mathematics Education in the College of Education and Human Development at Texas A&M University. He assumed this position in 2016, after retirement from Yale University, where he was a member of the Yale Mathematics Department for over forty years, and is now the William Kenan Jr. Professor of Mathematics, Emeritus. Beginning in the late 1990s, Dr. Howe served on a multitude of committees studying mathematics education, including several that produced major reports on mathematics education. He has reviewed texts and instructional materials for several publishers and curriculum developers. He served on the Committee of Education for the American Mathematical Society, the Steering Committee for the Park City/IAS Mathematics Institute, the U.S. National Commission on Mathematics Instruction (2006–2016), and the executive committee of the International Commission on Mathematics Instruction (ICMI) (2008–2016). In 1997 and 1998, Dr. Howe served as a Phi Beta Kappa Visiting Scholar. He is a member of the American Academy of Arts and Sciences, the National Academy of Sciences, and fellow of the American Mathematical Society; he received their Award for Distinguished Public Service in 2006. Dr. Howe's mathematical research investigates symmetry and its applications. His work in mathematics education is directed toward clarifying the conceptual development of mathematical ideas through the K–12 curriculum. He has focused especially on place value, the role of word problems, and productive use of the number line.

Appendix C: English Language Arts Review & Scoring Criteria

Below are the content-specific criteria upon which the Florida B.E.S.T. English language arts standards were evaluated for their "Content" score (see also the *Scoring criteria* that follows).

Content-specific criteria

Elementary School (Grades K-5)

Reading
1. The standards delineate explicit and systematic outcome expectations in foundational skills (e.g., phonemic awareness, phonics, fluency, vocabulary) and comprehension.
2. The standards outline specific expectations for reading and for analyzing narrative and informational texts[6] (e.g., recognizing and interpreting genres and subgenres; organizational and/or argument structures; narrative elements; stylistic devices).
3. The standards reflect the importance of knowing specific works of outstanding literature and culturally significant informational texts.
4. The standards describe the quantitative and qualitative text complexity[7] of both narrative and informational texts to be studied and include lists (authors and/or titles), sample passages, and/or commentary that serve as exemplars of the levels of complexity required.
5. The standards require students to analyze and evaluate information presented in multimedia formats (e.g., the effect of various visual and aural techniques; how information presented in print is different from that which is presented through the use of multimedia).

Writing
1. The standards delineate explicitly the foundational skills of writing (e.g., printing, handwriting, keyboarding, spelling) as well as providing a clear progression of expectations that address the characteristics and quality of writing products that students must learn to produce (e.g., organization of ideas and focus; introduction, body, and conclusion; elements of a paragraph; elaboration; accuracy).
2. The standards require students to recognize, explain, and produce writing that reflects the defining characteristics of various grade-appropriate writing genres and subgenres, including specific literary elements or organizational structures and stylistic devices.

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[6] Informational texts include biographies, autobiographies, historical books, technical texts, and literary nonfiction.
[7] Measures of quantitative text complexity include formulas for calculating word frequency and sentence and word length. Qualitative measures include the language, structure, and knowledge demands of a text.

3. The standards describe or reference the use of specific criteria for evaluating pieces of writing (e.g., logically organized and detailed genre- or prompt-specific rubrics) that include examples regarding the quality of writing expected.
4. The standards specify expectations for the correct use of Standard English, describing a grade-appropriate facility with the parts of speech, sentence structure, usage, and mechanics appropriate to the grade level (e.g., nouns, verbs, adjectives, adverbs, conjunctions, prepositions, and nominative/objective/interrogative pronouns; sentence types; complete/incomplete sentences; subject/verb (S/V) agreement; initial, internal, and ending punctuation; and basic spelling rules, such as plurals, contractions, and inflections).
5. The standards specify the expectations for using technological tools to produce and revise writing, including word processing software, spell checkers, etc.

Listening and Speaking
1. The standards clearly address active listening and effective speaking skills (e.g., summarizing information presented orally, asking and answering relevant questions).
2. The standards address the ability to make formal oral presentations (e.g., recitation; story retelling; and sequencing).
3. The standards describe or reference the use of specific criteria for evaluating oral presentations (e.g., content, organization, and presentation style).
4. The standards include specific expectations for participation in group discussions (e.g., turn-taking and applying agreed-upon rules for decision making).
5. The standards require that students learn about multimedia techniques for presenting information.

Research
1. The standards require students to learn to conduct research, outlining specific expectations for the essential components of the process (e.g., identifying or finalizing a research question, locating information, evaluating and compiling information, using evidence from text to present their ideas and findings, and acknowledging sources using a standard format).
2. The standards specify that students be able to use and evaluate digital and multimedia sources and technological within the research process.

Middle School (Grades 6-8)

Reading
1. The standards address vocabulary development (e.g., knowledge of word meanings, roots and affixes, context clues, connotation and denotation, figurative language, and use of the dictionary for clarifying multiple meanings, etymology, and pronunciation).
2. The standards describe specific expectations for reading and analyzing narrative and informational texts—including specific requirements for mastering particular literary genres and subgenres and rhetorical structures (e.g., recognizing and interpreting genres, subgenres,

and literary elements; organizational and/ or argument structures; narrative elements; stylistic devices).

3. The standards reflect the importance of knowing specific works of outstanding American literature that reflect our common heritage, world literature that expands students' understanding of different human experiences, as well as culturally significant informational texts.

4. The standards describe the quantitative and qualitative text complexity of both narrative and informational texts to be studied and include lists (authors and/or titles), sample passages, and/or commentary that serve as exemplars of the levels of complexity required.

5. The standards specify that students learn to deal with text features unique to the different disciplines and that they develop reading skills or approaches that are appropriate to the specialized reading demands of the disciplines (e.g., determining theme in literary works, sourcing information in history, comparing prose and graphic sources in science reading).

6. The standards require students to analyze and evaluate information presented in multimedia formats (e.g., how information presented in print is different from that which is presented through the use of multimedia, noting what is conveyed through the use of various visual and aural techniques, such as bias and propaganda).

Writing

1. The standards delineate expectations for writing that address the characteristics and quality of writing products appropriate to each grade level and there is a clear progression from grade to grade that demonstrates increased rigor (e.g., increasingly sophisticated understanding of audience and purpose, clear organization and consistent focus, development of ideas through multi-paragraph essays, use of transitions, elaboration, accuracy).

2. The standards require students to interpret and produce writing that reflects the defining characteristics of various writing genres and subgenres (e.g., argument, rhetorical, narrative, and informational).

3. The standards describe or reference the use of specific criteria for evaluating writing (e.g., logically organized and detailed genre- or prompt-specific rubrics) that include examples regarding the quality of writing expected.

4. The standards specify expectations for the correct use of Standard English, describing a grade-appropriate facility with the parts of speech, sentence structure, usage, and mechanics appropriate to the grade level (e.g., parts of the verb; interjections, possessive/ demonstrative/relative/indefinite pronouns; tenses; analysis of sentence structure; types of phrases and clauses; fragments and run-on sentences; and facility with mechanics grounded in understanding of sentence structure).

5. The standards require students to learn to write in ways that reflect the specified communication demands of the various disciplines (e.g., history, mathematics, science, literature).

6. The standards specify the expectations for using technological tools to produce and revise writing, including word processing software, spell checkers, etc.

Listening and Speaking

1. The standards clearly address active listening and effective speaking skills (e.g., give, restate, and execute multi-step directions; convey ideas orally and interpret spoken ideas; make inferences from spoken information; ask and answer clarifying questions).
2. The standards address the ability to make formal oral presentations (e.g., recitation, informative and persuasive presentations that offer supporting details and evidence, and address anticipated counterclaims and include a call to action when appropriate).
3. The standards describe or reference the use of detailed criteria for evaluating formal oral presentations.
4. The standards include specific expectations for participation in group discussions (e.g., designation of roles and eliciting and considering suggestions).
5. The standards require that students use multimedia techniques to present information.

Research

1. The standards require that students learn to conduct research, specifying expectations for the essential components of the inquiry process (e.g., identifying and refining a research question; locating information; evaluating the quality of information/sources; selecting information that supports a thesis; using evidence from text to present their ideas and findings; citing sources correctly using standard guidelines; avoiding plagiarism).

High School (Grades 9-12)

Reading

1. The standards address vocabulary development and skills for building discipline- specific vocabulary (e.g., applying knowledge of roots and affixes to help determine meanings of words; applying knowledge of context clues to determine word meanings; tracing etymology; determining shades of meaning).
2. The standards describe specific expectations for reading and analyzing narrative and informational texts—including specific requirements for mastering particular literary genres and subgenres and rhetorical structures (e.g., analyzing specific literary elements for the genres/subgenres, the effectiveness of rhetorical techniques, and the manipulation of stylistic devices; describing the truth and/or validity of an argument; recognizing and explaining the presence of fallacious reasoning).
3. The standards reflect the importance of knowing specific works of outstanding American literature that reflect our common literary heritage, world literature that expands students' understanding of different human experiences, as well as culturally significant informational texts.

4. The standards describe the quantitative and qualitative text complexity of both narrative and informational texts to be studied and includes lists (authors and/or titles), sample passages, and/or commentary that are exemplars of the levels of complexity required.
5. The standards specify that students learn to deal with text features unique to the different disciplines and that they develop reading skills or approaches that are appropriate to the specialized reading demands of those disciplines (e.g., determining theme in literary works, sourcing information in history, comparing prose and graphic sources in science reading).
6. The standards require students to analyze and evaluate information presented in multimedia formats (e.g., noting instances of manipulation, bias, propaganda, and potential fallacies).

Writing
1. The standards delineate expectations for writing, including rhetorical and argumentative writing, that address the characteristics and quality of writing products appropriate to the grade level (e.g., strong organization and development of ideas, facility with selection and blending of genres appropriate to audience and purpose, the use of sophisticated transitions, active rather than passive voice, and other stylistic elements for rhetorical effect).
2. The standards require students to analyze and produce writing that reflects the defining characteristics of writing genres and subgenres (e.g., argumentation, explanatory).
3. The standards describe or reference the use of specific criteria for evaluating writing (e.g., logically organized and detailed genre- or prompt-specific rubrics) that include examples regarding the quality of writing expected.
4. The standards specify expectations for the correct use of Standard English, describing a grade-appropriate facility with the parts of speech, sentence structure, usage, and mechanics (e.g., demonstrate control of sentence structure, usage, and mechanics).
5. The standards require students to learn to write in ways that reflect the specified communication demands of the various disciplines (e.g., history, mathematics, science, literature).
6. The standards require that students use multimedia techniques to prepare and present information.

Listening and Speaking
1. The standards clearly address active listening and effective speaking skills (e.g., interpret complex information and ideas presented orally, convey complex information or ideas orally).
2. The standards address the ability to make formal oral presentations (e.g., recitation and complex informative or persuasive oral presentations that require a logical structure, well-chosen supporting evidence/details, skillful rhetorical techniques, and a strong presentation style).
3. The standards describe or reference the use of detailed criteria for evaluating formal oral presentations.
4. The standards include specific expectations for participation in group discussions (e.g., tolerating ambiguity, building on the ideas of others, and reaching consensus).

Research

1. The standards require students to learn to conduct research, outlining specific expectations for the essential components of the process (e.g., identifying and refining a research question; locating information; evaluating the quality of information/sources; selecting information and evidence that supports a thesis; excluding extraneous information; presenting findings in a format appropriate for the audience and purpose; citing sources correctly in a standard format; avoiding plagiarism).

Scoring criteria

Standards are evaluated in two categories: "content and rigor" and "clarity and specificity." Based on the degree to which the standards included the content above, Florida could earn up to 7 points for content and rigor as summarized below.

Content and rigor

7 points
Standards meet all of the following criteria:
- The standards are of high quality in terms of the content chosen. Categories of content deemed crucial include: Foundational Knowledge; Comprehension; Vocabulary; Language; Fluency; Writing; Text Complexity; Research; Familiarity with important Literary/Cultural Works; and Disciplinary Literacy.
- The standards focus on learning outcomes, as opposed to learning processes. (Less that 5 percent of the standards focus on learning processes.)
- The standards connect to content standards in other disciplines such as art, science, and social studies.
- The content identified by the standards is well explained.
- Good decisions are made about what content should be omitted. (Less than 5 percent of the content in the standards is unnecessary or superfluous.)
- The standards do not overemphasize topics of little importance or underemphasize topics of great importance.
- The level of rigor is appropriate for the targeted grade level(s), and these expectations are clearly articulated. Students are expected to learn the content and skills in a sensible order and at an increasing level of difficulty.
- The standards articulate the level of text complexity expected of students and provide text exemplars of this level of complexity.
- The standards are specific about the genres and subgenres that students need to master, including particular literary elements relevant to those genres/ subgenres.

- The standards are specific about the types of literature and informational text that students should know, including specifying some particular texts/authors that students should be familiar with.
- The standards, taken as a whole, define core literacy for all students in the subject under review; at the same time, the standards that run through grade 12 are sufficiently challenging to ensure that students who achieve proficiency by the final year of high school will be college- or career-ready.
- The standards do not overemphasize the importance of students' life experiences or "real-world" problems. They do not embrace fads, suggest political bias, or teach moral dogma. They do not imply that all interpretations are equally valid (regardless of logic or the adequacy of supporting evidence). The standards also avoid other major subject-specific problems identified by the reviewers.

6 Points

Standards fall short in one or more of the following ways:

- Some content (as specified in the content-specific criteria) is missing (approximately 5 percent and up to 20 percent).
- The standards include learning outcomes. Approximately 6 percent to 15 percent of the standards focus on learning processes rather than learning outcomes.
- The standards haphazardly connect to standards in other disciplines such as art, science, and social studies.
- Some of the content in the standards is unnecessary (approximately 5 percent and up to 20 percent).
- The level of rigor is appropriate for most of the targeted grade level(s), and these expectations are articulated. Students are expected to learn the content and skills in a sensible order and at an increasing level of difficulty.
- The standards are inconsistent in their coverage of the text complexity expected of students.
- The standards specify types of literature and informational text (e.g., poetry, American literature) that should be known by students, but without indicating any specific texts or authors. The standards do not fully distinguish between more-and less-important content and skills (i.e., importance is neither expressly articulated nor conveyed via the number of standards dedicated to particular topics). In other words, the standards overemphasize one or two topics of little importance or underemphasize one or two topics of great importance.
- Standards at particular grade levels are not as rigorous as they should be, or are too rigorous (i.e., expectations are slightly too high or too low).
- There are minor problems or shortcomings (e.g., one or more of the problems listed in the last paragraph under the 7-point score affects the standards in a small way, or there are other minor subject-specific problems).

5 Points
Standards fall short in one or more of the following ways:
- Crucial content is missing (approximately 20 percent and up to 35 percent).
- Standards include learning outcomes (approximately 20 percent, but less than 50 percent, of the standards focus on learning processes rather than learning outcomes).
- While most of the appropriate content is covered by the standards, the content is nonetheless covered in a manner that is not satisfactory (i.e., the standards cover the right material but do not cover that material robustly; thus, the material is shortchanged in some way).
- Some of the content in the standards is unnecessary (approximately 35 percent).
- The level of rigor is appropriate for about half of the targeted grade level(s) and these expectations are not always clearly articulated. Students are expected to learn the content and skills in a sequential order and at an increasing level of difficulty, but this order and increasing level of difficulty are not always articulated.
- The standards are inconsistent in their descriptions of text complexity expected of students.
- Standards do not distinguish between more- and less-important content and skills (i.e., importance is not articulated or conveyed in any way). The standards often overemphasize topics of little importance or underemphasize topics of great importance.
- The standards specify only that students should be familiar with literary and informational texts.
- Standards generally need to be more or less rigorous than they are at certain grade levels (i.e., expectations are too high or too low).
- There is an important shortcoming (perhaps one of the problems listed in the last paragraph of the 7-point score, or there are other subject-specific problems).

4 Points
Standards fall short in one or more of the following ways:
- At least 35 percent and up to 50 percent of crucial content is missing.
- Some of the content in the standards is unnecessary (at least 35 percent, and up to 50 percent).
- The level of rigor is appropriate for less than half of the targeted grade level(s), and these expectations are not always clearly articulated. Students are expected to learn the content and skills in a sequential order and at an increasing level of difficulty, but this order and increasing level of difficulty are infrequently articulated.
- More than 50 percent of the standards focus on learning processes rather than learning outcomes.
- The standards are inconsistent in their descriptions of the text complexity expected of students.
- There are a few critical shortcomings (as listed above).

3 Points

Standards fall short in one or more of the following ways:

- At least 50 percent of crucial content is missing.
- The majority of the content in the standards is unnecessary.
- The standards focus on learning processes rather than outcomes.
- The level of rigor is inappropriate for more than half of the targeted grade level(s) and these expectations are not clearly articulated. Students are expected to learn the content and skills in a sequential order and at an increasing level of difficulty, but this order and increasing level of difficulty are infrequently articulated.
- The standards do not mention text complexity expected of students.
- There are serious problems, shortcomings, or errors in the standards, although the standards have some redeeming qualities and there is some evidence of rigor.

2 Points

Standards fall short in one or more of the following ways:

- At least 50 percent of crucial content is missing.
- The majority (approximately 80 percent) of the content in the standards is unnecessary.
- There are several serious problems, shortcomings, or errors (as listed above).

1 Point

Standards fall short in one or more of the following ways:

- At least 80 percent of crucial content is missing.
- At least 80 percent of the content in the standards is unnecessary.
- There are numerous problems, shortcomings, or errors (as listed above).

0 Points

Standards fall short in one or more of the following ways:

- The content of the standards does not address or barely addresses the subject-specific content expectations.
- The content is poorly chosen and fails to provide the level of rigor appropriate for the targeted grade level(s).
- Content is full of problems, shortcomings, and errors (as listed above).

Clarity and specificity

Standards should be clearly written and organized. The purpose of standards is to communicate educational goals to students, parents, and educators. To meet the needs of all of these audiences, standards must be clearly written, without jargon, and must be laid out in a manner that makes them easy to follow and understand.

Florida could earn up to three points for clarity and specificity, as explained below.

3 Points
- Standards are coherent, clear, and well organized. The scope and sequence of the standards are apparent and sensible. They provide solid guidance to users (students, teachers, curriculum directors, test developers, textbook writers, etc.) as to the content knowledge and skills required to be college- or career-ready. The right level of detail is provided.
- The document(s) are written in prose that the general public can understand and are mostly free from jargon. The standards describe things that are measurable (i.e., can lead to observable, comparable results across students and schools). The standards as a whole clearly illustrate the growth expected through the grades, and the organization of the standards across reading, writing, and oral language are clearly specified.

2 Points
- The standards are somewhat lacking in coherence, clarity, or organization.
- The scope and sequence of the standards is not completely apparent or sensible. The standards do not provide a complete guide to users as to the content knowledge and skills required to be college or career ready (i.e., as a guide for users, there are shortcomings that were not already addressed by the content and rigor score). The standards provide insufficient detail. There is some connection between the organization of the different components of the language arts (reading, writing, speaking, listening); perhaps there are connections between reading and writing or speaking and listening.
- The prose is generally comprehensible but there is some jargon and some vague or unclear language. Some standards are not measurable.

1 Point
- The standards are somewhat coherent, clear, and organized. They offer limited guidance to users (students, teachers, curriculum directors, textbook writers, etc.) about the content knowledge and skills required to be college- or career-ready, but there are significant shortcomings (as a guide for users) that were not already addressed by the content and rigor score. The standards are seriously lacking in detail, and much of the language is vague enough to be unclear in what is being asked of students and teachers. There is no obvious connection among the components of the language arts.

0 Points
- The standards are incoherent and/or disorganized. They are not helpful to users. They are sorely lacking in detail. Scope and sequence are not apparent.

Overall ratings

Florida can earn a total of 10 possible points. Final scores translate to the following overall ratings in Table C-1.

Table C-1. Score Ratings		
Total Score	Overall Rating	Recommendation
9–10	Strong	Recommend implementation of these standards and the development of sample lessons that demonstrate their use.
7–8	Good	Recommend implementation of these standards with targeted revisions.
5–6	Weak	Weak. Recommend significant and immediate revisions. Standards are not suitable until and unless these revisions occur.
0–4	Inadequate	Highly recommend complete revision or rewrite. Do not recommend implementation of standards as they have critical shortcomings.

Appendix D: Mathematics Review & Scoring Criteria

Below are the content-specific criteria upon which the Florida B.E.S.T. mathematics standards were evaluated for their "Content" score (see also the *Scoring criteria* that follows).

Content-specific criteria

Whole Numbers

Standards related to number and operations involving whole numbers should include standards that are foundational to the development of number sense. Such standards include those that involve counting, composing and decomposing whole numbers, place value, and comparing and ordering numbers. The pervasive role of place value should be articulated and emphasized. The standards should address developmental understandings and the related learning trajectories leading to computational fluency with addition/ subtraction and multiplication/division, including access to and use of the commutative, associative, and distributive properties.

Within the elementary and middle school grades, students should be expected to:
- Demonstrate instant recall with single-digit addition and multiplication facts and their related subtraction and division combinations.
- Use a variety of representations as they develop understanding of whole numbers and whole number operations, including concrete models, drawings (e.g. arrays), and equations.
- Fluently add and subtract using strategies and algorithms based on place value, properties of operations, and/or the relationships between addition and subtraction, developmentally leading to understanding of and fluent use of the standard algorithm for addition and subtraction.
- Fluently multiply and divide using strategies and algorithms based on place value, properties of operations, and/or the relationships between multiplication and division, developmentally leading to understanding of and fluent use of the standard algorithm for multiplication and division.
- Solve problems that make use of whole number arithmetic.

Fractions

Standards should develop number sense concerning fractions and decimals. Such standards include recognizing fractions and decimals when represented as part of a region, parts of a set, as the count of dividing a number of objects into groups, through the area model, and on the number line; fraction

and decimal equivalence; comparing and ordering fractions and decimals; and placing various representations of numbers (whole numbers, fractions including fractions greater than 1, mixed fractions, and decimals) on a common number line. The standards should address developmental understandings and the related learning trajectories leading to computational fluency with addition, subtraction, multiplication, and division of fractions and decimals, including access to and use of the commutative, associative, and distributive properties.

Within the elementary and middle school grades, students should be expected to:
- Use a variety of representations as they develop understanding of fractions and decimals, and operations involving fractions and decimals, including concrete models, the number line, drawings (e.g. area models), and equations.
- Fluently add, subtract, multiply, and divide fractions using strategies and algorithms based on equivalence, common denominators, properties of operations, and the relationships between the operations.
- Fluently add, subtract, multiply, and divide decimals using strategies and algorithms based on place value, properties of operations, and/or the relationships between the operations, developmentally leading to understanding of and fluent use of the standard algorithm for each of the operations.
- Extend understandings related to multiplication, division, and fractions to represent and solve problems involving ratio, rate, proportion, and percent.
- Solve problems that involve fractions and decimals.

Other standards that should be addressed, typically in middle and high school, include negative numbers, radicals, rational exponents, scientific notation, estimation (including the use of scientific notation to approximate, compare and calculate approximately with numbers, especially large and small numbers), rational numbers as repeating decimals, and the arithmetic of complex numbers.

Measurement and Data

Standards related to measurement and data should engage students in applying concepts, understandings, and procedures involving these topics.

Within the elementary and middle school grades, students should be expected to:
- Estimate and measure lengths to the nearest centimeter, meter, inch, and foot.
- Know and understand the concept of area, relating it to the operations of multiplication and addition, and use and understand formulas to determine the area of a rectangle and triangle.
- Know and understand how to convert measurements within and between the metric and customary systems.
- Know and understand measurement applications related to time, liquid measures, weight, perimeter, surface area, volume, and angle measurement.
- Represent and interpret data using graphs and line plots.

Algebra

Standards related to algebra, including those at the elementary school level, help to ensure college and career readiness. Rigorous K–12 standards must include algebra standards that cover the following essentials.

Standards covering linear equations should ensure that students:
- Extend understandings of ratio, rate, and proportion to linear equations.
- Solve equations and inequalities that are linear or involve the absolute value and know how to graph them.
- Know about slope and the various forms of linear equations and be able to write equations given different types of information, such as for a line through a given point with a given slope, a line through two points, or a line through a given point that is perpendicular to a given line.
- Solve a system of two linear equations in two unknowns.

Standards covering quadratic equations should ensure that students:
- Solve quadratic equations by factoring, completing the square, and using the quadratic formula, including complex solutions.
- Are able to graph y=ax2+bx+c, transform such a quadratic function into vertex form, find its vertex, its maximum or minimum, and its line of symmetry, and explain the geometric meaning of these quantities or objects.

In addition, students should be fluent with the four arithmetic operations with polynomials and be able to carry out elementary factoring, be able to use general function notation and multiple representations of functions (algebraic, graphical, verbal descriptions, and numerical), as well as exponential and logarithmic functions and their inverse relationship, and basic trigonometry and trigonometric functions. They should also be able to analyze suitable word problems using algebra.

Geometry

Standards related to geometry provide opportunities in the elementary grades for spatial visualization, and in late middle and high school, opportunities for logical reasoning about geometric objects.

Within the elementary and middle school grades, students should be expected to:
- Identify and draw shapes and distinguish between the attributes of shapes.
- Identify properties of and classify two-dimensional and three-dimensional shapes.
- Graph points on the coordinate plane.
- Understand and apply the Pythagorean Theorem.

As part of the study of high school geometry, students should understand:
- Congruence, similarity, and symmetry.
- Proofs of standard results about angles of triangles and angles associated with lines crossing parallel lines, including perpendicular lines.
- Proofs of the standard theorems about congruence and similarity of triangles.
- Proofs of the standard theorems about circles, chords, tangents, and angles.
- How to do standard geometric constructions.

Students should also be able to solve problems involving two- and three-dimensional geometry.

Statistics and Probability

Middle school and high school standards related to statistics and probability should engage students in the selection and use of appropriate statistical methods to analyze data, develop and assess inferences and predictions, and apply basic concepts of probability.

Within middle school and high school mathematics, students should be expected to:
- Read, analyze, and construct a variety of graphs and tables for univariate and bivariate data.
- Understand that responses to statistical problems should consider variability, and make inferences and justify conclusions from data.
- Determine and understand theoretical and experimental probabilities of simple and compound events, and use probability in the context of decisionmaking.
- Be able to carry out counting arguments involving combinations and permutations.

The Development of Mathematical Thinking and Practices

Content standards at each level of instruction should regularly engage with ways of discussing, thinking about, and working on mathematics. In particular, problem solving, reasoning, mathematical precision, constructing mathematical explanations, modeling with mathematics, assessing the reasonableness of answers using estimation or other strategies, and the use of appropriate tools[8] should be consistently integrated with mathematical content.

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[8] The main focus in elementary school math is developing number sense and the mastery of arithmetic. In particular, students must be able to instantly add and multiply single-digit numbers and be fluent with use of the corresponding subtraction and division facts. They must also be able to add, subtract, multiply, and divide multi-digit whole numbers, decimals, and fractions without a calculator, and be able to select the best approach to efficiently carry out a computation. To support this expectation, calculators in elementary school should either not be used or else used only for specifically targeted lessons. At all grade levels (K–12), technology should not be used as a replacement for mathematical understanding or the development of computational skills, but rather to develop and support students' understanding.

Scoring criteria

Standards are evaluated in two categories: Content (focus, coherence, and rigor) and Communication (clarity, specificity, and access). Based on the degree to which the standards included the content above, Florida could earn up to 7 points for Content, as summarized below.

Content: focus, coherence, rigor

6 or 7 Points

Standards meet or exceed all or nearly all of the following criteria:
- The content domains and standards provided are appropriate for respective grade, course, and developmental levels.
- The standards show focus of content:
    - Critical topics for each grade level or course are clearly addressed. (These are outlined in the math-specific content criteria below.)
    - The standards do not include superfluous content topics nor overemphasize particular topics.
    - The balance between critical or more important mathematics standards within particular grades, levels and courses, and other, less important, standards within such grades or courses, is appropriate.
- Coherence across and within mathematical topics and coherence across grade levels and courses is evident within the standards. The standards build logically and sequentially from grade to grade and from elementary to middle to high school, reflecting the cumulative nature of mathematics.
- The level of rigor of the standards is appropriate for the targeted grade level(s) or course(s). The standards balance conceptual understanding, procedural skill and fluency and applications.
- The standards clearly address mathematical practices, i.e., ways of thinking about and working on mathematics, and integrate these practices within and across mathematical content domains and standards.
- The standards that run through grade 12 are sufficiently comprehensive and challenging to ensure that students who achieve proficiency by the final year of high school will be college- or career-ready.
- The standards avoid other major subject-specific problems identified by the reviewers.

4 or 5 Points

Standards fall short in one or more of the following ways:
- The content domains and standards provided are not always appropriate for respective grade, course, and developmental levels.
- The focus, coherence, or rigor of the standards is inconsistent. For example:
    - Critical topics for grade levels or courses are not always clearly addressed.
    - The standards sometimes overemphasize topics of little importance or underemphasize topics of substantial importance (for which importance is neither expressly articulated nor conveyed via the number of standards dedicated to particular topics).
    - Coherence across and within mathematical topics or coherence across grade levels and courses is uneven.
    - The level of rigor of the standards is not always appropriate for the targeted grade level or course.
- The standards sometimes fail to balance conceptual understanding, procedural skill and fluency and applications.
- The standards address mathematical practices, i.e., ways of thinking about and working on mathematics, but do not consistently integrate mathematical practices with the content standards.
- There are other particular problems or shortcomings related to the standards.

2 or 3 Points

Standards fall short in two or more the following ways:
- Several crucial content domains or standards are not provided.
- Some of the content domains and/or standards are unnecessary.
- The standards do not achieve focus.
- The standards lack coherence concerning one or more important mathematical topics.
- The standards lack sufficient rigor in their treatment of one or more important mathematical topics.
- There are very limited connections between the content standards and mathematical practices, i.e. ways of thinking about and working on mathematics.

There are serious shortcomings in the standards, as presented.

0 or 1 Points

Standards fall short in two or more the following ways:
- A significant number of crucial content domains and standards are not provided.
- Many of the content domains and/or standards are unnecessary.
- The standards do not achieve focus.

- The standards lack coherence.
- The standards lack sufficient rigor.
- The standards do not address mathematical practices, i.e. ways of thinking about and working on mathematics.
- There are critical problems, shortcomings, or mathematical errors in the standards.

Communication: clarity, specificity, access

Standards should be clearly written, organized, and easy to find and navigate. The purpose of standards is to communicate educational goals to students, parents, and educators. To meet the needs of all of these audiences, standards must be clearly written, without unnecessary jargon, and must be laid out in a manner that makes them easy to follow and understand. Florida could earn up to three points for clarity, specificity, and access as explained below.

3 Points

Standards are clear and well organized, suitably detailed, and can be easily accessed.
- The standards provide understandable and appropriate guidance to users (especially teachers and curriculum directors) about the content knowledge and mathematical practices communicated. The standards as a whole clearly communicate the growth expected throughout the grades.
- The standards describe expectations that are specific and measurable (i.e., can lead to observable, comparable results across students and schools). It is clear what is expected of students. An appropriate level of detail is provided.
- The organization of the standards, including print and online versions, is appropriate and accessible. Important support documents are identified and easy to find. The standards are written in prose that the general public can understand and are, for the most part, free from jargon.

2 Points

Standards are somewhat lacking in clarity, specificity or accessibility. They fall short of the criteria for 3 points in at least one of the following ways:
- The standards often, but not always, provide understandable and appropriate guidance to users (especially teachers and curriculum directors) about the content knowledge and mathematical practices communicated. The standards as a whole mostly communicate the growth expected throughout the grades, but there are shortcomings.
- The standards usually describe expectations that are specific and measurable (i.e., can lead to observable, comparable results across students and schools); however, other standards are not measurable. It is sometimes unclear what is expected of students. An appropriate level of detail is often provided, but sometimes the standards are either vague or overly prescriptive.

- The organization of the standards, including print and online versions, is not completely apparent and accessible. Important support documents, while extant, are not always identified and easy to find. The standards are written in prose that is generally comprehensible but there is some jargon and some vague or unclear language.

1 Point

Standards are frequently lacking in clarity, specificity or accessibility. They fall short of the criteria for 2 points in at least one of the following ways:
- The standards sometimes provide understandable and appropriate guidance to users (especially teachers and curriculum directors) about the content knowledge and mathematical practices communicated, but frequently do not. The standards as a whole communicate the growth expected throughout the grades in only a limited way.
- The standards sometimes describe expectations that are specific and measurable (i.e., can lead to observable, comparable results across students and schools); however, they frequently do not. It is often unclear what is expected of students. The standards are often either vague or overly prescriptive.
- The organization of the standards, including print and online versions and related supporting materials, is not apparent or seriously lacking in accessibility. The standards are difficult to understand.

0 Points

Standards are lacking in clarity, organization or accessibility. They fall short of the criteria for 1 point in at least one of the following ways:
- The standards and related support materials do not provide understandable and appropriate guidance to users (especially teachers and curriculum directors) about the content knowledge and mathematical practices communicated. The standards do not communicate the growth expected throughout the grades.
- The standards do not describe expectations that are specific and measurable.
- The organization of the standards, including print and online versions and related supporting materials, is badly flawed. Accessibility is difficult or limited. The standards are extremely difficult to understand.

Overall ratings

Florida can earn a total of 10 possible points. Final scores translate to the following overall ratings in Table D-1.

Table D-1. Score Ratings		
Total Score	Overall Rating	Recommendation
9–10	Strong	Recommend implementation of these standards and the development of sample lessons that demonstrate their use.
7–8	Good	Recommend implementation of these standards with targeted revisions.
5–6	Weak	Weak. Recommend significant and immediate revisions. Standards are not suitable until and unless these revisions occur.
0–4	Inadequate	Highly recommend complete revision or rewrite. Do not recommend implementation of standards as they have critical shortcomings.