

Review of SAT Alignment Studies

Submitted by
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The following is a summary of MARC's review of SAT alignment studies. This summary included the key talking points about the comparison of Algebra 1 standards across states, the alignment methods (including the comparison of Algebra 1 blueprints across states), and the alignment results. The alignment methods and results are summarized for alignment studies using the standard-to-standard and item-to-standard approaches, respectively. In general, the item alignment to two domains: *Number & Quantity* and *Statistics* did not meet the evaluation criteria in the majority of the studies for both content standards and cognitive complexity. Less than 50% of standards were covered by the SAT items in 9 out of 11 alignment studies.

Talking points

Comparison of Algebra I standards across states

(Refer to the attached Excel file: 1_CCSS vs State Standards.xlsx)

1. Ten states included:
 - i. Maryland (MD)
 - ii. Arizona (AZ)
 - iii. Connecticut (CT)
 - iv. Delaware (DE)
 - v. Florida (FL)
 - vi. Georgia (GA)
 - vii. Maine (ME)
 - viii. New Hampshire (NH)
 - ix. Rhode Island (RI)
 - x. Tennessee (TN)
2. The standards for the majority of the states were retrieved from the state Department of Education (DOE) website. However, the standards for Delaware, Maine, and New Mexico were not available on their DOE website but were retrieved from www.ixl.com.
3. 70 Algebra I Common Core State Standards (CCSS), with 4 domains and 11 subdomains.
 - a. All states except Florida include 4 domains, while Florida includes 3 domains.
 - b. Only Arizona includes 11 subdomains. All other states include 10 subdomains, excluding *Conditional Probability and the Rules of Probability (CP)*.
4. The number of Algebra I standards across states varies from 47 to 63.
5. Two states further divided one CCSS Algebra I standard into several sub-standards, flagged in red color in the Excel file.
 - a. Georgia divided Standard MGSE9-12.N.Q.1 into MGSE9-12.N.Q.1a, MGSE9-12.N.Q.1b, and MGSE9-12.N.Q.1c.

- b. Rhode Island divided **HSA.APR.A.1** into **HSA.APR.A.1a** and **HSA.APR.A.1b**.
- 6. Two states added new standards that are not in CCSS, flagged in green color in the Excel file.
 - a. Rhode Island added a new standard **HSF.IF.C.10** (*Given algebraic, numeric and/or graphical representations of functions, recognize the function as polynomial, rational, logarithmic, exponential, or trigonometric*).
 - b. Tennessee added a new standard **A1.A.REI.C.4** (*Write and solve a system of linear equations in context*).
- 7. Maryland CCR Algebra I standards contain 49 standards, 4 domains, and 10 subdomains. One of the CCSS subdomains *Conditional Probability and the Rules of Probability (CP)* is not covered in the Maryland CCR Algebra I standards and the fourth domain is labeled *Statistics*.
- 8. **APR.B.3** (*Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial*) is only covered in Maryland, Arizona, and Florida standards.
- 9. Maryland MCAP do NOT cover **HSS-ID.A.1** (*Represent data with plots on the real number line (dot plots, histograms, and box plots)*), **HSS-ID.A.2** (*Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets*), and **HSS-ID.A.3** (*Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers)*) while all other states do cover these standards.
- 10. Maryland MCAP and Tennessee test do NOT cover **HSS-ID.B.5** (*Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data*) while all other states do.
- 11. Some states may use a different code for the same standard, marked by * in the file.
- 12. This current review includes 2 alignment studies for Florida conducted in 2017 and 2018, respectively. Both studies referred to the Mathematics Florida Standards (MAFS). Although the content standards are the same, MAFS was modified from CCSS and used different domain categorizations and labels. Note that Florida has switched to Benchmarks for Excellent Student Thinking (B.E.S.T.) Standards on February 12, 2020. However, we are not aware of an alignment study on the B.E.S.T standards.
- 13. This review includes 1 alignment study for Texas. Texas standards (TEKS) were not compared in this table due to a divergent standards structure from CCSS.
- 14. **Highlights:** Among the 11 states, only Delaware, Maine, and New Mexico used the same Algebra I standards. All other states used different numbers of Algebra I standards.

Alignment methods

1. Standards to standards

- a. Five states (CT, NM, RI, TN, and TX, a total of 6 alignments) used the standard-to-standard alignment approach (refer to 4_Summary of Alignment Studies (Standards-Standards).xlsx).
 - b. These studies examined the proportion of state standards matched by at least one SAT standard.
 - c. The cutoff values for the criterion:
 - i. Very Strong alignment: more than 75% of standards are covered;
 - ii. Strong alignment: 50-75% of standards are covered;
 - iii. Weak/no alignment: less than 50% of standards are covered.
2. Items to standards
- a. Six states (MD, AZ, DE, FL, GA, and ME) used the item-to-standard alignment approach (refer to 5_Summary of Alignment Studies (Items-Standards).xlsx).
 - b. 13 alignment studies were reviewed; one alignment study was conducted for Delaware and Maine.
 - c. Only Maryland aligned two digital forms of SAT to the state standards. All other states aligned paper-and-pencil forms of SAT to the state standards.
 - d. The blueprints across states are different. Maryland's blueprint follows strictly the structure of CCSS domains, whereas other states used domain names different from the CCSS structure (Refer to the attached Excel file: 2_Blueprint Comparison.xlsx).
 - e. Five frameworks of alignment evaluation were used (refer to 3_Alignment Evaluation Criteria.xlsx):
 - i. Four states (MD, AZ, FL, and GA), reported in 12 studies, used Webb's 4 criteria to evaluate the content alignment. Georgia evaluated the 4 criteria in 10 subdomains, while the other 3 states evaluated the 4 criteria in 4 domains. Florida combined *Number & Quantity* and *Statistics* as one reporting category *Statistics & the Number System*.
 - Categorical Concurrence
 - Range of Knowledge
 - Balance of Representation
 - DOK Consistency
 - ii. Two states (DE and ME), reported in one study, used HumRRO's 4 criteria to evaluate the content alignment which was adapted from Webb's 4 criteria:
 - Items Represent Intended Content
 - Items Represent Intended Categories
 - Item Sufficiency for Category Reporting
 - Item DOK Represents Test Specifications
 - iii. Two states (DE and ME), reported in one study, used the CCSSO evaluation framework:

- C2: Assessing a balance of concepts, procedures, and applications
 - C3: Connecting practice to content
 - C5.1: Ensuring high-quality items and a variety of item types (C.5.1 Distribution of item types, C.5.2 Degree of high-quality items)
 - C4: Requiring a range of cognitive demand
- iv. Three states (AZ, FL, GA), reported in 6 studies, used the number of items to be revised or replaced (Webb's 4 criteria).
- Fully aligned, if no item needs to be revised/replaced;
 - Acceptably aligned, if 1-5 items need to be revised/replaced;
 - Slight adjustments, if 6-10 items need to be revised/replaced;
 - Major adjustments, if more than 10 items need to be revised/replaced.
- v. Two states (FL and GA), reported in 4 studies, used the proportion of standards matched by at least one item: 50% is considered acceptably aligned.
3. Cognitive complexity alignment methods
- a. Webb's Depth of Knowledge (DOK) levels:
- Recall (DOK level 1)
 - Skill/Concept (DOK level 2)
 - Strategic Thinking (DOK level 3)
 - Extended Thinking (DOK level 4)
- b. Cognitive Rigor categories:
- Procedural Fluency
 - Conceptual Understanding
 - Application

Findings of alignment of content standards

1. **Standard-to-standard alignment** (refer to 4_Summary of Alignment Studies (Standards-Standards).xlsx)
 - a. Six studies aligned SAT standards with the state Algebra I standards.
 - b. The proportions of CCSS Algebra I standards range from 45% (NM, 2015; RI, 2016) to 82% (TX, 2020).
 - c. Among the 6 alignments, 3 weak/no, 1 strong, and 2 very strong.
 - d. The College Board conducted one alignment for the digital SAT for CT, showing 77% of the Connecticut Algebra I standards covered by the digital SAT standards.
 - e. Standard-to-standard matching does not necessarily represent the alignment between items and standards based on Algebra I test specifications.
2. **Item-to-standard alignment** (refer to 5_Summary of Alignment Studies (Items-Standards).xlsx)

- a. Webb's 3 content alignment criteria (used in MD, AZ, FL, GA)
- Categorical Concurrence
 - 12 alignment studies reported for 4 states are reviewed under this criterion.
 - *Number & Quantity*:
 - Met only in Maryland 2023 paper-and-pencil SAT (1/12);
 - Not met in 7 alignments (7/12);
 - Florida did not contain this domain (4/12).
 - *Algebra*:
 - Met in all alignments (12/12).
 - *Functions*:
 - Met in all alignments except one alignment in Arizona (11/12).
 - *Statistics*:
 - Met in 4 alignments (4/12);
 - Partially met in in 3 Maryland 2023 alignments (3/12);
 - Not met in one alignment in Georgia (1/12).
 - Florida did not contain this domain (4/12).
 - *Statistics & the Number System* (reported in 4 SAT forms by Florida only):
 - Met in Florida 2018 alignments (2/4); not met in Florida 2017 alignments (2/4).
 - Across the four content domains, the item alignment to these two domains: *Number & Quantity* and *Statistics* did not meet the evaluation criterion in the majority of the studies.
 - Range of Knowledge
 - No result available in Maryland PARCC 2021 alignment, 11 alignments reviewed under this criterion.
 - *Number & Quantity*:
 - Met in Maryland 2023 paper-and-pencil SAT and 1 alignment in Arizona (2/11);
 - Not met in 5 alignments including 2 from Maryland 2023 digital SAT forms and 3 from Arizona and Georgia (5/11);
 - Florida did not contain this domain (4/11).
 - *Algebra*:
 - Met in 10 alignments (10/11);
 - Not met in 1 alignments in Georgia (1/11).
 - *Functions*:
 - Met in 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT (3/11);

- Weakly met in 2 alignments in Arizona and Florida (2/11);
- Not met in 6 alignments in Arizona, Florida, and Georgia (6/11).
- *Statistics*:
 - **Met** in 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT and 1 alignment in Georgia (4/11);
 - Weakly met in 1 alignment in Arizona (1/11);
 - Not met in other alignments in Arizona and Georgia (2/11);
 - Florida did not contain this domain (4/11).
- *Statistics & the Number System* (reported by Florida only):
 - Not met in 4 Florida alignments (4/4).
- Across the four content domains, the item alignment to these three domains: *Number & Quantity*, *Functions*, and *Statistics* did not meet the evaluation criterion in the majority of the studies.
- Balance of Representation
 - No result available in Maryland PARCC 2021 alignment, 11 alignments reviewed under this criterion.
 - *Number & Quantity*:
 - **Met** only in 1 Arizona alignment (1/11);
 - Not met in 6 alignments in Maryland, Arizona, and Georgia (6/11);
 - Florida did not contain this domain (4/11).
 - *Algebra*:
 - **Met** in 8 alignments including 2 Maryland 2023 alignments on digital SAT (8/11);
 - Weakly met in Maryland 2023 paper-and-pencil SAT alignment (1/11);
 - Not available (N/A) in 2 alignments in Georgia (2/11) due to the lack of original reported data.
 - *Functions*:
 - **Met** in 7 alignments including Maryland 2023 alignment on one SAT digital form (7/11);
 - Weakly met in Maryland 2023 alignment on one SAT digital form (1/11);
 - Not met in Maryland 2023 alignment on the SAT paper-and-pencil form (1/11);
 - Not available (N/A) in 2 alignments in Georgia (2/11) due to the lack of original reported data.
 - *Statistics*:

- Met in 7 alignments including 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT (7/11).
 - Florida did not contain this domain (4/11).
 - *Statistics & the Number System* (reported by Florida only):
 - Met in 3 alignments (3/4); Not met in 1 alignment (1/4) due to the absence of items aligned to this domain.
 - Across the four content domains, the item alignment to these three domains: *Number & Quantity* did not meet the evaluation criterion in the majority of the studies.
- b. HumRRO's 3 content alignment criteria (used in DE and ME which have the same standards.)
 - Items Represent Intended Content: met.
 - Items Represent Intended Categories: met.
 - Item Sufficiency for Category Reporting: met at section or test or subscore levels.
- c. CCSSO 4 content alignment criteria (used in DE and ME)
 - Assessing a balance of concepts, procedures, and applications (C2): partially met.
 - Connecting practice to content (C3): met.
 - Ensuring high-quality items and a variety of item types (C5.1): met at section, test, or sub-scores.
 - Degree of high-quality items (C5.2): partially met.
- d. The number of items to be revised/replaced (used in AZ, FL, GA)
 - 6 alignments reported items to be revised/replaced.
 - The number of items to be revised or replaced ranges from 4 (FL) to 35 (GA).
 - 1 alignment showed SAT was acceptably aligned (1/6), 2 showed SAT needs slight adjustments (2/6), and 3 showed SAT needs major adjustment (3/6).
- e. The proportion of standards matched by at least one item (used in FL, GA)
 - The proportion of standards by covered SAT items reported in FL and GA studies ranges from 26% (GA) to 44% (Florida).
 - Following this criterion, the proportion of standards covered by SAT items ranges from 26% (GA) to 58% (Florida) for all reviewed studies.
 - Following this criterion, 43% of Maryland standards were covered by SAT items for both digital and paper-and-pencil forms in the 2023 study.

Findings of Alignment of Cognitive Complexity

1. Cognitive complexity was only examined in item-to-standard alignment studies (refer to 5_Summary of Alignment Studies (Items-Standards).xlsx).

2. Webb's 4 DOK levels

- a. Six states, 13 alignments used Webb's 4 DOK levels, of which 12 used *DOK consistency* index originally proposed by Webb while 1 alignment study used *item DOK representation of test specification* based on the 4 DOK levels.
- b. **DOK Consistency:** Four states (MD, AZ, FL, and GA) reported **DOK Consistency** based on Webb's cognitive complexity alignment criteria.
 - *Number & Quantity:*
 - Met in Maryland 2021 and 2023 paper-and-pencil SAT alignments and one Georgia alignment (3/12);
 - Weakly met in Arizona alignments (2/12);
 - Not met in 2 Maryland 2023 digital SAT alignments and 1 in Georgia alignment (3/12);
 - Florida did not contain this domain (4/12).
 - *Algebra:*
 - Met in 11 alignments including 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT (11/12);
 - Not met in 1 alignment in Florida (1/12).
 - *Functions:*
 - Met in 9 alignments including 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT (9/12);
 - Weakly met in one alignment in Georgia (1/12);
 - Not met in 2 alignments in Florida and Georgia (2/12).
 - *Statistics:*
 - Met in 6 alignments including 3 Maryland 2023 alignments on paper-and-pencil form and digital forms of SAT (6/12);
 - Weakly met in one alignment in Arizona (1/12);
 - Not met in 1 alignment in Arizona (1/12).
 - Florida did not include this domain (4/12).
 - *Statistics & the Number System* (reported by Florida only):
 - Met in 3 alignments (3/4); not met in 1 alignment (1/4).
 - Across 4 content domains, the item alignment to these two domains: *Number & Quantity*, and *Statistics* did not meet the evaluation criterion in half of the studies.
- c. **Item DOK Represents Test Specifications:** Two states (DE and ME) reported **Item DOK Represents Test Specifications** from HumRRO's cognitive complexity alignment criteria.
 - Partially met.

3. Cognitive Rigor Categories

- a. Two states (DE and ME) used Cognitive Rigor Categories from CCSSO.
 - **Requiring a range of cognitive demand (C4):** partially met.