Alignment of the SAT Mathematics Items and the PARCC Algebra I Items to the Maryland Algebra I College and Career Ready Standards

Maryland Assessment Research Center

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Executive Summary

The purpose of this study is to evaluate the appropriateness of using SAT as a substitute of the Partnership for Assessment of Readiness for College and Careers (PARCC) Algebra I test as the high school graduation assessment in Maryland. Specifically, an alignment study of the SAT mathematics items to the Maryland Algebra I College and Career Ready Standards was conducted. The study was designed to evaluate the extent the SAT items are aligned with the Maryland Algebra I College and Career Ready Standards and the depth of knowledge (DOK) levels of the SAT items. In addition, the study also aligned PARCC math items with the Maryland Algebra I College and Career Ready Standards and evaluated the DOK levels of the PARCC math items. The similarities and the differences between the SAT items and PARCC items were evaluated in terms of content standard coverage and the DOK level distribution to evaluate the content representation and the rigor of each test against the Maryland Algebra I standards.

A group of panelists was recruited to evaluate the alignment of the SAT math items related to Algebra and PARCC Algebra I items to the Maryland Algebra I College and Career Ready standards. Further, the DOK level of each SAT Algebra item and PARCC Algebra I item was evaluated. A training session was conducted before the alignment session. The alignment session evaluated 52 SAT math items and 42 PARCC Algebra I items. In each session, three rounds of ratings and discussions for the SAT items and two rounds of ratings and discussions for the PARCC items were carried out. The final alignment ratings of the content standards and the DOK level of each SAT item and PARCC item were further cross-validated by a national and Maryland alignment content expert. In-depth discussions among all three parties including the panelists, the national expert and the Maryland expert were carried out before consensus among all parties was reached. The major findings of this alignment study presented below are based on analyzing the final alignment results in terms of content standards and the DOK levels agreed upon by all parties.

Major Findings

The details of this alignment study are documented in this report. The following summarizes the major findings of this study.

1. Panelists aligned 52 SAT math items (excluding geometry items) and 42 PARCC items to the Maryland Algebra I College and Career Ready Standards in multiple rounds. The agreement among the panelists increased after each round of discussion and eventually reached perfect agreement.
2. The final alignment ratings of the 52 SAT items and 42 PARCC items to the Maryland Algebra I College and Career Ready Standards were cross validated by two content experts: one national and the other from Maryland. Among the 52 SAT items, 2 items were considered to measure the Algebra II standards, thus, no Algebra I standards were assigned for these two items. All PARCC items measured one or more of the Maryland Algebra I standards.
3. The distribution of content standards is similar between the 50 SAT items (excluding two Algebra II items) and the 42 PARCC Algebra I items. Please note some items were

double- or multiple-coded on different standard categories and counted more than once. Thus, the sum of the number of item counts does not add up to the total number of SAT items (50) or PARCC items (42). There were 69 SAT item counts and 53 PARCC item counts due to that some items were counted repeatedly in different standard categories. The percentages are the proportion that a category was assessed by the whole SAT item counts or PARCC item counts, and they add up to 100%.

4. There are 10 categories in the Maryland Algebra I College and Career Ready Standards. The 50 SAT items aligned in the current study cover 8 of the 10 standards, including
    1) quantities (3 item counts, 4.3%),
    2) seeing structure in expressions (6 item counts, 8.7%),
    3) arithmetic with polynomials and rational expressions (2 item counts, 2.9%),
    4) creating equations (14 item counts, 20.3%),
    5) reasoning with equations and inequalities (13 item counts, 18.8%),
    6) interpreting functions (12 item counts, 17.4%),
    7) building functions (8 item counts, 11.6%), and
    8) interpreting categorical and quantitative data (11 item counts, 15.9%).
   The 2 standards not covered by the SAT items are
    1) real number system (0 item counts, 0%), and
    2) linear, quadratic, and exponential functions (0 item counts, 0%).
   The 42 PARCC items aligned in the current study cover 9 of the 10 standards, including
    1) real number system (2 item counts, 3.8%),
    2) seeing structure in expressions (5 item counts, 9.4%),
    3) arithmetic with polynomials and rational expressions (3 item counts, 5.7%),
    4) creating equations (10 item counts, 18.9%),
    5) reasoning with equations and inequalities (8 item counts, 15.1%),
    6) interpreting functions (11 item counts, 20.8%),
    7) building functions (6 item counts, 11.3%),
    8) linear, quadratic, and exponential functions (5 item counts, 9.4%), and
    9) interpreting categorical and quantitative data (3 item counts, 5.7%).
   The standard that was not covered by the PARCC items is
    1) quantities (0 item counts, 0%).

5. The distribution of the DOK levels is similar between the 50 SAT items and the 42 PARCC items. The DOK levels obtained from the panelists were cross validated by the national and Maryland content experts. The final numbers of SAT items of DOK levels 1 to 4 are 0, 38, 11, and 1; the percentages are 0%, 76.0%, 22.0%, and 2.0%, respectively. The final numbers of PARCC items of DOK levels 1 to 4 are 3, 30, 7, and 2; the percentages are 7.1%, 71.4%, 16.7%, and 4.8%, respectively. There was no SAT item at the DOK level 1 while the PARCC test contained more items at DOK levels 1 and 4.

6. Given that the SAT math items covered 8 of the 10 Maryland Algebra I College and Career Ready Standards, Algebra II and Geometry standards, the SAT math items in general cover the Maryland Algebra I standards well with higher rigor. If the two missing Algebra I standards should carry certain amount of weight in the evaluation of the Algebra I assessment requirement though the Algebra II and Geometry standards are assessed in the SAT math, additional source of information such as Algebra I course grades could be considered to supplement SAT math scores to assure the full coverage of the Maryland College and Career Ready standards for Algebra I.

7. The findings related to content standard alignment from this study are consistent with the results from other alignment studies conducted for Florida, Delaware, Maine, and Connecticut, which indicated that SAT math items did not fully cover their state standards.
8. The findings from this study regarding the DOK levels indicated that the SAT math items spanned from middle to high cognitive demand (i.e., DOK levels 2 to 4). There was not such information on DOK from other alignment studies such as the Connecticut and Delaware studies. The Florida alignment study found the SAT items cover DOK levels 1 to 3, which may be due to the use of a different SAT test form.