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Table of Contents

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Research Article

A Comparison of Higher-Order Thinking Between the Common Core State Standards and the 2009 New Jersey Content Standards in High School

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Abstract

The creators and supporters of the Common Core State Standards claim that the Standards require greater emphasis on higher-order thinking than previous state standards in mathematics and English language arts. We used a qualitative case study design with content analysis methods to test the claim. We compared the levels of thinking required by the Common Core State Standards for grades 9-12 in English language arts and math with those required by the New Jersey Core Curriculum Content Standards in grades 9-12 English language arts and math (used prior to the Common Core) using Webb's Depth of Knowledge framework to categorize the level of thinking required by each standard. Our results suggest that a higher percentage of the 2009 New Jersey high school curriculum standards in English language arts and math prompted higher-order thinking than the 2010 Common Core State Standards for those same subjects and grade levels. Recommendations for school administrative practice are provided.

Key Words

Common Core State Standards, standardization, higher-order thinking

According to officials from National Governors Association (NGA) Center for Best Practices and the Council of Chief State School Officers (CCSSO), the Common Core State Standards are "based on rigorous content and application of knowledge through higher-order thinking skills" and "informed by other top performing countries in order to prepare all students for success in our global economy and society" (NGA Center & CCSSO, 2015, About the Standards). An overt message we draw from the Common Core State Standards (CCSS) developers regarding their product is that the Standards are designed to ensure that students will have the knowledge and academic skills necessary to succeed in the global economy. Documentation on the official CCSS website presents "higher-order thinking skills" as a key component of the Standards (NGA Center & CCSSO, 2015, About the Standards). But what constitutes the higher-order skills necessary for success in the global economy?

Mainstream Calls for Higher-Order Thinking

Some commentators from business, economics, and education circles argue that the types of higher-order thinking skills that students need to be globally competitive include creative thinking and strategic thinking. For example, the IBM Corporation (2012), the United States Council on Competitiveness (2012), the Institute for Management Development (2012), the Organisation for Economic Co-operation and Development [OECD] (2013), Pink (2006), Robinson (2011), and Zhao (2012), and others identified variations of creative and/or strategic thinking they believe are important skills that high school graduates need in order to access better options for college, careers, and global economic competitiveness.

Similarly, Cisco Systems Inc., Intel Corporation, Microsoft Corporation, and the University of Melbourne (2010) drew similar conclusions from *The Assessing and Teaching of 21st Century Skills* (ATC21S) study. They found higher-order thinking related to greater global competitiveness. The results from the ATC21S identified and categorized skills that future employees will need in order to remain viable in the global economy. The ATC21S study divided the skills into four categories, one of which was based exclusively on creative and strategic thinking:

- Ways of thinking: creativity, critical thinking, problem solving, decision making, and learning
- Ways of working: communication and collaboration
- Tools for working: information and communications technology (ICT) and information literacy
- Skills for living in the world: citizenship, life and career, and personal and social responsibility

Andreas Schleicher (Asia Society, 2010), OECD's head of the Programme for International Student Assessment (PISA) echoed the ATC21S findings of a need for higher-order non-routine competencies when he stated, "In the developing knowledge economy, workers are expected not to take orders, but to think in complex ways with ever-changing variables." Schleicher's emphasis on critical thinking was repeated in the United States by various business and education lobbying groups. The American Society for Training and Development (2010) identified "innovative thinking and action; the ability to think creatively and to generate new ideas and solutions to challenges at work" as crucial competencies and skills students will need to succeed in the global economy (p. 13). The National Education Association (NEA), the largest public educator special interest group in the U.S., warned its members that their students will not be able to meet the varied demands of a global economy and join the 21st century workforce unless schools prepare them with the skills to "create and innovate" (NEA, 2012, p. 24).

Although the type of creative and strategic thinking that public school personnel should develop in students can be debated, there seems to be some agreement in the school-reform literature that creativity and strategic thinking have a role to play in P-12 education to prepare students for economic life beyond compulsory schooling. The literature on economic global competitiveness and the shift to a knowledge economy reflects a conviction shared by leading corporate voices and some education officials that successful education will need to place greater emphasis on creative and strategic thinking.

New Jersey context

As in almost 40 other states, the New Jersey education landscape is not immune to the perceived pressure to equip students with higher-order thinking skills. New Jersey Department of Education (NJDOE) officials adopted the Common Core State Standards on June 16, 2010; 14 days after the NGA and CCSSO (2010) officially released the final version of the standards. The NJDOE (2010) reiterated the CCSS creators' claims on its state education Common Core website that the Standards will prepare New Jersey students for 21st century college and career expectations:

> The Common Core State Standards, adopted by the New Jersey State Board of Education in 2010, define grade-level expectations from kindergarten through high school for what students should know and be able to do in English Language Arts (ELA) and mathematics to be successful in college and careers.

By replacing the former New Jersey state standards in ELA and math with the CCSS, New Jersey education officials implied that the CCSS are superior to the former NJ standards in those areas.

The concern with the skills necessary to compete economically in a global economy extends to systemic reform plans in New Jersey. For example, officials from the NJDOE (2012a) issued a warning about the need to improve high school graduates' higher-order thinking in their *Education Transformation Task Force Final Report*:

> The dramatically changed economic environment of the 21st century characterized by increased global competitiveness and a shift from an industrial to a knowledge-based economy has shed a harsh light on another achievement gap. There is a growing chasm between what we require children to learn to be eligible to graduate from high school and what they actually need to learn to be truly ready for college and career. (p. 3)

Officials at the NJDOE created policies that correspond with the CCSS creators' claims of superior development of higher-order thinking and preparation for the global economy. The NJDOE leadership mandated that all school district leaders fully align their K-12 curricula in ELA and math with the CCSS shortly after the NJ State Board of Education voted to adopt the Standards, as did other states like California, Tennessee, and Illinois. NJDOE officials also indicated in their state's application for a United States Department of Education Race To The Top Phase III grant that 100% of schools would use CCSS aligned curricula by the start of the 2014-2015 school year (NJDOE, 2012b).

New Jersey provides an example of what took place in almost 40 other states around the nation since the 2010 launch of the Common Core. In essence, it is a microcosm of changes happening at state education agencies across the country. New Jersey was one of the first states to sign on to the Common Core and also a founding member of the Partnership for Assessment of Readiness for College and Careers consortium (PARCC), one of the two national testing bodies that created tests aligned to the Common Core, and thus represents an early adopter of the large-scale curriculum national standardization movement.

High school focus

The CCSS claims of enhancing higher-order thinking and global competitiveness seem to resonate most concretely in high school. High school represents the end of compulsory schooling, and, according to the information posted on the official CCSS website, "The standards define the knowledge and skills students should gain throughout their K-12 education in order to graduate high school prepared to succeed in entry-level careers, introductory academic college courses, and workforce training programs" (NGA Center & CCSSO, 2015, About the Standards). Policies adopted by New Jersey education officials signal that high school curriculum standards play an important role in ensuring that students will graduate with the skills necessary to compete in the global economy. One example of the NJDOE officials' concern about raising the level of thinking in high school is their continued emphasis on high school exit exams. Not only did they reaffirm their commitment to high school exit exams, NJDOE officials also took the additional step of increasing the number of mandated exams from two to six, all of which must be aligned to the CCSS.

Given the rhetoric regarding the ability of the CCSS to prepare all students for all colleges and careers in a global knowledge economy, one might expect to see creativity and strategic thinking embedded throughout the CCSS high school standards for English language arts (ELA) and mathematics (M) more so than previous versions of New Jersey curriculum standards in those subjects.

Problem, purpose, and questions

No qualitative analytical research has been done to test the assumption that the CCSS are superior to previous state standards in the development of higher-order thinking and creativity at the high school level. Our purpose for this qualitative case study using content analysis techniques was to describe and compare the percentages of the CCSS and former New Jersey Core Curriculum Content Standards (NJCCCS) in ELA and M that require students to demonstrate strategic and/or creative thinking at the high school level.

Three questions guided our study:

1. To what extent are creative and strategic thinking, as defined by Webb's Depth of Knowledge, embedded in the

Common Core State Standards for English Language Arts and Mathematics for grades 9-12?

2. To what extent are creative and strategic thinking, as defined by Webb's Depth of Knowledge, embedded in the New Jersey Core Curriculum Content Standards for English Language Arts and Mathematics for grades 9-12?
3. What differences and similarities exist in creative and strategic thinking between the Common Core State Standards and New Jersey Core Curriculum Content Standards in English Language Arts and Mathematics for grades 9-12?

Significance

Our study includes an important innovation over previous works by not only including all CCSS anchor standards, but also drilling down to the sub-standards or individual learning objectives embedded within each standard. Sat et al.'s (2011) Smarter Balanced Study deviated from Webb's (2005) recommendations by giving multiple ratings to one Common Core anchor standard to account for all the sub-standards.

For example they labeled ELA RL.9-10.1 as a DOK 1, 2, and 3. Therefore one standard could receive credit as a 3 even if it were populated by a majority of Level 1 objectives.

We sought to provide greater precisions with our ratings and gave one DOK rating per standard and rated each sub-standard. Another study, Florida State University's (2012) CPALMS study, gave one rating for each Common Core standard and sub-standard within the Grades 9-12 ELA and Math CCSS and NJCCCS. The precision in our methods translates to greater precision of the results and more a complete picture of the CCSS.

Literature Touchstones

Conceptual framework

There have been various attempts to define what constitutes higher-order thinking in the public high school curriculum. The mainstream, non-empirical, literature on standards-based education reform tends to group creativity, innovation, entrepreneurship, and strategic or critical thinking together. However, scholarly frameworks allow researchers to deconstruct and categorize curriculum standards according to expected levels of cognition or thinking. Webb's (1997; 2007) Depth of Knowledge (DOK) is one such framework.

According to Webb (1997), Depth of Knowledge encompasses multiple dimensions of thinking, including the "level of cognitive complexity of information students should be expected to know, how well they should be able to transfer the knowledge to different contexts, how well they should be able to form generalizations, and how much prerequisite knowledge they must have in order to grasp ideas" (Webb, 1997, p. 15). DOK is a way to define and categorize cognitive complexity of curriculum standards and tasks. The "DOK level of an item does not refer to how easy or difficult a test item is for students" (Wyse & Viger, 2011, p. 188). The focus of DOK is on the cognitive complexity of required tasks or curriculum standards.

Complexity Versus Difficulty

Although complexity and difficulty are necessary components of an intended curriculum, the Depth of Knowledge or complexity of a learning objective is dynamic and encompasses the multiple dimensions of an objective ranging from the "level of cognitive complexity of information students should be expected to know, how well they should be able to transfer this knowledge to different contexts, how well they should be able to form generalizations, and how much prerequisite knowledge they must have in order to grasp ideas" (Webb, 1997, p. 15).

Sousa (2006) defined complexity as the thought processes required to address a task. Complexity can be thought of as the difference between remembering a fact or imitating a procedure and developing an original product, conclusion, or process. Remembering facts and imitating procedures are less cognitively complex than developing an original conclusion, product or process.

Difficulty is a more static component of a learning objective that simply refers to the amount of work or effort a student must use to complete a task, regardless of complexity. For example, asking students to solve an addition problem with two one-digit numbers is less difficult than solving the same problem with four one-digit numbers. The complexity is still at the "remember and imitate" procedure level, but the second problem is theoretically more difficult because it requires more effort to add more numbers. Our concern rests with cognitive complexity.

DOK levels

Webb (1997) described Depth of Knowledge within an educational objective as cognitively complex, involving the numerous connections students make from prior knowledge to current knowledge using strategic and extended forms of thinking in order produce an idea that is original and purposeful (p. 15). We used Webb's (1997; 2007) four DOK levels as lenses through which to deconstruct and describe the cognitive complexity of the CCSS and former 2009 NJCCCS in grades 9-12 for ELA and M for this study:

> Level 1 (recall): Standards at this level require students to recall a simple definition, term, or fact, or replicate a procedure, or algorithm.
>
> Level 2 (skill/concept): Standards at this level require students to develop some mental connections and make decisions about how to set up or approach a problem or activity to produce a response, apply a recalled skill, or engage in literal comprehension.
>
> Level 3 (strategic thinking): Standards at this level require students to engage in planning, reasoning, constructing arguments, making conjectures, and/or providing evidence when producing a response and require students to do some complex reasoning and make original concepts or draw conclusions.
>
> Level 4 (extended thinking): Standards at this level require students to engage in complex planning, reasoning, and conjecturing, and to develop lines of argumentation. Items at this level require students to make multiple connections between several different key and complex concepts, inferencing, or connecting the dots to create a big picture generalization.

Depth of Knowledge includes multiple forms of knowledge such as declarative, which is based on facts, and procedural, which can be described as practical "know-how" (Runco & Chand, 1995, p. 245). Declarative knowledge is linked to procedural knowledge; together they form the foundation that structures creative and strategic thinking opportunities. Levels 1 and 2 of Webb's DOK focus on declarative and procedural knowledge (in other words, recall and basic application). Although basic application of material is the first of many steps involved in creative and strategic thought, thinking does not stop at the declarative and procedural levels.

Webb's Levels 3 and 4 include creative and strategic thinking and provide opportunities for students to experience deeper, analytical, and more divergent types of thinking. Sternberg (1999) asserts that creativity is the "aptitude to generate work that is unique and original as well as suitable for the specific task or problem one is attempting to solve" (p. 3); this comports with Webb's higher levels of DOK.

We equated DOK Levels 3 and 4 with the types of thinking that commentators in the mainstream literature on standards-based education reform refer to when they call for students to develop higher-order thinking skills. Webb (1997) views DOK Levels 3 and 4 as the levels at which students have opportunities to be flexible, creative, and strategic in their thinking because they are not bound to converge on one correct answer or to imitate one procedure.

If a set of curriculum standards does not have an appropriate flexible mix of cognitive complexity, including various DOK levels of thinking, students have fewer opportunities to gain the consistent learning experiences they need in order to think effectively at Webb's DOK 3 and 4 levels of cognition. Their thinking can become somewhat rigid if they receive a predominance of declarative and procedural thinking opportunities (Runco and Chand, 1995; Sternberg, 2003). If cognitive flexibility is not embedded in the standards and they are over-weighted with Level 1 and 2 standards, students will reach what Runco and Chand (1995) call "functional fixedness" (as cited in Ward, Smith, & Finke, 2010, p. 201, p. 247).

Functional fixedness is "the rigidity or mental set that locks thinking so an individual cannot see alternatives" (Runco and Chand, 1995, p. 247). A curriculum standard with functional fixedness would be categorized as a Level 1 recall or, a Level 2 basic application in terms of Webb's DOK. Standards at levels 1 and 2 do not have the divergent thinking opportunities needed to develop cognitive flexibility and they are dominated by convergent thinking aimed at finding one correct, pre-determined answer based on imitation processes.

If the purposeful cognitive design of curriculum standards and the dangers of functional fixedness are understood during the creation of curriculum standards, then standards can potentially increase cognitive "originality and flexibility," by ensuring that a mix of cognitive levels appears throughout the standards in each subject and for each grade level (Runco & Chand, 1995, p. 245). Although curriculum standards focused on procedural and declarative knowedge are not the lead actors in fostering creative and strategic thinking, they do play a supporting role.

Procedural and declarative knowledge provide a foundation needed to reach complex and extended forms of thinking; however, too much focus on the lower levels of thinking can crowd out opportunities for more divergent thinking and turn students into "intellectual clones" (Sternberg, 2003, p. 335). If deeper levels of cognitive demand are absent and content is repetitive in nature, standards can jeopardize complex efforts to help students become creative and orginal thinkers (Runco & Chand, 1995, p. 245).

DOK Examples in the Content Areas

Attributes and key words for each DOK level provide descriptive language and concrete boundaries for abstract concepts like strategic thinking. Each DOK level in Webb's framework describes a specific type of thinking and its associated cognitive complexity. In general, the higher the cognitive complexity of a standard, the more creativity and strategic thinking will be embedded in it.

Below are example descriptions we used to frame the parameters of the levels of thinking for the purposes of this study:

Mathematics DOK Level 1. Standards at Level 1 require the recall of information such as basic facts, definitions, mathematical terms, as well as the ability to follow through a process by performing a simple algorithm or applying a formula. A one-step, well-defined algorithmic procedure should be included at Level 1.

Mathematics DOK Level 2. A Level 2 standard requires students to make some decisions regarding how to approach the problem or activity; whereas, a Level 1 only requires students to demonstrate a rote response, perform a previously learned algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Keywords that might distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These prompt students to perform multi-step procedures.

Mathematics DOK Level 3. Curriculum standards at this level require reasoning, planning, using evidence to generate an original thought or interpretation, and doing more complex and inventive thinking than the previous two levels. Problems that ask students to explain their thinking by making original inferences or conclusions, beyond regurgitating memorized steps or processes, and make conjectures can be classified as Level 3. The cognitive demands at Level 3 are non-standard, complex, open-ended, and more abstract. The complexity results from the standards requiring more demanding creative reasoning.

Mathematics DOK Level 4. Students must demonstrate complex reasoning, planning, developing, and strategic thinking, usually over an extended period of time. Extended time is not a requirement for Level 4, but it is often a component of the type of cognitive work done at this level. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2. However, if the student conducts a river study that requires interpreting and drawing conclusions from data and proposing original solutions, based on evidence, to a non-standard problem, based on multiple variables and data points collected over time, the problem would be Level 4. The work is complex and divergent. More often there is not a single answer, as much as there are original conclusions or interpretations that are reached and multiple, nonstandard ways to arrive at them. Students are generally required to make several connections within the content area and among content areas.

Reading Level 1. This level requires students to remember or recite facts or to use simple skills or abilities. Oral reading and basic comprehension of a text (but not analysis of a text) are included. Questions require only a shallow understanding of the text presented and often consist of verbatim recall, slight paraphrasing of specific details from the text, or simple understanding of a single word or phrase.

Reading Level 2. Level 2 involves some mental processing beyond recalling or reproducing a response; it requires both comprehension and subsequent processing of text or portions of text. Inter-sentence analysis or inference is required. Questions at this level might include words like "cite evidence," "summarize," and "explain." Students might also be asked to determine whether a statement is a fact or an opinion. Literal main ideas are stressed.

Reading Level 3. Deep knowledge becomes a greater focus at Level 3. Students must show an understanding of the ideas in the text and are encouraged to go beyond the text to make connections. Students might be prompted to explain, generalize, or connect ideas. Standards at Level 3 involve reasoning and planning; students must be able to support their conclusions or interpretations. Questions might involve abstract theme identification, inference across an entire passage, or the application of prior knowledge to form a generalization.

Reading Level 4. Higher-order thinking is central and deep knowledge is required at Level 4. The standard at this level will probably require participation in a longer-term activity that is non-repetitive and requires the application of significant conceptual understanding and divergent thinking. Students must take information from at least one passage of a text and apply this information to a new task or in an original way or to create and support original conclusions and interpretations. They might also be asked to develop hypotheses and perform complex analyses of the connections among texts in order to develop original ideas, uses, processes, or productions from knowledge.

Writing Level 1. Level 1 requires the student to develop basic ideas and write facts from recall. The students might be asked to list ideas, words, or simple sentences, the way one might work during a brainstorming activity. They might also be required to copy notes from a pre-made source. Students are expected to write, speak, and edit using the conventions of Standard English and they are required to demonstrate a basic understanding and appropriate use of reference materials, such as a dictionary or thesaurus.

Writing Level 2. Level 2 requires some degree of mental processing. At this level, students engage in first-draft writing or brief extemporaneous speech for a limited number of purposes and audiences. Students are expected to begin connecting ideas to form paragraphs and might also need to work at independent note taking, outlining, or summarizing.

Writing Level 3. Students develop original works with multiple paragraphs that include complex sentence structure and demonstrate some synthesis and analysis of a topic. Students show awareness of their audience and purpose through focus, organization, and the use of appropriate compositional elements such as voice. At this stage, students use known criteria to independently engage in editing and revising to improve the quality of the composition.

Writing Level 4. A curriculum standard at this level would involve writing a multi-paragraph composition that demonstrates the ability to synthesize, analyze, and develop complex ideas or themes. Students should demonstrate a deep awareness of purpose and audience. For example, informational papers should include hypotheses and supporting evidence and original interpretations or conclusions.

Methodology

We used a qualitative case study design with content analysis methods to describe and compare the percentages of the CCSS and of the former New Jersey Core Curriculum Content Standards (NJCCCS) in ELA and M that require students to demonstrate strategic and/or creative thinking.

Qualitative content analysis refers to research methods for interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p. 1278).

The content analyzed in this study consisted of CCSS and NJCCCS documents presenting the curriculum content standards for grades 9-12 mathematics and English language arts.

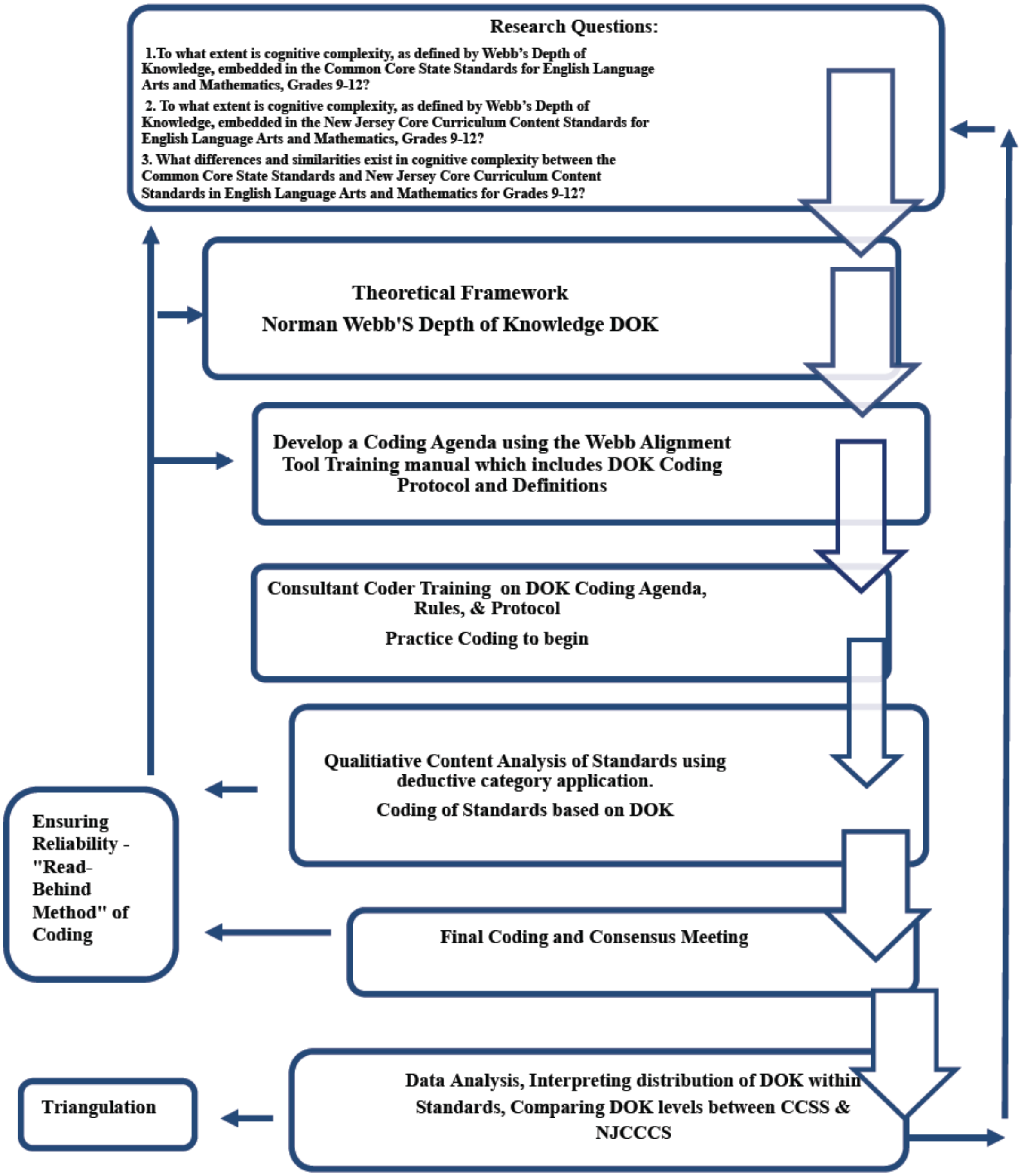
Deductive category application was used to connect Webb's existing Depth of Knowledge framework to the high school CCSS and NJCCCS in ELA and M (Mayring, 2000). Figure 1 shows the *Step Model* of deductive category application, as described by Mayring (2000), that we used to guide the process of coding and analyzing the standards. Hsieh and Shannon (2005) stressed that the "success of a content analysis depends greatly on the coding process" (p. 1285). The coding activities for each set of standards in each subject area and grade level followed the same procedure as described by Mayring (2000).

Instead of aligning the standards with an external assessment, as is commonly done in alignment studies, we compared the cognitive complexity of one set of curriculum standards to another based on DOK levels. School districts across the country are mandated by their state education agencies to align their curriculum to the CCSS, not an assessment.

We analyzed and coded the grades 9-12 Common Core English language arts and mathematics standards and the grades 9-12NJCCCS in English language arts and mathematics based on their corresponding DOK levels. Each standard was assigned a 1-4 Depth of Knowledge level based on Webb's Depth of Knowledge methodology. Utilizing Mayring's (2000) step model as the guide (see

Figure 1), a coding agenda was created using the DOK definitions, examples, and coding rules as described in the Webb Alignment Tool (WAT) training manual (Webb, et al., 2005).

Figure 1. Mayring's (2000) step model used to guide analyses.



Coding

Webb's Alignment Tool (WAT) training manual contains definitions, explanations, and examples for coders to reference and specifically understand how the DOK levels should read for English Language Arts and Mathematics objectives. We used two trained coders to analyze and code each set of standards. Webb's definitions of each DOK level helped ensure the coders' reliability and consistency as they rated each standard (Webb, et al., 2005, p. 36).

Below are samples of the rules—adapted from the WAT training manual—that the two coders followed when assigning DOK levels to each standard.

- The DOK level of an objective should be the level of work students are most commonly required to perform at that grade level to successfully demonstrate their attainment of the objective.
- The DOK level of an objective should reflect the *complexity* of the objective, rather than its *difficulty*. The DOK level describes the kind of thinking involved in a task, not the likelihood that the task will be completed correctly.
- In assigning a DOK level to an objective, coders should consider the complete domain of items that would be appropriate for measuring the objective and identify the depth-of-knowledge level of the most common of these items.
- If there is a question regarding which of two levels an objective matches, such as Level 1 or Level 2, or Level 2 or Level 3, it is usually appropriate to select the higher of the two levels.
- The team of reviewers should reach consensus on the DOK level for each objective before coding any items for that grade level.

Two coders using Webb's coding protocol have already proven to be effective in two large-scale studies that used the WAT to analyze and code standards based on DOK complexity (Yuan & Le, 2012; Sato et al., 2011). Each deductive category within Mayring's (2000) step model (See Figure 1) has explicit descriptions, examples, and DOK coding rules adapted from the WAT (Webb, et al., 2005) training manual.

The descriptions, examples, and coding rules helped to increase the probability that coders understood thoroughly which DOK level should be assigned to each standard. Mayring's step model was adapted and revised for this study to include descriptions of Webb's depth of knowledge (DOK) levels excerpted from the Web Alignment Tool (WAT) training manual (Webb, 2005, p. 45-46, 70–75). Two coding agendas were developed, one for all mathematics standards and one for all English language arts standards. Webb's DOK wheel was used as an additional reference tool to increase the reliability and consistency of the coding process.

Reliability

According to Merriam (2009), documentary data are persuasive, allowing little room for the researcher to "alter what is being studied" (p. 155). A document content analysis is valid in the context of this study because it is "grounded in the product in which it was produced and therefore grounded in the real world" (Merriam, 2009, p. 156). In order to increase the reliability of the findings between coders and the overall credibility of the results, the findings of this study were compared to previous studies, for which researchers coded the Common Core State Standards using the WAT for alignment purposes.

Another step we took to increase the coders' reliability was a "double-rater read behind consensus model," which proved effective in coding standards for other studies (Miles, Huberman, & Saldaña, 2014, p. 84; Sato, Lagunoff, & Worth, 2011, p. 11). Maxwell (2005) recommended using member checks to ensure the credibility of research. We used member checks as an additional inter-rater reliability strategy. The member checks allowed us to validate the coding analyses completed by the first coder using those of the second coder (p. 111). Both analysts in this study used the same data, coding agenda, and rules of coding.

Content clustering or grouping of standards, similar to those used in Sato et al.'s (2011) study, was used in coding the standards for this study. We used content clustering in cases when the content of one standard or a portion of a standard overlapped with another standard or strand (Sato, et al., 2011). The content clustering allowed us to make more reliable decisions about the DOK of overlapping standards.

Niebling (2012) provided an important warning that we heeded in preparing our coding standards: "Perhaps the most complicated work involved in using the Webb alignment model is helping coders of standards, objectives, and test items understand and reliably code them according to the DOK framework" (p. 12). Along with the preparation described above, we held preparatory meetings with coders prior to the coding sessions to discuss the methods. Coders also participated in practice coding sessions to ensure that they fully understood the coding process as well as the member check and double-rater read behind methods.

The analysts completed two practice sessions prior to the formal coding meetings. The practice sessions allowed time for the coders to familiarize themselves with the specific coding situation comparing one set of standards to another and allowed for inter-rater reliability calibration.

After the initial training meetings, the coding team read and coded the grades 9-12 NJ M and ELA standards (2009), using the "double-rater read behind consensus model" (Sato, Lagunoff, & Worth, 2011, p. 11). The second analyst reviewed the DOK findings of the first analyst and noted agreements or disagreements with each coded standard. Any disagreements were noted and discussed in follow-up meetings.

The double-rater read behind consensus model continued with the grades 9-12 CCSS in ELA and Math. Following the completion of all coding for the NJCCCS and CCSS, the coders compared their CCSS findings with Florida State University's CPALMS (2012) study, which rated all CCSS based on DOK.

This triangulation strategy of using the double read behind method and comparing the coders' results with those from previous studies increased the validity of our findings. A final member check meeting was held at the completion of each coding session to compare the completed findings of the coded CCSS from our sessions to those of the results from the study of Florida's state mandated standards, known as CPALMS (2012), in an effort to increase reliability among coders and to external results.

During instances of disagreement, the coders followed a protocol to attempt to reach consensus. For example, there was initial disagreement on the DOK level for a CCSS ELA standard. One coder rated it a Level 3 and the other rated it at Level 2. Although one rater felt the ELA standard could be rated at a DOK Level 2, the rater who coded the standard at a DOK Level 3 explained why it should be rated at a DOK Level 3, providing specific examples and descriptions from the WAT training manual to support the rating.

The rationale was that students had to use strategic skills in order to analyze the specific literature listed in the standard; therefore, a DOK Level 3 rating was appropriate because it satisfied more of the descriptions found in Level 3 than Level 2. Coders followed Webb's et al. (2005) recommendation and used the higher of the two DOK levels in rare cases in which they could not reach consensus.

Findings

Overall, the high school Common Core State Standards in ELA and M contained fewer standards rated at DOK Levels 3 and 4 than the 2009 New Jersey high school standards in ELA and math. That is, the standards that NJ had in place prior to adopting the Common Core provided more of the Level 3 and 4 higher-order skills cited in mainstream business and education publication as necessary capabilities for competing in a global economy.

The following sections provide an account of the results for each subject area as they relate to each research question.

CCSS high school standards

Our first research question asked: To what extent is cognitive complexity, as defined by Webb's Depth of Knowledge, embedded in the high school Common Core State Standards for English Language Arts and Mathematics for grades 9-12?

CCSS English language arts

Level 1 and 2 Depth of Knowledge complexity accounted for 72% of the high school ELA Common Core State Standards. Thirty-seven percent (37%) of the 9-12 CCSS ELA standards were rated at Level 1. Two examples of grades 9-12 CCSS ELA standards coded at a DOK Level 1 were:

> *Reading, grades 9-10*: 9-10.RL.10. By the end of Grade 9, read and comprehend literature, including stories, dramas, and poems, in the grades 9–10 text complexity band proficiently, with scaffolding as needed at the high end of the range.
> *Writing, grades 11-12:* 11-12.W.3.d. Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.

The distribution of ELA standards coded at a DOK Level 2 in the grades 9-12 ELA CCSS was 35%. Two examples of grades 9-12 ELA standards coded at a DOK Level 2 were:

> *Writing, grades 9-10:* 9-10.W.9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
> *Reading, grades 11-12:* 11-12.RI.2. Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.

DOK Level 3 standards made up 26% of the CCSS grades 9-12 ELA. Deeper cognitive processing, strategic thinking, and more complex understanding are emphasized in ELA standards coded at a DOK Level 3. "Editing and revising" to add original ideas, not error identification, as well as the ability to provide evidence of student thinking were important components of ELA standards coded at a DOK Level 3. Furthermore, standards coded at DOK Level 3 prompted students to look beyond the required text and create essays by explaining, generalizing, and connecting ideas. Two examples of grades 9-12 ELA standards coded at a DOK Level 3 were:

> *Reading, grades 9-10:* 9-10.RI.7. Analyze various accounts of a subject told in different mediums (e.g., a person's life story in both print and multimedia), determining which details are emphasized in each account.
> *Writing, grades 11-12:* 11-12.W.2.a. Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aid comprehension.

The distribution of standards rated at a DOK Level 4 in the grades 9-12 ELA CCSS was only 2%. Extended activities with multi-paragraph essays and the ability to apply, analyze, critique, create, and connect ideas with empirical evidence were strong components of ELA standards coded at DOK Level 4. Two examples of grades 9-12 ELA standards coded at a DOK Level 4 were:

> *Writing, grades 9-10:* 9-10.W.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
> *Reading, grades 11-12:* 11-12.RI.9. Analyze seventeenth-, eighteenth-, and nineteenth-century foundational U.S. documents of historical and literary significance (including The Declaration of Independence, the Preamble to the Constitution, the Bill of Rights,

> and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features.

CCSS mathematics

As was the case with the CCSS ELA standards, lower-level declarative and procedural thinking dominated the mathematics CCSS, with 90% rated as either DOK Level 1 or 2. The distribution of standards rated at a DOK Level 1 in the grades 9-12 Mathematics CCSS was 19%. Two examples of grades 9-12 Math CCSS coded at a DOK Level 1 were:

> *Math, grades 9-12 (The Real Number System):* N.RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.
> *Math, grades 9-12 (Congruence):* G.CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

The distribution of standards rated at a DOK Level 2 in the grades 9-12 mathematics CCSS was 71%. DOK Level 2 mathematics standards had language that prompted students to make judgments and observations about how to solve problems and to classify and compare different data sets (Webb, et al., 2005). Two examples of grades 9-12 Math CCSS coded at a DOK Level 2 were:

> *Math, grades 9-12 (Vector and Matrix Quantities):* N.VM.3 (+). Solve problems involving velocity and other quantities that can be represented by vectors.
> *Math, grades 9-12 (Similarity, Right Triangles, And Trigonometry):* G.SRT.11 (+). Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

The distribution of standards rated at a DOK Level 3 in the grades 9-12 Mathematics CCSS was 10%. To be rated a DOK Level 3, math standards needed to include language that created a valid argument for complex problems and situations that could yield more than one right answer or original conclusion. Two examples of grades 9-12 Math CCSS coded at a DOK Level 3 were:

> *Math, grades 9-12 (Seeing Structure in Expressions):* A.SSE.4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.
> *Math, grades 9-12 (Building Functions):* F.BF.1.b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

None or 0%, of CCSS mathematics standards in grades 9-12 were rated as DOK Level 4 in grades 9-12.

New Jersey high school standards

Our second research question asked: To what extent is cognitive complexity, as defined by Webb's Depth of Knowledge, embedded in the New Jersey Core Curriculum Content Standards for Language Arts Literacy and Mathematics for grades 9-12?

NJ high school English language arts (ELA)

DOK Levels 1 and 2 accounted for 62% of the NJ ELA standards. The distribution of DOK Level 1 in the grades 9-12 ELA NJCCCS was 22%. Two examples of grades 9-12 ELA NJCCCS coded at a DOK Level 1 were:

> *Reading, grades 9-12:* 3.1.12.D.1. Read developmentally appropriate materials (at an independent level) with accuracy and speed.
> *Writing, grades 9-12:* 3.2.12.A.6. Review and edit work for spelling, usage, clarity, and fluency.

The distribution of NJCCSS standards coded at a DOK Level 2 in grades 9-12 ELA was 40%. ELA standards coded at a DOK Level 2 often required comprehension and continued processing of reading, along with unplanned speaking and simple writing tasks. Two examples of grades 9-12 ELA NJCCCS coded at a DOK Level 2 were:

> *Reading, grades 9-12:* 3.1.12.A.2. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships.
> *Writing, grades 9-12:* 3.2.12.B.13. Write sentences of varying length and complexity, using precise vocabulary to convey intended meaning.

The distribution of standards coded at a DOK Level 3 in the grades 9-12 ELA NJCCCS was 33%. Two examples of grades 9-12 ELA NJCCCS coded at a DOK Level 3 were:

> *Reading, grades 9-12:* 3.1.12.E.1. Assess and apply reading strategies that are effective for a variety of texts (e.g., previewing, generating questions, visualizing, monitoring, summarizing, evaluating).
> *Writing, grades 9-12:* 3.2.12.B.3. Draft a thesis statement and support/defend it through highly developed ideas and content, organization, and paragraph development.

The distribution of standards rated at a DOK Level 4 in the grades 9-12 ELA NJCCCS was 5%. Two examples of grades 9-12 ELA NJCCCS coded at a DOK Level 4 were:

Reading, grades 9-12: 3.1.12.G.2. Analyze how our literary heritage is marked by distinct literary movements and is part of a global literary tradition.
Writing, grades 9-12: 3.2.12.D.2. Write a variety of essays (e.g., a summary, an explanation, a description, a literary analysis essay) that develop a thesis; create an organizing structure appropriate to purpose, audience, and context; include relevant information and exclude extraneous information; make valid inferences; support judgments with relevant and substantial evidence and well-chosen details; and provide a coherent conclusion.

NJ high school mathematics
Levels 1 and 2 represented 62% of the NJCCSS math standards in high school. The distribution of standards rated at a DOK Level 1 in the grades 9-12 Mathematics NJCCCS was only 8%. Two examples of grades 9-12 Math NJCCCS coded at a DOK Level 1 were:

Math, grades 9-12 (Geometry and Measurement): 4.2.12 C.3. Find an equation of a circle given its center and radius, and, given an equation of a circle in standard form, find its center and radius.
Math grades 9-12 (Patterns and Algebra): 4.3.12 D.2. Select and use appropriate methods to solve equations and inequalities (e.g. linear equations and inequalities – algebraically; quadratic equations and factoring including trinomials when the coefficient of x2 is 1, and using the quadratic formula; literal equations; solve all types of equations and inequalities using graphing, computer, and graphing calculator techniques).

The distribution of standards rated at a DOK Level 2 in the grades 9-12 Mathematics NJCCCS was 54%. Two examples of grades 9-12 Math NJCCCS coded at a DOK Level 1 were:

Math, grades 9-12 (Numbers and Numerical Operations): 4.1.12 A.2. Compare and order rational and irrational numbers.
Math, grades 9-12 (Mathematical Processes): 4.5 F.4. Use calculators as tools to problem-solve (e.g., to explore patterns and validate solutions).

The distribution of standards rated at DOK Levels 3 and 4 was 38%. Level 3 standards accounted for 28% of the NJ 9-12 mathematics standards. Two examples of grades 9-12 Math NJCCCS coded at a DOK Level 3 were:

Math, grades 9-12 (Patterns and Algebra): 4.3.12 C.2. Analyze and describe how a change in an independent variable leads to change in a dependent one.
Math, grades 9-12 (Mathematical Processes): 4.5 A.2. Solve problems that arise in mathematics and in other contexts (i.e. open-ended problems; non-routine problems; problems with multiple solutions; problems that can be solved in several ways).

The distribution of standards rated at DOK Level 4 in the grades 9-12 Mathematics NJCCCS was 10%. Two examples of grades 9-12 Math NJCCCS coded at DOK Level 4 were:

> *Math, grades 9-12 (Mathematical Processes):* 4.5 B.3. Analyze and evaluate the mathematical thinking strategies of others.
> *Math, grades 9-12 (Data Analysis, Probability, and Discrete Mathematics):* 4.4.12 A.2. Evaluate the use of data in real-world contexts (e.g. accuracy and reasonableness of conclusions drawn; correlation versus causation; bias in conclusions drawn; statistical claims based on sampling).

Comparisons

Our third research question asked: What differences and similarities exist in creative and strategic thinking between the Common Core State Standards and the New Jersey Core Curriculum Content Standards in English Language Arts and Mathematics for grades 9-12?

We found a 10% difference in high school ELA standards categorized as Level 3 or 4 favoring the former NJ standards compared to the CCSS. There was a 26% difference in higher-order thinking favoring the NJ math standards compared to the CCSS (See Table 1 & Figures 2 -5).

Table 1

*DOK Comparisons for High School CCSS and **NJ ELA** and M Standards*

	Levels 1 & 2	**Levels 3 & 4**
CCSS ELA	72%	28%
NJ ELA	**62%**	**38%**
CCSS M	90%	10%
NJ M	**62%**	**38%**

Figure 2. Comparison of cognitive complexity between the Grades 9-12 ELA CCSS and Grades 9-12 ELA NJCCCS.

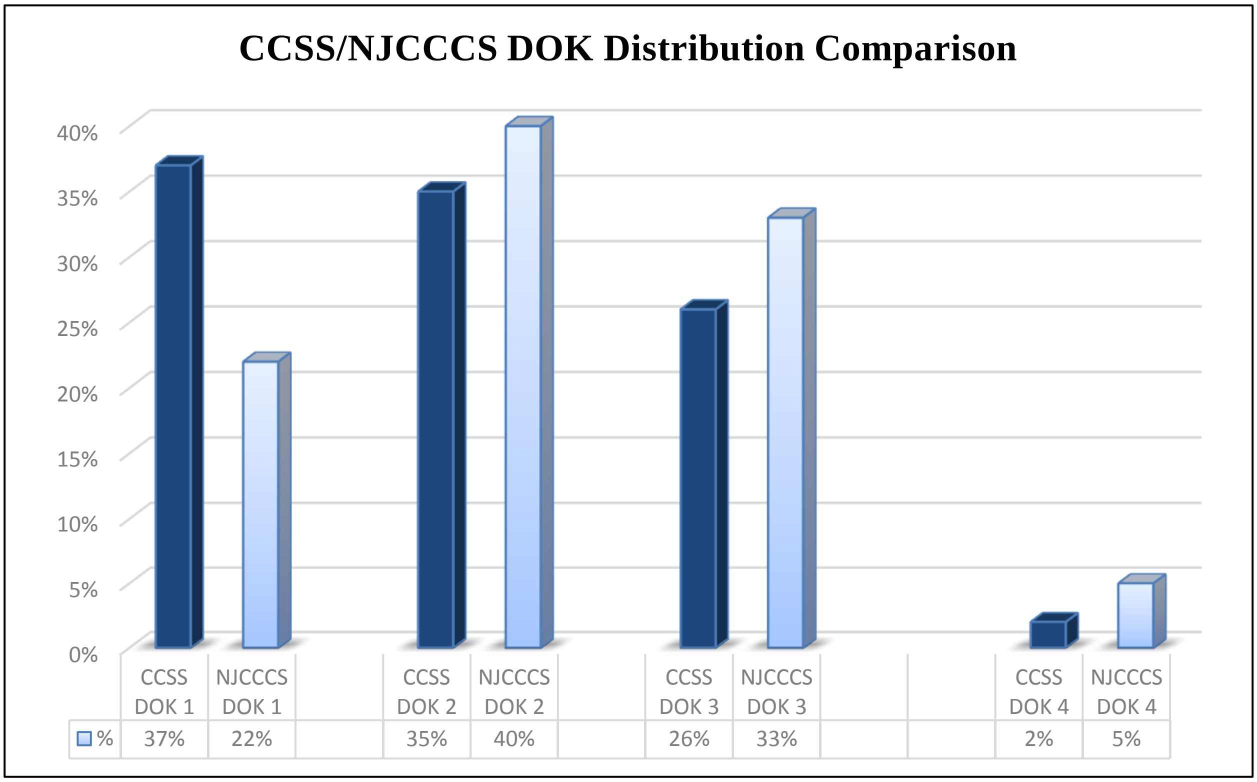


Figure 3. Grades 9-12 ELA CCSS/NJCCCS DOK distribution comparison.

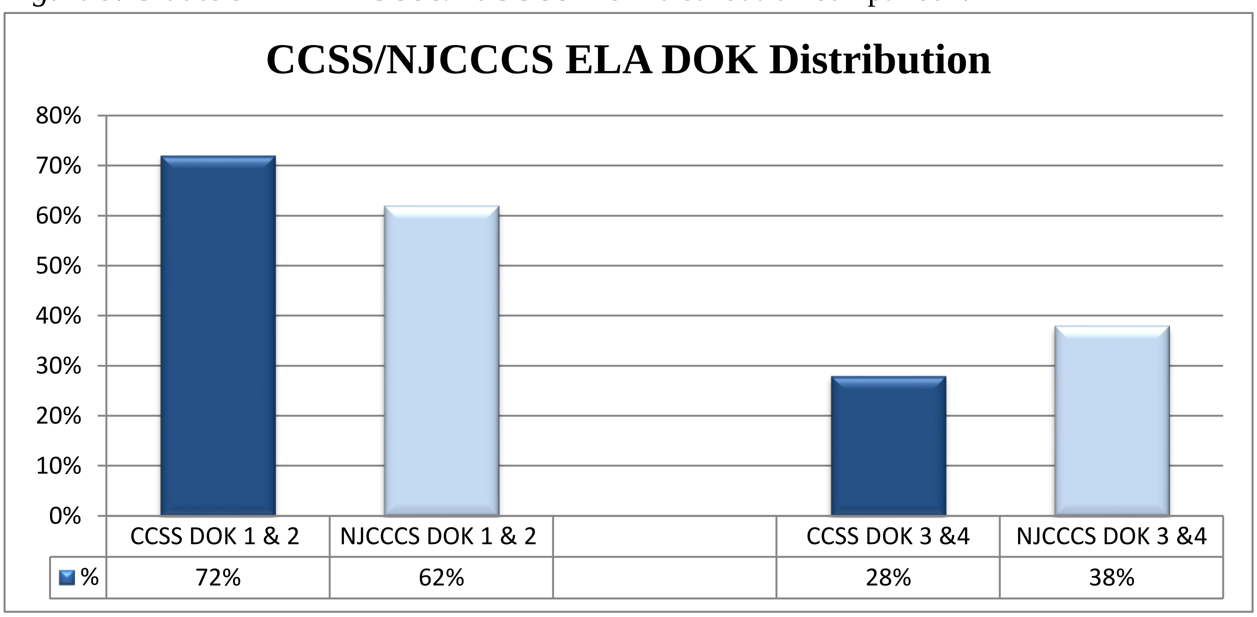


Figure 4. Comparison of cognitive complexity between the grades 9-12 Math CCSS and grades 9-12 Math NJCCCS.

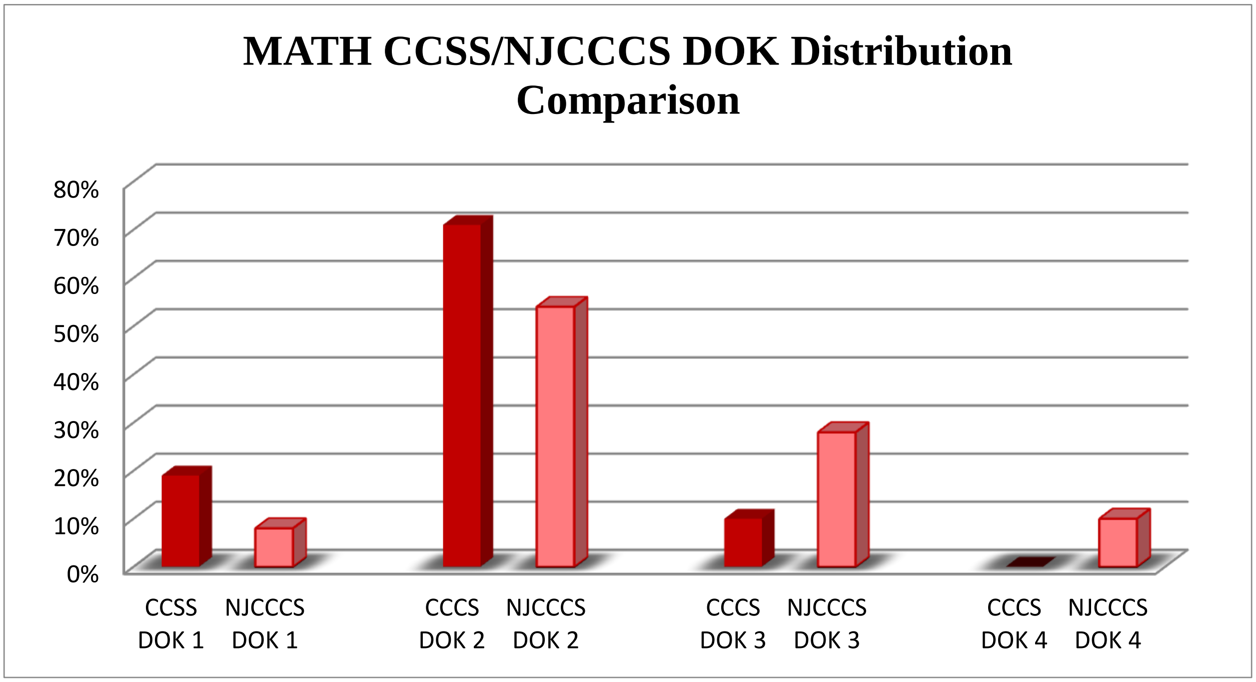
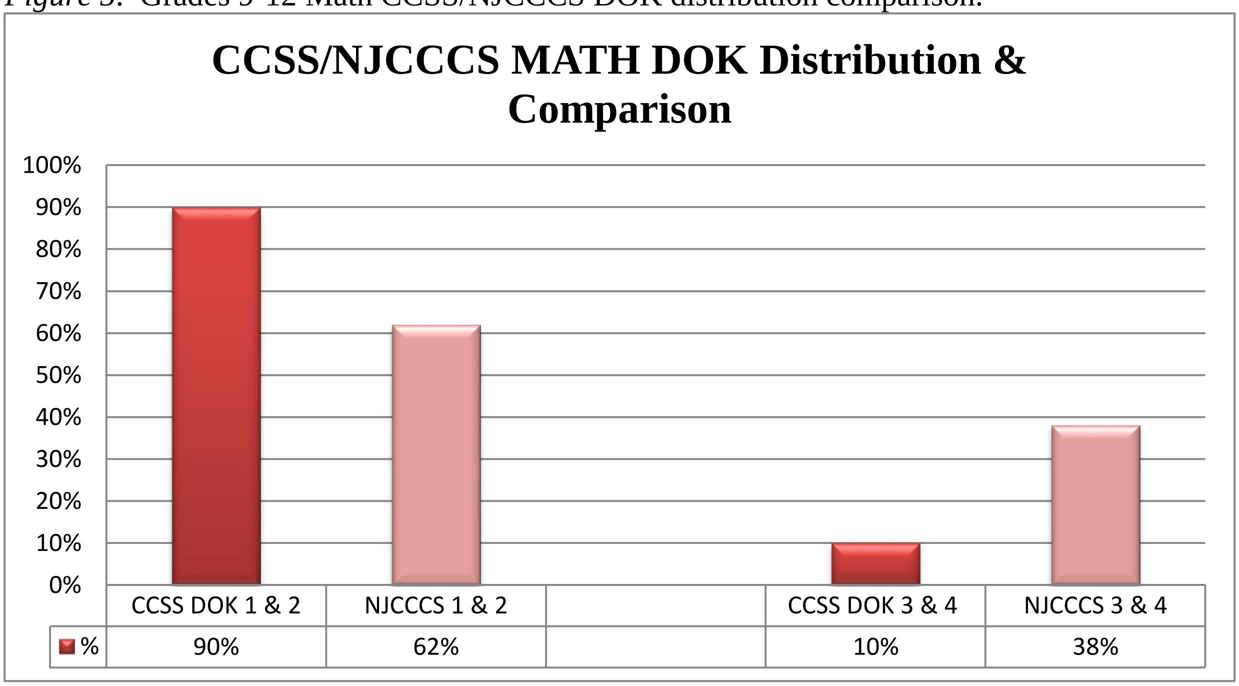


Figure 5. Grades 9-12 Math CCSS/NJCCCS DOK distribution comparison.



Common Core Less Complex

The results suggest that the previous versions of the NJ high school ELA and math standards included more complex, higher-order thinking and provided more opportunities to practice the types of thinking valued in the mainstream education reform literature as necessary to compete in the global economy. Although some have noted the CCSS as being more difficult than some previous states' standards, difficulty is not a proxy for creativity and strategic thinking (e.g. Porter, McMaken, & Hwang, 2011). Convoluted prompts and questions and unclear portions of some standards do nothing to foster creative or strategic thinking (Wiggins, 2014).

The CCSS are not superior to the previous version of the NJ high school standards in ELA and math in the areas of creative and strategic thinking. If a goal of the high school CCSS is to provide more opportunities for complex thinking then that goal has not been achieved compared to what existed previously in NJ. Our results suggest that a majority of the high school CCSS include procedural and declarative knowledge as opposed to necessary strategic and creative thinking. The intended curriculum of the CCSS requires students to more often engage in convergent thinking and use facts to imitate processes in order to find one correct answer than they were with the previous high school ELA and math standards in NJ.

Recommendations for School Leaders

Regardless of whether they support or reject the CCSS, school leaders in New Jersey and other states should work with their professional staff to review their schools' and districts' curriculum and augment it to include opportunities for creative and strategic thinking beyond those required by the CCSS in ELA and math if their curricula are directly aligned to the CCSS. School leaders, in collaboration with their professional staff, might endeavor to revise and customize existing objectives and activities in their state mandated ELA and math curricula to generate more creative and strategic thinking opportunities for students.

The results of our study suggest a preponderance of procedural and declarative knowledge and thinking in the ELA and math CCSS. The danger we fear is that the CCSS ELA and math standards in high school might instill functional fixedness in student thinking and hinder their ability to enter the post-secondary global economic environment (Runco & Chand, 1995).

One way to inject creativity and strategic thinking into curricula is to add activities that focus on socially conscious problem solving. Problem-based activities derived from issues found in American society, as well as international issues, have a long track record of providing students opportunities to engage in creative and strategic thinking, while also producing superior results on traditional measures of academic achievement (e.g., Aikin, 1942; Boyer, 1987; Dewey, 1938; Isaac, 1992). Although such activities can be decidedly un-standardized, allowing for various processes and answers, state mandated curriculum standards can be infused into them without violating compliance laws.

Another way to inject more higher-order thinking in the CCSS would be to put the previous NJ ELA and math standards categorized as Level 3 or 4 back into the New Jersey school curricula. School leaders in NJ could add at least 10% more higher-order thinking in ELA and 20% in math just by reusing a curricular "wheel" that already exists instead of trying to reinvent one. A drawback to this approach, though, would be the challenge of finding room in already over-stuffed ELA and math curricula. Perhaps school leaders can work with their professional staff to de-emphasize some of the procedural and declarative knowledge in the CCSS and replace it with some higher-order NJ standards or other quality standards and problem-based activities.

We are sensitive to the fact that NJ education officials instituted six new high school exit exams in grades 9-11 in ELA and math and to the fact that those exams are aligned to the CCSS standards. Given the high stakes for students (not graduating from high school) and for teachers and school administrators (lower evaluation ratings if student standardized test scores are low) attached to the high school exit exams, we understand the trepidation some superintendents and other district administrators might feel about de-emphasizing the CCSS.

We leave the moral and professional decision making about this issue up to them. However, we do remind our colleagues that students do not have a voice at the policy making table, and thus their rights to a high quality, comprehensive education are protected only by educators who take their duty to provide that comprehensive education seriously. We see equipping students with the ability to think creatively and strategically as moral and professional duties. Following ineffective or untested education policy simply to not upset state education officials is not leadership in our opinion.

School leaders, education officials, and policy-makers in other states might also take notice of our results. They might choose to engage in a review of their previous state standards in ELA and math to determine if they contained more higher-order thinking compared to the CCSS. As we were somewhat surprised to learn from the results of this study in New Jersey, high school administrators should not rely on the claims of others regarding the ability of the CCSS to provide superior levels of higher-order thinking. We suggest they adopt the mantra "show us the data" when it comes to this claim.

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