Virginia

Standards of Learning Assessments

Technical Report

2013–2014 Administration Cycle

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PART I: HISTORICAL OVERVIEW AND SUMMARY OF PROGRAMS

1. INTRODUCTION

The Virginia Standards of Learning (SOL) Assessment Program Technical Report provides information for users and other interested parties about the development and technical characteristics of the assessments within the Virginia Assessment Program. The SOL technical report is divided into two parts. Part I presents a summary of the components of the Virginia SOL assessment program from the 2013–2014 administration cycle. Part II provides statistical information based on results from Spring 2014.

2. STUDENT ASSESSMENTS IN VIRGINIA

2.1 Historical Overview of SOL Assessments

In 1994, Virginia initiated significant reform of its K–12 educational system. This reform, which has evolved over the last 20 years, consists of several major elements discussed in the following sections: high academic standards, tests to measure progress, and accountability.

2.1.1 High Academic Standards

In 1995, the Virginia Board of Education adopted a set of statewide standards: the Virginia SOL. The Virginia SOL set forth minimum learning standards for every child from K–12 in English, mathematics, science, and history/social science. Over time, the SOL were expanded to include the areas of family life, economics and personal finance, fine arts, foreign language, computer technology, health and physical education, and driver education.

The board recognized the need for regular review and evaluation of the SOL; therefore, in September 2000, it approved a cyclical schedule for the review of the standards. This has resulted in each subject area undergoing a review and potential revision every seven years[1].

2.1.2 Tests to Measure Student Progress on the SOL

Development of tests to measure the SOL began in 1996 with heavy involvement of classroom teachers, curriculum specialists, and other local educators throughout Virginia. A statewide census field test of the new SOL test items took place in the spring of 1997. The first administration of SOL tests took place in the spring of 1998, and the program has expanded significantly since that time.

The SOL assessment program is the cornerstone of Virginia's system of accountability for public schools and is authorized in Virginia law and administrative rules (see Article I, Section 15 and

[1] The review cycle can be accessed at the following website: http://www.doe.virginia.gov/testing/assessment_committees/review_schedule.pdf

Article VIII of the Constitution of Virginia and Title 22.1 Chapter 13.2 § 22.1-253.13:3C, Code of Virginia). The purposes of the assessment program are to

- establish and communicate high levels of achievement on the SOL for Virginia public school students;
- provide communication that indicates the progress of students and schools toward meeting achievement levels on the SOL;
- provide information that can be used to improve instructional programs; and
- provide assurance of the quality of public education.

The federally enacted No Child Left Behind Act of 2001 (NCLB) reinforced many strategies already present in Virginia's public education system. For a number of years, public educators throughout the commonwealth have focused on instructional standards, student assessment, reporting of results, and continuous improvement. To respond to NCLB, Virginia has maintained its rigorous academic content standards, measuring students against defined academic performance standards, added grade-level assessments in various subjects, and reported on the progress of student subgroups at the school, the division, and the state levels. The Virginia Assessment Program has been used to meet state and federal educational requirements including:

- monitoring the progress of students and schools toward meeting established achievement levels;
- identifying the educational needs of students;
- determining which achievement levels students have attained;
- determining whether students receive a high school diploma; and
- providing accountability information for school, school division, and state levels.

2.1.3 Accountability for Student Achievement

The Standards of Accreditation (SOA) for Virginia's public schools outlines the state requirements for student testing and graduation, as well as the requirements for the accreditation of schools in the commonwealth. The SOA may be found on the website of the Virginia Department of Education: http://www.doe.virginia.gov/boe/accreditation/.

2.2 Overview of Current Virginia SOL Assessments

The Virginia SOL assessments are standards-based tests designed to measure student performance on Virginia's content standards in the areas of reading, writing, mathematics, science, and history/social science. The SOL tests contain primarily multiple-choice (MC) items, however the mathematics, English, and science assessments also include technology enhanced items (TEIs).[2] TEIs are developed in a variety of formats that allow students to indicate their responses in ways other than the MC format. The writing tests administered at grades 5, 8, and high school include writing prompts in addition to MC items and TEIs.

[2]TEIs were used operationally on all assessments with the exception of paper-pencil tests and history/social science tests.

2.2.1 Online Testing in Virginia

In the 2000 session of the general assembly, legislation was passed that required and funded a statewide web-based technology initiative. The goal of this initiative was for Virginia school divisions to implement online, web-based SOL instruction, remediation, and testing in Virginia's high schools. The initiative provided funding for school divisions to purchase hardware, software, and to upgrade network and Internet capabilities.

Because the initial focus of the project was Virginia's high schools, the online testing initiative began with the end-of-course (EOC) SOL tests. The first online EOC tests were administered in fall 2001. Since that time, additional SOL tests have been move to the web-based delivery system in a phased approached so that all tests are now available in the online system.

2.2.2 Current SOL Assessments

In 2013–2014, students in grades 3–8 and high school were tested using SOL assessments in the content areas listed in Table 2.2.1. High school tests were designed to address specific course content, regardless of the student's current enrolled grade. The content-specific history assessments are not grade-level dependent and are typically taken in the upper elementary or middle school years.

Table 2.2.2.1 Virginia Standards of Learning Assessments at Each Grade Level

	Grade Level							
SOL Content Area	**3**	**4**	**5**	**6**	**7**	**8**	**Content-Specific History**	**High School**
English: Reading	•	•	•	•	•	•		•
English: Writing			•			•		•
Mathematics	•	•	•	•	•	•		
History	•							
Science	•		•			•		
Algebra I								•
Geometry								•
Algebra II								•
Virginia and U.S. History								•
World History I								•
World History II								•
World Geography								•
Earth Science								•
Biology								•
Chemistry								•
Virginia Studies							•	
U.S. History to 1865							•	
U.S. History: 1865 to Present							•	
Civics and Economics							•	

3. DEVELOPMENT OF SOL ASSESSMENTS

The Virginia Department of Education works jointly with Virginia educators and its testing contractor to develop a series of tests to measure student achievement on the SOL content standards. The development of the SOL assessments involves the use of test blueprints, item development specifications, multiple review committees, and field testing.

3.1 Content Standards, Curriculum Frameworks, and Test Blueprints

3.1.1 Standards of Learning (SOL)

The SOL represent a broad consensus of what parents, classroom teachers, and school administrators—as well as academic, business, and community leaders—believe schools should teach and students should learn. In each of the four core areas of English, mathematics, science, and history/social science, a curriculum framework is provided that details the specific knowledge and skills students must possess to meet the content standards for these subjects. The SOL are reviewed and updated on a seven-year cycle.

3.1.2 Curriculum Frameworks

The SOL Curriculum Frameworks[3] amplify the SOL and provide additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. The curriculum frameworks assist teachers as they plan their lessons by identifying the essential knowledge and skills students need to learn.

School divisions use the curriculum frameworks as a resource for developing sound curricular and instructional programs, but the curriculum frameworks are not intended to limit the scope of instructional programs. Additional knowledge and skills that can enrich instruction and enhance students' understanding of the content identified in the SOL should be included as part of quality learning experiences.

3.1.3 Test Blueprints

The SOL test blueprint[3] serves as a guide for test construction. Each test covers a number of SOL. In the test blueprint, SOL are grouped into categories that address related content or skills. These categories are called *reporting categories*. When the results of the SOL tests are reported, the scores will be presented in terms of scores for each reporting category and a total test score. Each SOL is assigned to only one reporting category.

The number of test items that will be assessed in each reporting category, as well as on the test as a whole can be found in the test blueprint. Because of the large number of SOL in each grade-level content area, every SOL will not be assessed on every version (form) of an SOL test. By

[3]The curriculum frameworks and test blueprints can be accessed at the following website: http://www.doe.virginia.gov/testing/

necessity, to keep the length of a test reasonable, each test will sample from the SOL within a reporting category. However, every SOL is eligible for inclusion on each form of an SOL test. In some content areas, there are SOL that do not lend themselves to assessment within the current format of the SOL tests. The SOL not tested are listed as "Excluded from Testing" at the end of the blueprint for each test.

There is a specific blueprint for each test. Each blueprint contains three components relevant to each SOL test: general test information, a blueprint summary table, and the expanded blueprint.

The general test information section provides information about the following topics:

- test blueprint;
- reporting categories;
- assignment of SOL to reporting categories;
- Standards of Learning excluded from testing;
- coverage of SOL; and
- use of curriculum frameworks.

A summary table of the blueprint displays the following information:

- reporting categories for each test;
- number of test items in each reporting category;
- SOL included in each reporting category;
- SOL excluded from the SOL test;
- number of operational items on the test;
- number of field-test items on the test; and
- total number of items (operational and field-test items) on the test.

The expanded blueprint provides full text for each SOL. In addition, SOL that are excluded from the test are categorized by the reason they were not included.

3.2 Item Development

3.2.1 Specifications and Development

Item specifications are determined by the Virginia Department of Education for appropriate assessment of the SOL. All items assess content specified by the SOL and within the guidelines contained in the associated curriculum frameworks. Item types include MC, TEIs, and writing prompts. On an annual basis, item development plans are drafted based on an evaluation of the pools of items available for traditional test forms construction. Item pool distributions map the counts of items by SOL, by item type, by Rasch item difficulty estimates, and by cognitive complexity level. The annual item development plans for new items are approved by the Virginia Department of Education.

The item authoring and development process is multi-phased and involves a variety of expert groups. Item writers external to the testing vendors' staff are trained on requirements for the SOL assessment program. Item writers author items in accordance with item development plan-driven

assignments and the SOL item specifications. Item writers are experienced in item authoring for K-12 statewide assessments and have teaching experience in their assigned subject matter and grade span.

Testing vendors' content/assessment specialists review and edit newly submitted items for content accuracy and grade-level appropriateness and for adherence to principles for quality item construction, accessibility (i.e., universal design[4]), and fairness (e..g., bias, sensitivity, and limited English proficiency). Content/assessment specialists are usually former teachers in their designated subject matter and grade span. Items are developed for the primary presentation mode of online delivery. Each item is coded for the SOL it is intended to measure. Items are reviewed and edited to ensure the annual batch of new items meets expected distributions of item difficulty and cognitive complexity levels as required by the SOL being assessed. There are a series of internal item reviews involving different staff expertise. These reviews include content reviews, a professional editorial review, and a fairness review. Additional guidance and feedback is provided regarding the appropriateness of the content match to the SOL and adherence to item specifications through Virginia content review committee meetings, as well as reviews completed by Virginia Department of Education.

3.2.2 New Item Content Review Committees

On an annual basis, Virginia educators from across the state participate in the development of the SOL assessments. Every summer, content review committees convene to review content materials for the SOL program. Content committees are composed primarily of educators teaching the subject of the test, including special education teachers. A small number of committee members may be division curriculum staff or other school division employees. They represent all grade levels—grade 3 through high school—all content areas, and the racial/ethnic diversity of Virginia students. Committee members also represent a geographical cross section of Virginia. Approximately one-third of every committee is new members each year in order to provide a balance of experienced educators and new members and to bring new perspectives into committee meetings. The committee members review the newly developed test items to confirm that they appropriately and fairly measure student knowledge and skills in accordance with the SOL and curriculum frameworks.

The committee members receive an orientation to the SOL assessment program, an overview of the test development process, and information about their important role. Training focuses on educators making judgments about the match of content to SOL, the appropriateness of the content for the grade level, and fairness and accessibility issues. Committees meet separately by grade level and subject. In addition to reviewing the match of the items to the SOL, content review committee members also identify and note their concerns regarding potential item bias in the areas of gender, racial/ethnic, religious, socioeconomic, and regional characteristics. Additionally, special populations concerns may be noted regarding students with disabilities and limited English proficiency (LEP). Following discussion, the committee as a whole recommends

[4]The application of the principles of universal design to assessments entails a blend of good test design, consideration of as many users as possible, assistive technology where appropriate, and builds in appropriate visual design (Dolan & Hall, 2001).

that an item be accepted, edited, or rejected. Each committee member is also provided an individual comment (input) form. While committee recommendations are made by consensus, committee members also record their individual recommendations which may differ from the committee consensus, on the comment forms. All recommendations are tallied, and all comments are compiled into a master document that becomes an official record of the committee review. Only after committee recommendations are counted and comments recorded, is the final decision about an item made. As a result of the new item review process, some items are eliminated from the prospective field-test set, while others are edited in the manner directed for field testing.

3.3 New Writing Prompt Development

3.3.1 Specifications and Development

Writing prompts are used to assess students' writing skills on the SOL writing tests in grades 5, 8, and EOC. New writing prompts are developed and field tested every four or five years as needed to support test construction. English language arts content specialists and item writers draft large numbers of potential writing prompts. Each writing prompt adheres to SOL specifications and is written in the form of a question, an issue, or a hypothetical situation.

3.3.2 New Writing Prompt Review Committees

As needed, the summer writing content review committees are asked to provide input on new writing prompts including evaluating the prompt's clarity, appropriateness for the SOL, similarity to prior prompt topics,[5] and perceived ability of the prompt to elicit an extended written student response. The review process is similar to that used for the review of new MC and TEIs. The committee as a whole provides a consensus recommendation, with individual members' comments captured on prompt comment forms. Based on committee feedback, edits may be made to the prompts prior to field testing.

3.4 Field Testing

Once items and prompts have been developed, reviewed, and approved by the content review committees and the Virginia Department of Education, they are eligible for inclusion on a field test.

3.4.1 Embedded Field Testing of MC and TEIs

Field-test items are embedded within the Spring test forms in such a way that they appear throughout the operational test form and are not identifiable to students. This allows for the collection of data on the new items that is not impacted by motivation, as might occur if the students knew that the new items did not contribute to their score.

The position of the field-test items is pre-determined for each core form, as is the number of field-test variations per core. Each form has the same number of field-test items to keep the test

[5] New prompts are compared to old prompt pools to make sure that the same topic is not used again.

length consistent. The number of field-test forms is determined based on how many new items need to be field tested in a given year.

In the fall and summer administrations where the population taking the test is not representative of the state's student population, place-holder items are included in the field-test positions to maintain consistent test lengths. These items do not contribute to a student's score, nor is the data used to update item statistics.

3.4.2 Stand-Alone Field Testing of Writing Prompts

For writing tests, new prompts are field tested as needed using a separate, stand-alone field-test administration. Typically, new writing prompts are developed and field tested every four to five years. The last stand-alone field test for writing occurred during the 2011–2012 administration.

3.4.3 Sampling

During each spring test administration, test forms are distributed throughout the commonwealth in a way that will facilitate timely equating and the collection of representative field-test data. The manner in which test forms are distributed across the school divisions is called the sampling plan. The sampling procedures are based on data files containing participation counts that schools submit prior to the Spring administration. These files indicate the number of students in each school who will take each test online or in paper-and-pencil format. In conjunction with the participation counts, the school division's graduation date and the date that school closes for the year are considered when assigning test forms in the sampling plan.

An attempt is made to assign test forms to divisions in such a way that approximately equal numbers of students respond to each field-test variation across the cores.[6] Also, test forms are assigned at the school division level so that all schools are administered the same core for a given test. The core that is assigned to a division by the above process is labeled the *Main* form for that division. Each division is also assigned an alternate form. The alternate form is utilized in retesting students in the case of a testing irregularity. For instance, an administrator may need to assign a different test form if the student becomes ill during a test, or if there is a disruption that prevents the student from completing the test.

The MC/TEI section of the writing tests is assigned to divisions in the same way as the non-writing tests. In addition, there are six to seven writing prompts that are administered each spring. Of the six to seven prompts, four or five are new writing prompts that must be equated; the other prompts have been equated during a previous administration. In order to obtain enough data to calibrate each new prompt for equating purposes, the new prompts are randomly assigned across the divisions.

[6]Each core generally contains multiple forms. The core and linking items are identical across each form, but the embedded field-test items vary.

3.4.4 Data Review Committees

In addition to reviewing new items during the summer item content review meetings, Virginia educators review field-tested items. During the data review meeting, committee members' are asked to review the appropriateness of items' content, using the field-test item statistics to inform their judgments, as appropriate. During the data review meeting, committees recommend accepting or rejecting items. As with new item review, comment (input) forms are the official record of committee activity.

The same committee that reviews the writing MC items and TEIs also reviews writing prompt results (when available). As part of the training for the prompt reviews, committee members are provided with information on the scoring rubrics. The Virginia SOL Writing Field Test Prompt Evaluation Form, which Virginia's testing contractor completes as an evaluation of the prompts, is also provided to the committee. This form is a hybrid of qualitative and quantitative information. During the scoring process for field-tested prompts, scorers and team leaders record their observations about the student responses to each prompt. Team leaders then compile a qualitative report that addresses the following questions:

- Did the students understand what the prompt asked them to do?
- Did the students seem engaged by the prompt?
- Were the students able to effectively focus on a central idea and provide specific information and details?
- Did the scorers, based upon reading hundreds of student responses to the prompt, recommend that this prompt be used for live testing?

The report also includes the following pieces of information for each prompt:

- final frequency distribution of prompt scores
- suggestions and comments from the scorers
- several examples of students' written responses

Committee members review the prompt and responses to ascertain whether the prompt actually elicited responses that are complete and well elaborated. Members also review the prompt itself for appropriate content and to ensure fairness for all students. A prompt that elicits responses that are similar to lists, or a prompt that seems to confuse students is considered to be poorly performing and is usually recommended for rejection. In some circumstances, a prompt will be recommended for field testing again at a different grade level. Feedback and comments from committee members is added to the final report.

3.4.5 Statistics Reviewed During Data Review Meetings

For the purpose of reviewing the quality of new test items, reviewers are provided with various data to assist them in decision-making. These data include classical statistics and item response theory (IRT) statistics (Rasch measurement model).

The classical statistics calculated for the MC items/TEIs include

- numbers of students tested overall and by gender and ethnic group (African American, Caucasian, Hispanic, and Asian);
- traditional difficulties (*p*-values);
- item-option response distributions for all respondents by gender and ethnic group; and
- point-biserial correlations.

Classical statistics computed for field-tested writing prompts include

- numbers of students tested overall and by gender and ethnic group (African American, Caucasian, Hispanic, and Asian); and
- frequency distributions, means, and standard deviations for the writing domain raw and total scores.

To supplement the classical statistics, item difficulty parameter estimates based on the Rasch IRT model are computed. More information about the Rasch model is included in Section 8 of this report.

Three types of differential item functioning (DIF) data are calculated: separately calibrated Rasch difficulty comparisons, Mantel-Haenszel Alpha and associated chi-square significance, and response distributions for each analysis group. The differential Rasch comparisons provide item-difficulty estimates for each analysis group. Under the assumptions of the Rasch model, the item-difficulty value obtained for one group can be different from that of another group only because of variations in some group characteristics and not because of variations in achievement. When the Rasch item-difficulty estimate shows a statistically significant difference between groups, the item is flagged to indicate that further examination of the particular item is needed. The Mantel-Haenszel Alpha is a log/odds probability indicating when it is more likely for one of the demographic groups to answer a particular item correctly. When this probability is significantly different across the various groups, the item is flagged for further examination. Response distributions for each analysis group indicate whether members of a group were drawn to one or more of the answer choices for the item. If a large percentage of a particular group selected an answer choice not chosen by other groups, the item is inspected carefully.

Statistical analyses merely serve to identify test items that have unusual characteristics. They do not specifically identify items that are “biased;” such decisions are made by item reviewers who are knowledgeable about the state’s content standards, instructional methodology, and student testing behavior.

3.5 Test Construction

3.5.1 Procedures

New core operational test forms are generally used for the first time in the spring test administration. For non-writing tests, generally three new core forms are developed annually for all EOC assessments, except EOC World Geography. Typically, three new core forms are also developed annually for all writing tests (at grades 5, 8, and EOC). For all other SOL tests two

new core forms are typically developed annually. In some cases, fewer core forms are developed and core forms from previous years are reused.

Test specifications and test construction guidelines are developed and approved by the Virginia Department of Education. Test construction guidelines provide the operational process and the established expectations (both psychometric and content characteristics) to guide SOL forms assembly. The goal is to create test forms that are equivalent in content representation and psychometric characteristics both within a year and across years.

A common item linking design is used year to year. Items from a core form from the prior spring test administration are placed in the new administration's two or three core forms and serve as the anchor items. Anchor items are placed in the same, or nearly the same sequence positions in the new core form that they appeared in on the old form. For tests with items that are associated with passages (reading and writing), the passages (and associated items) are placed in as close as possible to the same position within the new test form as they were placed in the prior form. Anchor items represent approximately 20–30% of the operational forms. Content specialists select anchor items, and psychometrics and the Virginia Department of Education approve them.

Following the approval of anchor items, content specialists select the remaining operational items for each test. During the test construction process, psychometricians review each form to see whether it meets the test specification blueprint and the statistical targets established to produce forms of similar difficulty, statistical quality, and content representation within and across years.

These draft forms are reviewed by the Virginia Department of Education. Any item replacements are reviewed by psychometricians. The review process continues iteratively until the Virginia Department of Education has provided final approval.

3.5.2 Test Form Review Committees

The newly drafted operational test forms for each SOL assessment are reviewed by content review committees at the summer meetings. The new core forms are reviewed for each SOL test. Committee members receive training for this task including information on the match of the items on a form to the SOL test blueprint, the arrangement of items within the form, and the balance of topic coverage and item types. Members are asked to confirm the appropriateness of the item content and the accuracy of the keys.

Individual committee members have comment forms to record their overall evaluation of the test form, as well as comments on individual items. Individual members' comments and recommendations are compiled into a master document following the meeting. Committee review may result in the need to replace one or more items on a core form. These changes are subject to review and approval by psychometrics and the Virginia Department of Education.

Once operational test cores are finalized, content specialists select field-test items and create multiple sets that are embedded into the core forms to create multiple core form variations. These field-test sets are reviewed and approved by the Virginia Department of Education.

4. TEST ADMINISTRATION

4.1 Training and Materials

To ensure the successful administration of the SOL assessments, Virginia Department of Education staff provides training to the division directors of testing (DDOTs) before each fall and spring test administration. DDOTs in turn provide appropriate training to the divisions' school test coordinators (STCs). STCs provide training to the schools' examiners and proctors including information about security requirements, manuals, local directions received from the DDOTs, and other pertinent information. They address training preparation of the test sites and the provision of accommodations for eligible students.

Test implementation manuals contain detailed instructions about administration procedures. These manuals are provided on the Virginia Department of Education website: http://www.doe.virginia.gov/testing/test_administration/index.shtml.

4.2 Testing Windows

There are three test administrations: Spring, Summer, and Fall. The Spring administration is the main administration during which most students test. During the Spring administration SOL assessments for all grades and subjects are provided. The Summer administration is available for only grade 8 math and reading and all EOC tests. This administration provides an opportunity for students to retest who are enrolled in summer school for EOC courses, for students who need to retake an SOL tests to earn verified credits, and for transfer students who are seeking to earn verified credits for qualifying transfer courses. The Fall administration is available for only grades 6–8 and EOC. This administration is available for students who are retesting to earn verified credits for graduation, and for students taking courses with block schedules who complete a course during the fall. Some Virginia schools provide a block schedule for grades 6–8.

A fairly long testing window is provided for online assessments so that schools have enough time to coordinate student access to computers and to accommodate different school calendars across the state. Divisions can choose the weeks within the testing window during which they will administer the assessments, leaving sufficient time for make-up testing. The testing window for the writing assessments is earlier than the testing window for the non-writing assessments to provide extra time for the human-scoring of the short paper (essay) component of the assessment. In addition, the MC item/TEI component and the short paper component can be administered separately. Unlike the online tests, paper tests are administered on a specific day.

The testing calendar is posted on the Virginia Department of Education website: http://www.doe.virginia.gov/testing/test_administration/index.shtml.

4.3 Test Security Procedures

Everyone in the division who has access to, or assists with the administration of the paper-and-pencil or online SOL assessments must read the *Test Security Guidelines* and sign the *Test*

Security Agreement. The security agreement requires that those involved in the test administration exercise the necessary precautions to ensure the security of the test content and all test materials. This includes security procedures pertinent to the receipt, inventory, distribution, and storage of test materials. These forms are included in each examiner's manual and testing implementation manual.[7]

4.4 Testing Accommodations

All students in tested grade levels and courses are expected to participate in Virginia's assessment program, unless specifically exempted by state or federal law or by Board of Education regulations. Virginia's assessment system includes students with disabilities and LEP students. Students with disabilities and LEP students may take SOL tests with or without accommodations or they may be assessed through alternate or alternative assessments. The tests that comprise the Virginia Assessment Program are offered in English only; administration of the tests in other languages is not permitted.

The individualized education program (IEP) team or 504 committee has the responsibility for decisions regarding the need for and the selection of accommodations for students with disabilities. Similarly, the LEP committee determines how LEP students will participate in the SOL assessments and what, if any, accommodations should be provided to individual LEP students. Accommodations allow students with disabilities or LEP designation more appropriate access to test content so they can demonstrate their content knowledge.

Accommodations considered for testing should be those that the student uses routinely during classroom instruction and assessments, as identified in the student's IEP, 504 plan, or LEP participation plan. The student should be familiar with an accommodation because the use of an unfamiliar accommodation during testing may have a negative impact on the student's performance. However, it is important to note that certain accommodations used for instruction or classroom assessment may not be allowed on the statewide assessment. Finally, providing an accommodation based solely on its potential to enhance performance beyond allowing for more appropriate access is inappropriate.

4.4.1 Testing Accommodations for Students with Disabilities

There are many assessment options for students with disabilities. These include the SOL assessments without accommodations, the SOL assessments with accommodations, and alternative (on-grade level) or alternate assessments including the Virginia Substitute Evaluation Program (VSEP), the Virginia Grade Level Alternative (VGLA)[8], the Virginia Modified Achievement Standards Test (VMAST), and the Virginia Alternate Assessment Program (VAAP). Information on state assessment options available to students with disabilities is provided in the *Students with Disabilities: Guidelines for Assessment Participation* document available on the Virginia Department of Education's website.

[7] These manuals may be downloaded from the following website: http://www.doe.virginia.gov/testing/test_administration/

[8] VGLA is available for qualifying students with disabilities in 3–8 writing, science, and history.

http://doe.virginia.gov/testing/participation/index.shtml.

The SOL assessments must be considered by the IEP Team or 504 Committee before alternate/alternative assessments are considered. Although many students with disabilities will be able access the SOL assessments without accommodations, others will require test accommodations to address their disabilities and individual needs. Test accommodations for students with disabilities are grouped in the following categories: time/scheduling, setting, presentation, and response. The accommodations available within each of these categories are provided in the table below and are described in more detail on the Virginia Department of Education website.

http://www.doe.virginia.gov/testing/participation/guidelines_for_special_test_accommodations.pdf.

Timing/Scheduling Accommodations	**Setting Accommodations**
Adjust the scheduling of a test: • time of day • planned breaks during test * • flexible schedule (multiple test sessions) * • order of tests administration	Adjust the place in which the testing normally occurs: • individual testing (one-on-one) • special lighting • adaptive or special furniture • test administered in locations with minimal distractions • hospital/home/non-school setting
Presentation Accommodations	**Response Accommodations**
Adjust the presentation of test material and/or test directions: • visual aids * (e.g., interactive/electronic whiteboard, colored overlay, tinted screen, magnifying glass, large monitor, screen magnifier, graphic organizers, templates, masks or markers to maintain place) • amplification equipment (e.g., auditory trainer, whisper phone) • large-print test * • braille test * • Plain English version of a *Mathematics* test • reading directions to students • written directions accompanying oral directions * • reading of test items aloud * • audio version of test items * • interpreting/transliterating directions (e.g., sign language, cued speech) * • interpreting/transliterating test items (e.g., sign language, cued speech) * • specific verbal prompts *	Adjust the manner in which students respond to or answer test items: • enlarged copy of the answer document * • Examiner records responses * • augmentative communication device * • communication board or choice cards * • brailler * • word processor or word processor with speech-to-text * • spelling aids * • English dictionary * • dictation using a recording device • dictation to a scribe * • read back student response * • word prediction software * • calculator or arithmetic tables * • math aids * • calculator with additional functions * • dry erase board * • additional markers, highlighters, colored pens, and/or pencils *

4.4.2 Testing Accommodations for LEP Students

Testing accommodation determinations for LEP students, made by the LEP Committee, should be based on the evidence collected from the student's educational record, such as:

- demographic information, including grade, age, number of years in U.S., prior schooling;
- standardized testing scores, the ACCESS for ELLs[9] test scores, and other academic testing achievement;
- current academic achievement, including general education achievement and comments from general education teachers; and
- English Language Proficiency Level as reported on the ACCESS for ELLs score report.

There are two types of accommodations available for LEP students on the Virginia SOL assessments—direct and indirect linguistic accommodations.

Direct linguistic testing accommodations involve adjustments to the language of the test. The following direct linguistic testing accommodations are available to LEP students on the SOL assessments:

- Read-Aloud Test (English only)
- Audio Test (English only)
- Bilingual Dictionary
- Dictation to a Scribe (Writing, short-paper component only)
- English Dictionary
- Plain English Mathematics Test (grades 3 through 8 and Algebra I)

Audio tests are created by taking SOL items and recording a narrator who reads the test items out loud in English. This recording can then be used for many students rather than depending on a test administrator to read an item aloud over and over on an as-needed basis. Plain English test versions include items that have less complex language, but still measure the full breadth and depth of the SOL mathematics content standards. When Plain English forms were first developed, existing SOL items would be evaluated, and the language would be simplified where possible. Now items are created that assess the content without including complex language as part of the item development process. Item writers are trained to use the following guidelines.

- Avoid words that have double meaning
- Avoid potentially unfamiliar words
- Use short sentences
- If lots of information is needed, break it up into bullets

Indirect linguistic testing accommodations involve adjustments to the conditions under which LEP students take SOL tests. The following indirect linguistic testing accommodations are available to LEP students on the SOL assessments:

[9] Assessing Comprehension and Communication in English State-to-State for English Language Learners (ACCESS for ELLs®) is Virginia's English language proficiency assessment.

- Flexible schedule
- Visual Aids
- Student indicates a response

Additional information about the accommodations available for LEP students on the Virginia SOL assessments is provided on the Virginia Department of Education website.

http://www.doe.virginia.gov/testing/participation/lep_guidelines.pdf.

5. WRITING SCORING

5.1 Human Scorer Recruitment and Qualifications

The constructed response portion of the SOL writing assessment is scored by human raters. Highly qualified, experienced raters score all writing samples. These raters are drawn from a database of college graduates who completed the selection process for scorers. The need for ethnic and racial diversity is emphasized throughout the selection process. Scorers for the Virginia SOL writing test have a minimum of a bachelor's degree in an appropriate academic discipline (e.g., English, education), demonstrated ability in performance assessment scoring, and, preferably, teaching experience at the elementary or secondary level. The selection process requires that each candidate successfully complete a personal interview, online scorer training, and attain a high enough score on a qualification activity.

In addition to the scorers, scoring supervisors, scoring directors, and content specialists are involved in the scoring process. Scoring supervisors are selected based on their proven ability to score responses accurately and communicate scoring standards to scorers. Scoring directors are chosen based on their expertise in evaluating writing and their experience training and supervising scorers. A writing content specialist monitors quality and provides support and direction for scoring directors. The content specialist is assigned based on educational background and scoring experience.

5.2 Rangefinding

The writing samples used for training scorers are from the samples scored during the rangefinding process. Rangefinding is the process of identifying model writing samples for the two writing domains (composing/written expression and usage and mechanics) that characterize each score point of the writing rubric (1–4). Scoring directors and the content specialists work with Virginia rangefinding committees to create training sets. These writing samples, and others identified by Virginia Department of Education and testing contractor staff, are used as scoring guides during scorer training, qualifying, and calibration. The primary goal of the training is to convey the decisions made during rangefinding to the scorers and to help them internalize the scoring protocol.

5.3 Scorer Training and Qualifying Procedures

Scorers are required to take several training modules where they learn about using the online scoring system and implementing the scoring rubric. Each student essay response receives a score on a scale of 1–4 points for each of the domains. The four rubric score points represent the following:

- 4 = consistent control
- 3 = reasonable control
- 2 = inconsistent control
- 1 = little or no control

Training also includes a review of the anchor sets identified during rangefinding. These sets represent each of the four rubric scores and both writing domains. The sets have been scored and annotated so that scorers learn how and why the scores were determined. Next they complete practice sets which include additional writing samples. Finally, they receive qualification writing sets which they must score accurately in order to continue participating in the scoring of student essays.

5.3.1 Anchor Sets

Scorers review an anchor set for each of the two domains. Anchor sets include clear examples of each score point (1–4) and include annotations that provide a rationale for the scores assigned during rangefinding. These papers help the scorers internalize the scoring rubric.

5.3.2 Practice Sets

After reviewing each anchor set, scorers practice on sample papers, applying a score for the domain they are reviewing. The sets include examples of each score point. After applying scores to practice papers, scorers review annotations. The annotations provide feedback on true scores (the scores approved by the rangefinding committee) and explain the correct scores for the practice papers.

5.3.3 Qualifying Sets

In order to qualify to score the Virginia SOL writing assessment, scorers take four sets of 10 papers and must achieve 70% perfect agreement and 100% adjacent agreement with rangefinding-committee-approved scores for each domain on two of the four sets. Scorers who do not meet these standards are released from the project.

5.4 Scoring Procedures

5.4.1 Two Raters with Resolution for Nonadjacent Scores

In each test administration cycle, each writing response is reviewed by at least two professional scorers. The first and second raters score the writing response. If the scores match or are adjacent, they are summed together to create the final student score. If they are not adjacent, a scoring supervisor provides a third score. If the third score matches one of the first two, then it is summed with the matching score to provide the final score. If the third score is adjacent to one (or both) of the first two scores, then the third score and the higher of the adjacent scores are summed together to provide the final score. If the three scores do not match, and are not adjacent, then the response is scored a fourth time by a scoring director. If the fourth score matches any of the first three scores, then it is summed with the matching score which provides the final score. If the fourth score is adjacent to any of the first three scores, then it is summed with the highest adjacent score to provide the final score.

For responses that receive a backread score, this third score can overrule the outcome from the first two scorers. For example, if the first two scorers provided a score of 2, but the backread provided a score of 3, then instead of adding the first two scores together to provide the final score, the backread score and the highest adjacent score would be added together. So in this example, the student would receive a final score of 5 instead of the original score of 4. If the backread score was 4 in this example, it would not match or be adjacent to the first two scores, so the response would require a fourth score.

5.4.2 Backreading

Backreading is a system that allows a scoring supervisor and/or a scoring director to monitor an individual rater's score. Scoring supervisors read responses already scored by scorers they are monitoring. While backreading, the scoring supervisor can evaluate the scorer's performance, provide feedback, and—if necessary—adjust an assigned score. The scoring supervisor may also halt the scoring activity of an individual or group of scorers whose performance has declined. The inter-rater reliability requirements are 65% perfect agreement and 96% perfect plus adjacent agreement for all scorers. Approximately 5% of papers are included in the backreading process.

5.4.3 Validity Checks

Throughout scoring, scorers receive and score validity papers. These papers are pre-scored according to rangefinding standards. All scores on validity papers are approved by the Virginia Department of Education. Validity papers are used to monitor consistency in scoring over time; they are interspersed with and indistinguishable from other student responses. Approved true scores for these papers are loaded into the scoring system, and a report is run that indicates what percentage of accuracy a scorer achieves on validity papers in scoring against the true score. Validity papers are used as a check to ensure that scorers, as well as scoring supervisors, do not drift from the rubric but continue to score accurately. For scorers that do not meet the 65% perfect and 96% perfect plus adjacent agreement, targeted calibration sets are sent to further evaluate a scorer and provide re-training.

5.4.4 General Calibration Sets

Calibration is a process whereby scorers apply scores to student papers that had been scored previously by scoring directors and possibly a scoring supervisor. Calibration sets include student responses and are used as a training tool to improve agreement among scorers. After scorers take a calibration set, annotations provide an explanation for the correct scores for the responses.

Calibration is a form of training that creates consensus and accuracy among scorers. Calibration sets may focus on particular scoring issues—including clarifying a scoring line, showing a response that is unusual or problematic to score, or showing a range of responses or performance skills for a particular score point. The scoring directors present scorers with calibration sets daily throughout scoring.

5.4.5 Targeted Calibration Sets

Targeted calibration sets are similar to the general calibration sets. They include pre-scored student responses. However, like the qualifying sets, scorers must achieve 70% exact agreement and 100% exact plus perfect agreement in order to be allowed to continue scoring. Scorers who do not attain the target accuracy rates are dismissed from the scoring process.

5.5 Rescore Process

The primary purpose of the rescore process is to provide an additional step to ensure that the score assigned to the student's writing sample produced as part of the writing tests is an accurate representation of the student's achievement.

5.5.1 Automatic Rescores

An automatic rescore process is applied to all EOC writing prompts scored as non-passing that meet the following criteria:

- student is attempting to achieve high school graduation by August 31 of that school year
- a non-passing score was assigned to the student's test
- given the earned score on the MC component of the writing test, a passing overall score is attainable when combined with a perfect score on the written component of the writing test

5.5.2 Rescore Requested by School Divisions

Requests to rescore a student's writing response may be initiated by parents or by school personnel. All requests must be reviewed and approved by the school division before being submitted. Requests should be considered only if there is substantial evidence that the writing sample should have received a higher score. School division staff familiar with the rubric used to score this assessment must review the writing sample. Rescore requests should be approved by the school division only if the reviewers agree that the paper should have received a higher score

according to the rubric. A school division may request that a student's writing sample be rescored if

- the student failed the test; **AND**
- there is evidence that the writing sample produced by the student for the writing test should have received a higher score. Evidence of this requires that at least two school division staff familiar with the rubric used to score the writing short-paper portion of the writing test review the paper and agree that it should have received a higher score.

6. SCORES

6.1 Raw Scores

A raw score represents the number of points a student received for correctly answering questions on a test. For the SOL non-writing tests that consist of MC items and TEIs only, the raw score that a student earns is equal to the number of items the student answers correctly. For the SOL writing tests that have a MC/TEI component and a short-paper component, the raw score of the short-paper component is calculated as the weighted sum of the ratings given for each domain[10] and the total raw score is the sum of the raw scores on the two components (MC/TEI plus short paper).

Because different tests have different item types and different numbers of questions, the raw score is only useful in relation to that test or content area. For example, consider a student who receives a raw score of 59 on mathematics and a raw score of 43 on reading. Now imagine that there were 75 total items on the mathematics test and 50 total items on the reading test. In simple terms, this can mean the respective percentage correct would be 79% for the mathematics test and 86% for the reading test.

Raw scores cannot be used for comparing student performance across different tests or test forms because they are affected by test length and difficulty. Raw scores are comparable only within a given test form. To make comparisons of student performance within a test across years, raw scores must be converted to scale scores.

6.2 Total Scale Scores

A scale score is a conversion of a student's raw score on a test to a common scale. The common scale allows for a numerical comparison of student scores across different years and versions of a specific test. Because Virginia uses multiple versions of a test within a grade and subject, the scale is used to control slight variations in difficulty from one version of a test to the next. For all SOL tests, the scale scores range from 0 to 600. Sometimes a scale score can be estimated as less than 0 (for very low raw scores), or greater than 600 (for very high raw scores). In these cases, to keep the range consistent, scale scores below 0 are set to 0 and scale scores above 600 are set to 600. In addition, at a raw score of 0, the scale score is always set to be 0, and at the top raw score

[10]Each essay is scored on two elements: 1) composing and written expression and 2) usage and mechanics.

(100% correct), the scale score is always set to 600 (see Section 8.2 for more information on Scaling).

While the scale scores can be used for comparisons across test forms within an SOL test, they cannot be compared across different SOL tests. For example, scale scores cannot be used to reliably determine whether a student or group of students is stronger in reading than in mathematics.

6.3 Reporting Category Scale Scores

SOL are grouped into categories that address related content or skills. These categories are called reporting categories.[11] For each SOL assessment, reporting category scale scores are reported in addition to the overall test scale score. There are varying numbers of reporting categories for the SOL assessments. For each assessment, the reporting category scale scores range from 0 to 50, with a 30 indicating approximate mastery of the content covered by that reporting category. Sometimes a reporting category scale score can be estimated as less than 0 (for very low raw scores), or greater than 50 (for very high raw scores). In these cases, to keep the range consistent, scale scores below 0 are set to 0 and scale scores above 50 are set to 50. In addition, at a reporting category raw score of 0, the reporting category scale score is always set to be 0, and at the top reporting category raw score (100% correct), the reporting category scale score is always set to 50 (see Section 8.2 for more information on Scaling).

Reporting category scale scores allow only comparisons within a given reporting category. A reporting category scale score cannot be used to reliably determine whether a student or group of students is stronger on one reporting category compared to another reporting category.

6.4 Performance Levels

In addition to test scores, performance levels are reported on all SOL assessments. Students are classified into performance levels on the basis of their scale scores as compared with the performance level cut scores, which were adopted by the Virginia Board of Education based on recommendations of educators who participated in standard setting meetings. For the reading and mathematics assessments in grades 3–8, there are four performance levels: fail/below basic, fail/basic, pass/proficient, and pass/advanced. For all other assessments, there are three performance levels: fail/does not meet, pass/proficient, and pass/advanced or advanced/college path for EOC Reading, EOC Writing, and Algebra II. For all SOL assessments, the cut score for the pass/proficient level corresponds to a scale score of 400, and the cut score for the pass/advanced level corresponds to 500.

Regardless of which form or test administration a student takes a particular SOL test, the same level of achievement is required to obtain a scale score of 400 for pass/proficient and a scale score of 500 for pass/advanced. For each SOL assessment, the scale scores that represent pass/proficient and pass/advanced remain the same over years, but they may correspond to

[11] A list of the reporting categories for a given SOL assessment can be found in the test blueprints: http://www.doe.virginia.gov/testing/

different raw scores across test forms and administrations. The fluctuation of raw scores does not mean that the requirements for the performance levels have changed. It only reflects changes in difficulty across test forms.

7. PERFORMANCE STANDARDS

7.1 Standard Setting

Performance standards relate levels of test performance directly to what students are expected to learn, as defined in the statewide curriculum. This is done by establishing cut scores that distinguish between performance levels. Standard setting is the process of establishing the cut scores that define the performance levels for an assessment.

7.1.1 Performance Level Descriptors (PLDs)

Performance level descriptors (PLDs) are statements of what a student should know and be able to do at each performance level given the content standards being assessed. In grades 3–8 reading and mathematics, there are four performance levels that a student may achieve: fail/below basic, fail/basic, pass/proficient, and pass/advanced. For all other assessments, three performance levels exist: fail/does not meet, pass/proficient, and pass/advanced or advanced/college path[12] for EOC Reading, EOC Writing, and Algebra II.

7.1.2 Selecting Standard Setting Committees

Standard setting committee meetings are used to establish cut scores on the SOL assessments that operationalize the PLDs. Virginia educators participate in the meetings and recommend cut scores. These educators are recruited by the Virginia Department of Education based on the following criteria:

- instructional training and experience in the content area;
- in-depth knowledge of the SOL content standards;
- instructional experience with students who have disabilities and/or LEP students; and
- balanced regional representation.

Additionally, secondary and higher education members are recruited to participate in setting the EOC performance standards.

[12]A student obtaining the proficiency level of advanced/college path on the Algebra II test should have the necessary knowledge and skills for enrollment, without remediation, in an introductory credit-bearing college mathematics course with Algebra II as the highest prerequisite. A student obtaining a proficiency level of advanced/college path on the EOC Reading test should have the necessary knowledge and skills for enrollment, without remediation, in an introductory credit-bearing college course with a substantial reading load. A student obtaining a proficiency level of advanced/college path on the EOC Writing test should have the necessary knowledge and skills for enrollment, without remediation, in an introductory credit-bearing college course with a substantial writing load.

7.1.3 Standard Setting Process

Standard setting panelists are guided through an established process to help them identify cut scores that make sense and reflect the PLDs.

Standard setting panelists participate in a general session in which the reason for setting new performance standards is described and an overview of the standard setting procedure is given. Following the general session, committees break into subject- and grade-specific groups, where they review the PLDs and define threshold descriptions which further define what "just barely basic", "just barely proficient" and "just barely advanced" students know and can do. After discussion and general agreement about what the threshold level descriptions are for the basic, proficient and advanced performance levels, the panelists review the operational test in order to experience it as a student would. For the SOL writing tests, they also review examples of short paper responses as well as scoring rubrics.

The methods in the Angoff (1971) family of standard setting procedures are among the most widely used approaches employed for selected-response (MC) exams. The particular variation of Angoff used in to set standards for the Virginia SOL assessments is called the Yes/No method. For MC items, panelists review each operational test item and evaluate whether or not the "just barely proficient" and "just barely advanced" student would be likely (at least 2/3rds of the time) to get the item correct (yes or no). MC score recommendations for each performance level are calculated by recoding each 'yes' to the value of one (1) and each 'no' to the value of zero (0) and then summing across all items for each individual.

For the short paper component on the writing assessments, another variation of Angoff known as the Expected Task Score approach is used. Using this method, panelists evaluate whether or not the "just barely proficient" and "just barely advanced" student would be likely (at least 2/3rds of the time) to get each rubric score (1, 2, 3, and 4). Although each domain is scored on a 1–4 point scale, the domains are differentially weighted when finding the total score. Essay score recommendations for each performance level are calculated by summing together the weighted rubric score across the two domains for each individual. Individual total cut score recommendations for each performance level are calculated by summing together the selected response score recommendations and short paper score recommendations for each panelist.

Panelists practice the Modified-Angoff rating methods using sample items and then engaged in three rounds of ratings for the individual items. Cut scores are calculated by aggregating the room-level data for each performance level. The cut scores are provided to the panelists as feedback after each round of ratings. Panelists then engage in room level discussions about how the individual items were rated as well as the resulting raw score cuts.

After the third and final round of ratings, panelists complete an evaluation of the standard setting process, their confidence in the results, and their satisfaction with the standard setting facilitator/facilities. These surveys are used to ensure that all panelists understood the process used to facilitate their recommendations and were confident in their recommendations and satisfied with the standard setting facilitator/facilities.

Next, a smaller group of committee members is convened to review the recommendations coming from Round 3. This articulation committee reviews the PLDs of all assessments included in a particular standard setting committee meeting (e.g., grades 3–8 reading) and discusses the results of Round 3 with regards to the estimated impact data. Impact data provides the percentage of students who would fall into each performance level if the Round 3 cut scores were adopted. The articulation committee can suggest modifications to the cut score recommendations if there is justification based on the content or the impact data. The final recommended cut scores are submitted to the Virginia State Board of Education for approval.

Approved cut scores for all SOL tests can be found on the Virginia Department of Education website.

http://www.doe.virginia.gov/testing/scoring/sol-cut-scores.pdf

7.2 Standard Setting Schedule

Each subject area undergoes a review and potential revision to the content standards every seven years. After the content standards are revised, the performance standards must also be revised. Therefore, standard setting in Virginia also occurs on a seven-year cycle. There were no standard-setting events during the 2013–2014 test administration cycle. The table below provides years of the previous standard settings and future standard settings.

Table 7.2.1 Virginia SOL Standard Setting Schedule

Subjects	Previous Standard Setting	Upcoming Standard Setting
History	2010–2011	2017–2018
Mathematics	2011–2012	2018–2019
Reading and Writing	2012–2013	2019–2020
Science	2012–2013	2019–2020

8. CALIBRATION, SCALING, AND EQUATING

8.1 Rasch Partial Credit Model (RPCM)

For the Virginia SOL assessments, the unidimensional IRT Rasch Partial Credit Model (RPCM; Masters, 1982; Rasch, 1980) is used for item calibration. The RPCM model is commonly used for calibration, scaling, and equating in large assessment programs. The WINSTEPS software program (Linacre, 2006) is used to calibrate items, that is, to calculate item difficulty estimates, and is also used to calculate student proficiency estimates.

There are several benefits to using the RPCM model:

- The model can handle both dichotomous (e.g., MC/TEI) and polytomous (e.g., prompt) items.

- Unlike raw scores or percent correct values, estimates of item difficulty and student proficiency based on RPCM are not dependent upon the particular items included on a test form. Therefore, item difficulty and student proficiency values can be compared across forms and administrations.
- The underlying proficiency scale that is created using RPCM can be used to maintain performance levels across forms so that the interpretation of passing the SOL test means the same thing regardless of the particular form a student happens to receive.
- There is a one-to-one relationship between raw scores and Rasch item difficulty estimates so that it is possible to develop a raw score to theta table, where theta (θ) is the student proficiency value estimated using RPCM.
- Item difficulty and student proficiency (theta) are estimated simultaneously, and the values are on the same scale. This makes it possible to predict which items a student is likely to get right or wrong based on their proficiency.

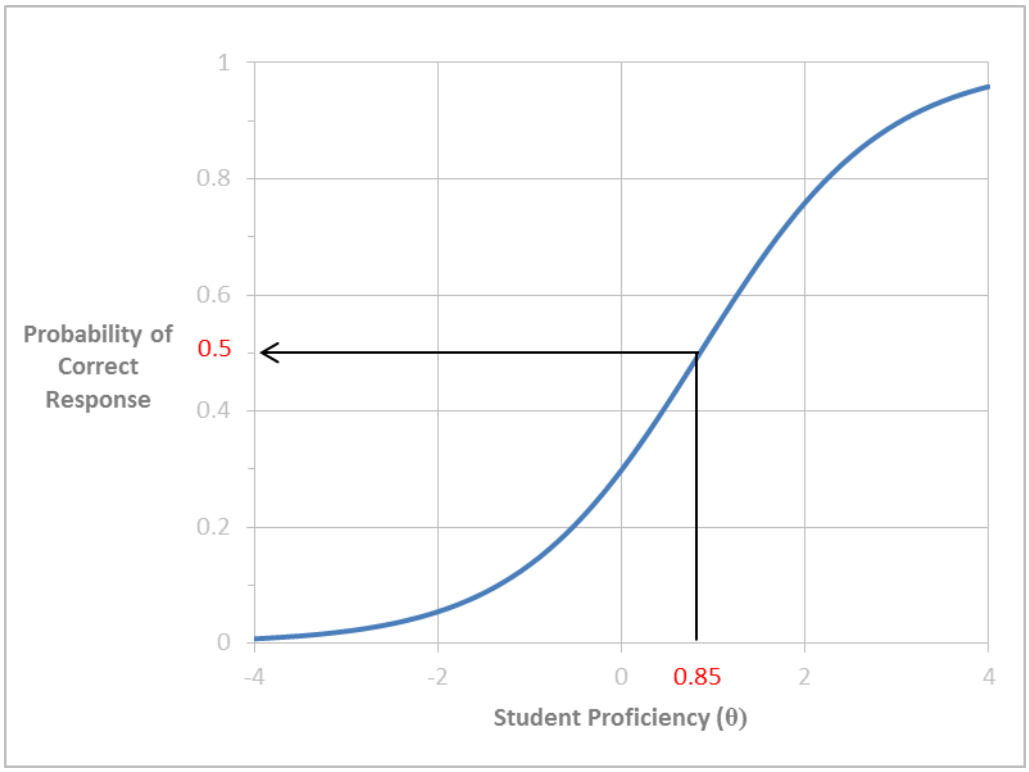
Masters (1982) provided a formula for calculating the probability of a student with proficiency θ obtaining a raw score of x on item/task i involving m_i+1 score categories with difficulties D_{ij}.

$$P_{xi} = \frac{e^{\sum_{j=0}^{x}(\theta - D_{ij})}}{\sum_{k=0}^{m_i}\left[e^{\sum_{j=0}^{k}(\theta - D_{ij})}\right]}, \quad x = 0, 1, ..., m_i \qquad (8.1)$$

For dichotomous items, the result of the equation 8.1 can be displayed as an item characteristic curve (ICC) where the vertical axis is the probability of a correct response, ranging from 0 to 1, and the horizontal axis is the student's proficiency estimate. The theta/proficiency scale is continuous and unbounded in theory. In practice, it typically ranges from -4 to +4 logits.

An example ICC is provided in Figure 8.1.1. The difficulty of an item corresponds to the location on the ICC where a student has a 0.5 probability of answering the item correctly. Because item difficulty and student proficiency are on the same scale, in the example ICC, the item difficulty is 0.85 and the student theta corresponding to a 0.5 probability of a correct response is also 0.85.

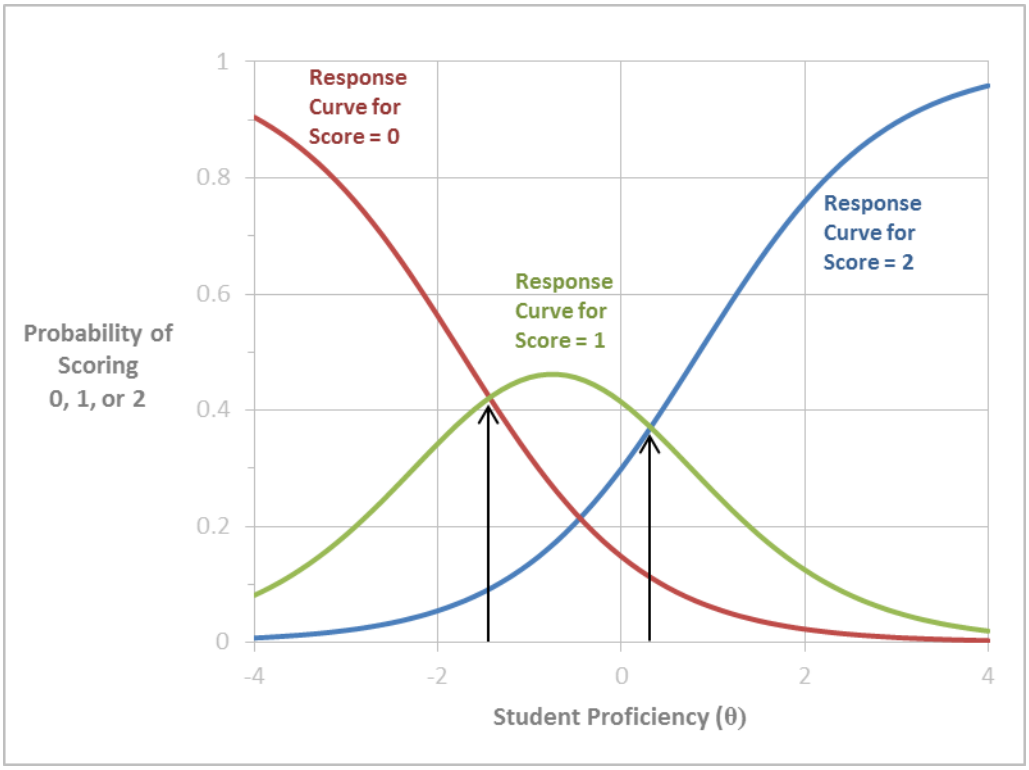
Figure 8.1.1 Sample Item Characteristic Curve for a Dichotomous Item



For polytomous items, a more complex graph is needed to display the probability of obtaining each of the possible score points based on student proficiency. For example, with an item with three score points (0, 1, 2), three response probability curves are needed. An example of the response curves for a polytomous item is provided in Figure 8.1.2. The left-most curve in Figure 8.1.2 represents the probability of students getting a score of 0 (completely incorrect) on the item given their proficiency. Students with very low proficiency (i.e., below –3) are likely to be in the score of 0 category and are more likely to be in this category than in the other two categories. Those receiving a score of 1 tend be moderately proficient. The final, right-most curve represents the probability for those receiving a score of 2 (completely correct). High-proficiency students are more likely to be in this category than in the other two categories, but there are still some of middle and low proficiency students that may obtain full credit on this item.

The black arrows in Figure 8.1.2 indicate "thresholds" where the response curves cross. Students with proficiencies lower than the proficiency indicated by the left arrow have a higher probability of receiving a score of 0 compared to a score of 1. But students with proficiencies higher than the proficiency indicated by the left arrow have a higher probability of receiving a score of 1 compared to a score of 0. Likewise, the right arrow indicates the threshold between students who are more likely to obtain a score of 1 and those that are more likely to receive a score of 2.

Figure 8.1.2 Sample Category Response Curves for a Polytomous Item



8.2 Scaling

The raw score scale is commonly used in classrooms. It is intuitive to the public. However, it is not as useful as it appears for standardized assessments. This is because the goal is to be able to compare student scores regardless of the particular set of items they took and to be able to make inferences about their proficiency that is not form specific or only accurate for a particular administration. In order to be able to make the desired score comparisons, it is important to be able to place all of the items from all test forms onto a common scale. This can be done with the RPCM.

8.2.1 Scale Scores for the Total Test

The RPCM is used to create a single scale for item difficulty and student proficiency values. However, the resulting scale has negative numbers and numbers with decimals. These values are not intuitive to the public. To create a more user-friendly scale, a linear transformation is applied to the theta (proficiency) scale to obtain scale scores. On the Virginia SOL tests the scale scores range from 0 to 600, with higher scores indicating higher proficiency. To make score interpretation even easier, the cut scores on the theta scale, which are different for every grade and subject, as determined during the standard setting process, have been set to scale scores of 400 for proficient and 500 for advanced for all SOL tests.

To determine the appropriate linear transformation (see Wright & Stone, 1979) to get from the

theta scale to the 0–600 scale, theta is multiplied by a slope constant (γ) and then an intercept constant (α) is added to the result.

$$\textit{Scale Score} = \alpha + \gamma \cdot \textit{theta}, \tag{8.2}$$

where the intercept of the linear transformation is

$$\alpha = \left(D_1 d_2 - D_2 d_1\right) / \left(d_2 - d_1\right), \tag{8.3}$$

and the slope is

$$\gamma = \left(D_2 - D_1\right) / \left(d_2 - d_1\right). \tag{8.4}$$

Here D_1 = 400 (the proficient cut scale score), D_2 = 500 (the advanced cut scale score), d_1 is the theta value associated with the proficient cut score, and d_2 is the theta value associated with the advanced cut score. Again, D_1 and D_2 are constant across SOL tests, but d_1 and d_2 differ based on the specific standards for each test.[13]

Although scale scores are a linear transformation of the theta scale, they are a nonlinear transformation of the raw scores from which they were obtained. That is, the distance between scale scores does not remain the same for each change in the raw scores. Typically, for the middle of the scale (around the 350–400 range), the increments are smaller than they are near the top or bottom of the scale. Sometimes a scale score can be estimated as less than 0 (for very low raw scores), or greater than 600 (for very high raw scores). In these cases, to keep the range consistent, scale scores below 0 are set to 0 and scale scores above 600 are set to 600. In addition, at a raw score of 0, the scale score is always set to be 0, and at the top raw score (100% correct), the scale score is always set to 600.

8.2.2 Scale Scores for Reporting Categories

Each assessment covers a number of SOL, which are grouped into categories that address related content or skills. These categories are called *reporting categories*. Reporting category scale scores are calculated to provide an interpretation of student performance in each reporting category in relation to the performance standard on the test as a whole. For example, Rasch item difficulty estimates for items in reporting category 1 (obtained from the calibration and equating process conducted at the total test level) are used to create a raw-score-to-theta table specific to reporting category 1. Once the raw-score-to-theta table is produced, the following formula is used to create a scale for reporting category 1:

$$\text{Reporting Category 1 Scale Score} = 30 + 7 \times \left(\frac{\theta_X - \theta_{PROF}}{\sigma_R}\right), \tag{8.5}$$

where θ_X is the theta value associated with the reporting category raw score, θ_{PROF} is the theta value associated with the passing cut on the overall test (equivalent to d_1 in equations 8.3 and

[13] Although the *proficient* and *advanced* scale score cuts are constant across SOL tests, for the tests that also have a *basic* cut score, the basic scale score cuts vary. This is because with a linear transformation it is not possible to fix three points.

8.4), and σ_R is the standard deviation of the theta values associated with the reporting category. The standard deviations used in these calculations are derived from the first administration of a test after new performance standards are set. The reporting category scale scores range from 0 to 50. Sometimes a reporting category scale score can be estimated as less than 0 (for very low reporting category raw scores), or greater than 50 (for very high reporting category raw scores). In these cases, to keep the range consistent, reporting category scale scores below 0 are set to 0 and reporting category scale scores above 50 are set to 50. In addition, at a reporting category raw score of 0, the reporting category scale score is always set to be 0, and at the top reporting category raw score (100% correct), the reporting category scale score is always set to 50.

The same process and formula is used to create scale scores for the rest of the reporting categories on a test.

8.3 Equating

Equating is a statistical procedure that adjusts for slight differences in difficulty between test forms. Once the adjustment is applied, scores can be compared across forms and students taking one form of a test are neither advantaged nor disadvantaged when compared to students taking a different form of a test.

The equating design used for the SOL assessments is the common item non-equivalent group design (Kolen & Brennan, 2014). In this design, a set of common items (also called linking items or anchor items) that was administered on a previous form is also included on a new form. This set of items provides a mechanism for estimating differences in form difficulty while taking differences in student proficiency into consideration.

8.3.1 Field-Test Equating

As described in Section 8.1, the items on the SOL assessments are calibrated using the RPCM. Once the items are calibrated, the item difficulty statistics are obtained. Each time a set of items is calibrated using the Winsteps software (with item centered scaling), the average difficulty for the set is always estimated arbitrarily as zero. However, some item sets may be easier than others, so the item difficulty statistics must be transformed to be on the same scale. An initial set of items can be used to set the scale. Then, each time new sets of items are calibrated, they can be transformed so their item difficulties are on this initial or *base scale*. The process for testing out new items is called *field testing*, and the estimation of item difficulties and transformation to the base scale is called *field-test equating*.

In field-test equating, rather than using equating to estimate the difficulty of a test form, the goal is to estimate the difficulty of new items. These new items are included on forms with operational items that have already been field tested during previous administrations. The operational items serve as the common items for equating. These items were placed onto the base scale previously. Rasch values for the common (operational) items are fixed while Rasch values for the field-test items are freely calibrated. By fixing the common item Rasch values, the Winsteps software can estimate the field-test values on the same underlying base Rasch scale.

8.3.2 Pre-Equating

One of the benefits of IRT is that item difficulty and student proficiency (θ) are estimated simultaneously, with both estimates on the same scale. Using this relationship, a raw score to theta table can be generated using the following equation:

$$Raw\ Score = \sum_{i=1}^{I} \sum_{j=0}^{m_i} j \times P_{ij}(\theta), \tag{8.6}$$

where $P_{ij}(\theta)$ is the probability of a correct response for each of the $i = 1, ..., I$ items given that the item categories (j) are scored $0, ..., m_i$. The scaling constants described in Section 8.2 can be applied to the theta values and a raw score to scale score (RSSS) table can be produced.

Pre-equating makes use of this relationship by using existing item difficulty estimates, obtained during field testing or previous post-equating analyses, to generate a RSSS table for a test form prior to the test being administered. No transformation of item difficulties is needed in this case because previous equating analyses have already placed all of the item statistics on the same scale.

Pre-equating is completed for all new SOL forms as a way to evaluate the difficulty of the test and the position of the cut scores that differentiate the performance levels on the form prior to administration. Test difficulty values can be compared to established targets and used to determine whether modifications should be made to a potential test form during the test construction process.

Although pre-equating is sufficient for generating the RSSS table needed for reporting student scores, often post-equating is completed after the administration in order to update the RSSS table, taking possible changes in item difficulty into account.

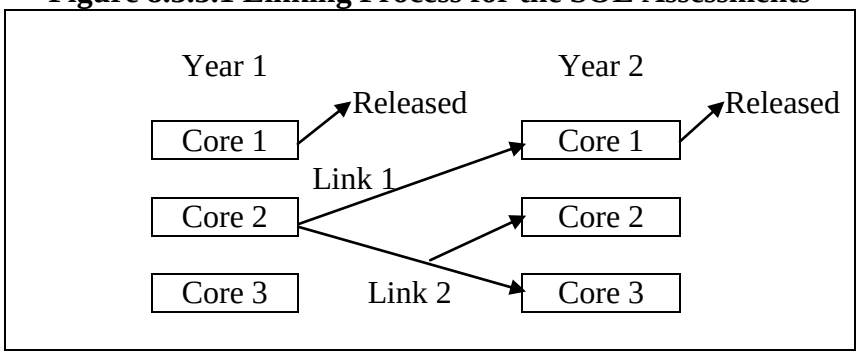
8.3.3 Post-Equating

Post-equating allows for new item difficulty estimates to be computed and used to generate scoring tables for reporting purposes. The item difficulty values can change for a variety of reasons including changes in instructional practice and item position effects (e.g., some items become harder if they move from earlier in a test form to later in a test form). As with pre-equating, the goal of post-equating is to estimate form difficulty rather than item difficulty, and to generate a RSSS table. Typically, new SOL forms are post-equated.

In order to post-equate, a linking design is implemented where a set of common items is included on a new form that has already been administered on a previous form. The common item set is made up of 20–30% of the operational items and is representative of the total test in terms of content and statistical properties. Figure 8.3.3.1 provides a diagram of an example linking design. Because Core 1 is typically released to the public annually, items on Core 1 cannot be carried forward to future forms. Therefore, linking items from the first year that link forward to the second year can only come from Cores 2 and 3. In this example, one set of linking sets comes from Core 2 (Year 1) and is included in Core 1 (Year 2); a second set of linking items comes from Core 2 (Year 1) and is included in both Core 2 (Year 2) and in Core 3 (Year 2). Therefore, Cores 2 and 3 (Year 2) share linking items. The linking design is similar for tests that have only

two core forms, except Core 2 in Year 1 provides the linking items for both Core 1 and Core 2 in Year 2.

Figure 8.3.3.1 Linking Process for the SOL Assessments



The Rasch item difficulty values for the linking items are already on the base scale. To post-equate the non-linking items, the Rasch values for the linking items are anchored (or fixed) while the Rasch values for the non-linking items are freely estimated. The Rasch values estimated by Winsteps for the non-linking items are on the base scale because of the anchoring of the linking item Rasch values during the estimation process. The anchored Rasch values for the linking items, and the newly estimated Rasch values for the non-linking items are used to generate a RSSS table for the new core form.

Post-equating is conducted on a sample of the student population so that scores can be reported back to schools quickly. Once scores are available for at least 3,000 students on a core form, the post-equating process begins. Data are evaluated to make sure the sample will adequately support the post-equating process, and item-level statistics are created to double check scoring accuracy. Additionally, linking items are evaluated for stability. Linking items should have stable item difficulty estimates over time or they will not provide a stable link to the base scale. Therefore, if linking items have a displacement value greater than 0.5 (indicating poor stability), they are removed from the link set. Content representation of the linking set is evaluated if items are dropped. Post-equating is replicated by at least two psychometricians from the testing contractor and an additional replication is provided by an external verification group. Based on this process, a RSSS table is generated and verified for reporting.

9. RELIABILITY

Because tests contain a limited number of items given to students during a single administration, the score each student obtains is only an estimate of their true proficiency. Reliability is a way of quantifying the level of stability in test scores. High reliability indicates that there is a high degree of stability in the observed score representing the student's true proficiency level, and that if the student was retested on the same content, they would likely obtain a very similar score. Conversely, low reliability indicates that there is a low degree of stability in the observed score and that if the student was tested again on the same content, they might obtain a very different

score. Highly reliable scores are essential to making inferences about what students know and can do. Reliability estimates for new SOL core forms are provided in Part II of this report.

9.1 Internal Consistency

There are many ways to estimate reliability, but one way that is commonly used on large-scale assessments where students only receive one form is to compute internal consistency reliability. Internal consistency quantifies the stability of scores by estimating how consistently individuals respond to items. A basic estimate of internal consistency reliability is Cronbach's coefficient alpha statistic (Cronbach, 1951). Coefficient alpha is equivalent to the average correlation between scores based on all possible divisions of a test into two halves. Coefficient alpha can be used on any combinations of dichotomous (two score categories) and polytomous (three or more score categories) test items and is computed using the following formula:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum_{j=1}^{n} S_j^2}{S_X^2}\right), \qquad (9.1)$$

where n is the number of items,

S_j^2 is the variance of students' scores on item j, and

S_X^2 is the variance of the total-test scores.

Cronbach's alpha ranges in value from 0.0 to 1.0, where higher values indicate greater reliability. Two factors affect estimates of internal consistency: test length and homogeneity of items. The longer the test, the higher the internal consistency value tends to be. Likewise, the more similar the items, the more likely examinees will respond consistently across items within the test, which also leads to higher reliability.

Stratified alpha (Cronbach, Schonemann, & McKie, 1965) provides a more appropriate reliability estimate for tests that are made up of homogeneous items clustered within heterogeneous components. For example, the SOL writing tests contain a combination of MC items paired with an open-ended writing prompt. Coefficient alpha for each component (MC and prompt) is included in calculating reliability for total test scores using the following stratified alpha formula:

$$\boldsymbol{Stratified\ \alpha = 1 - \frac{\sum \sigma_i^2 (1-\rho_{ii'})}{\sigma_T^2}},$$

(9.2)

where $\boldsymbol{\sigma_i^2}$ = variance of scores on item type i,

σ_T^2 = variance of total scores, and

$\rho_{ii'}$ = reliability coefficient of scores on item type i.

9.2 Inter-Rater Reliability

For assessments that are scored by human raters, for example, the SOL writing test prompt component, the consistency with which raters provide scores is an important measure of

reliability. Inter-rater reliability is calculated as the percentage of agreement between raters on the same student essay. Both perfect agreement and adjacent agreement are calculated. Perfect agreement occurs when the two independent scorers assign the same score point to the same piece of student work. Adjacent agreement occurs when the two independent scorers assign adjacent score points to the same piece of student work. The inter-rater reliability standards for the SOL writing assessments are 65% exact agreement and 96% exact plus adjacent agreement (see Section 5).

9.3 Measurement Error

9.3.1 Standard Error of Measurement

Whereas reliability coefficients provide an indication of the stability in test scores, measurement error quantifies the level of instability or uncertainty in test scores. The standard error of measurement (SEM) is inversely related to the reliability of a test; therefore, the greater the reliability, the lower the SEM. With a lower SEM, there is more confidence in the accuracy, or precision, of the observed test scores. The SEM is calculated using the following equation:

$$SEM = \sigma_X\sqrt{1-\rho_{XX'}}, \tag{9.3}$$

where σ_X is the population standard deviation of observed scores, and

$\rho_{XX'}$ is the population reliability coefficient.

Using coefficient alpha, SEM can be estimated as follows:

$$Est(SEM) = S_X\sqrt{1-\alpha}, \tag{9.4}$$

where S_X is the sample standard deviation of observed scores.

9.3.2 Conditional Standard Error of Measurement

The SEM provides a single measure of uncertainty in test scores. However, the uncertainty in test scores can vary depending upon the proficiency of the student (Andrich & Luo, 2004). The conditional standard error of measurement (CSEM) value based on IRT can vary across test scores. For example, if a person gets either a few or a large number of items correct (i.e., scores at the extremes of the score distribution), the CSEM will be greater in value than it will be if the person gets a moderate number of items correct. Scores near the middle of the score distribution typically have lower CSEM compared to the extremes because many tests are comprised of a large proportion of moderately difficult items which are suited to measuring students of moderate proficiency. By providing the CSEM, the error band quantifying uncertainty in a student's score is more precise than using the SEM.

Under the Rasch model, the CSEM for each person is as follows:

$$\sigma_{\hat{\beta}} = \frac{1}{\sqrt{\sum_{i=1}^{L} p_{vi}(1-p_{vi})}}, \tag{9.6}$$

where

v is for a particular person,

i is for a particular item,

L is the number of items on the test,

$\widehat{\beta}$ is the student proficiency estimate, and

p_{vi} is the probability that a person answers an item correctly and is defined as

$$p_{vi} = \frac{e^{\beta v - \delta_i}}{1 + e^{\beta v - \delta_i}}, \tag{9.7}$$

where β_v is person *v*'s proficiency and δ_i is the item's difficulty.

An approximate 68% confidence interval for $\hat{\beta}$ is given by $\hat{\beta} \pm CSEM$. To interpret this confidence interval, consider a student who takes the test 100 times. Assuming measurement error is normally distributed, the student's true proficiency would fall within the confidence interval 68% of the time (or 68 times out of 100).

9.4 Decision Accuracy and Consistency

Students are classified into performance levels based on a comparison of their scale scores to the performance level cut scores. The most important cut score on the SOL assessments is the pass/proficient cut score. Students who obtain a scale score less than the pass/proficient cut score have failed the test whereas students who obtain a scale score greater than or equal to the pass/proficient cut score have passed the test. However, observed scores always have some degree of measurement error. This error may lead to misclassifications. A misclassification occurs when a proficient student fails a test (false negative) or when a non-proficient student passes a test (false positive). Because of the decisions made based on these classifications, it is important to evaluate decision misclassifications to verify that they are kept to a minimum.

Decision accuracy is the extent to which the decision made based on students' scores on a particular test form (observed classifications) would agree with the decisions that would be made if each student were tested with all possible parallel forms of the assessments or an infinite number of independent administrations of the test (true classification). *Decision consistency* is the extent to which two observed classifications, based on taking two equally difficult forms of the test would classify students into the same performance category. Both decision accuracy and decision consistency are calculated for each SOL test form using the Livingston and Lewis (1995) equations as implemented in BBClass (Brennan, 2004).

10. VALIDITY

As noted in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), "validity refers to the degree to which evidence and theory support the interpretations of test scores for proposed uses of tests." Sources of validity evidence are often clustered into the following categories:

- Evidence Based on Test Content
- Evidence Based on Response Processes
- Evidence Based on Internal Structure
- Evidence Based on Relationships to Other Variables

However, these sources of validity evidence are not considered independent pieces that must be equally represented and studied. Instead, these categories are used in this chapter to provide a framework for validating the interpretation(s) of scores that result from the SOL assessments.

> "These sources of evidence may illuminate different aspects of validity, but they do not represent distinct types of validity. Validity is a unitary concept. It is the degree to which all the accumulated evidence supports the intended interpretation of test scores for the proposed use." (AERA, APA, & NCME, 2014)

10.1 Validity Evidence Based on Test Content

Content validity answers the question: "Does the test include items that measure all relevant aspects of the content while excluding irrelevant content?" Content validity is frequently defined in terms of the sampling adequacy of test items. That is, content validity is the extent to which the items in a test adequately represent the construct of interest (Suen, 1990). In educational testing, the state curriculum defines the content that is to be taught and assessed. Consequently, content validity provides judgmental evidence in support of the domain relevance and representativeness of the content in the test (Messick, 1989).

Section 3 of this technical report provides a good deal of information about the development of the SOL assessments including item development, prompt development, field testing of new items, and construction of new test forms. Virginia educators are included during each step of the test development cycle so that the SOL tests are very closely aligned with the SOL content standards from the beginning. The sections below provide a short summary of how this alignment provides content validity evidence for the SOL program.

10.1.1 Relation to Content Standards

Each Virginia SOL assessment is built to a specified test blueprint so that student scores reflect a consistent measure of the breadth of the commonwealth's content standards within each subject. This blueprint specifies the number of items to be used from each content strand within each reporting category. The content in the SOL test blueprint derives directly from the SOL curriculum framework.[14] The SOL curriculum framework amplifies the SOL and defines the content knowledge, skills, and understandings that are measured by the SOL tests. The

[14]The SOL curriculum frameworks and test blueprints may be accessed at the following website: http://www.doe.virginia.gov/testing/

curriculum framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers as they plan their lessons by identifying essential content knowledge and skills students need to acquire. This supplemental framework delineates in greater specificity the minimum content that all teachers should teach and all students should learn. This direct relationship of the SOL curriculum frameworks with the SOL test blueprint and the SOL assessments lends support to the content validity of the SOL assessments.

10.1.2 Educator Input on Item Development

The Virginia Department of Education and its testing contractor are engaged in a continuous item and test development cycle. All SOL items go through several review rounds both internally and with Virginia educators (see Section 3). New SOL test forms are also rigorously reviewed and vetted with Virginia educators to ensure a tight alignment between the content the tests measure and the Virginia content standards that are to be assessed. These steps include item bias reviews where educators look for cases where an item may be measuring more than just the intended construct, especially where unintended constructs would disadvantage certain student subgroups.

10.1.3 SOL Assessment Alignment Studies

In addition to Virginia's rigorous item and test development process, the Department of Education contracted with the Virginia Commonwealth University to conduct external reviews of the alignment between the SOL tests and the SOL content standards. The alignment studies were conducted using procedures developed by Norman Webb (Webb, 2005) and focused on four different alignment criteria:

- Categorical Concurrence
- Depth of Knowledge Consistency
- Range of Knowledge Correspondence
- Balance of Representation

Using a large panel of trained alignment evaluators, results indicated that the assessments and the standards were well aligned based on the four criteria used to evaluate the alignment. A few discrepancies were identified including cases where test items required a lower depth of knowledge than was anticipated based on the SOL. For some assessments, the balance of representation was also not perfectly aligned. However, in most cases all four alignment criteria were met. Alignment studies were conducted for all of the SOL reading, mathematics, and science assessments at grades 3–8 and EOC. These results provide evidence that the test development process has been successful in building assessments that measure the knowledge and skills identified as important in the Virginia content standards.

10.2 Validity Evidence Based on Response Processes

Response processes are the cognitive strategies that students use to respond to items. For example, if a test is measuring reading comprehension, then it is reasonable to expect that the

student would have to read a selection and respond to a question that requires understanding of the selection the student read. If the student read a passage about planets and was asked a question that he or she knew the answer to because of prior learning in an astronomy class, then his or her response to the question may not accurately reflect reading comprehension skills. Instead, the item might be better characterized as measuring astronomy content knowledge.

10.2.1 Item Development

SOL reading assessments include both passage-based items and stand-alone items that measure the reading SOL. Passages contain a variety of lengths, topics, and genres. Some items are even tied to a pair of passages so that item responses are dependent upon integrating concepts across two passages. Passages are selected to be grade-level appropriate and engaging for students. These features of reading test development are intended to elicit student responses that accurately reflect their proficiency in relation to the reading content standards.

Likewise, a variety of math items are developed. For many math tests some items are developed to measure math content knowledge in the context of calculator use, whereas other items are developed to measure math content knowledge where calculator use will not be permitted. Even among MC items, there are a wide range of math items, some of which require a simple computation, while others require problem solving and/or multi-step calculations.

History items contain excerpts from historical documents, images of historical figures, and maps of important locations. Likewise, science items contain diagrams, scenarios, and graphs, similar to what students see in the classroom.

Finally, the writing assessments include both MC and prompt item types. The MC items allow for quick measures of skills like punctuation, grammar, and revision skills, while the prompt items require students to create a piece of writing. Without the prompt, it would be difficult to truly evaluate the important writing response process of students creating a piece of writing. For writing, the prompt scoring is also a critical part of the validity evidence. Without appropriate and accurate application of the prompt rubric, valid interpretations of student scores would not be possible. Detailed information about the professional scoring of students' prompt responses is provided in Section 5.

A lot of planning goes into creating items that assess the breadth and depth of the content standards creatively with items that can be easily administered and scored under high-stakes conditions. Moreover, item development specifications provide guidance for developing items that measure the intended content, without measuring additional factors that are not what the test is intended to measure. For example, mathematics items are developed with English learners in mind. Unnecessarily complex language and double-meaning words are avoided. The Virginia Department of Education has also provided session breaks on some of the SOL assessments to allow students to test over two days. Breaking up the testing session allows students content knowledge to be measured without concern that the test will be speeded or that the items at the end of the test will be a better measure of testing endurance rather than content knowledge.

10.2.2 Technology Enhanced Items (TEIs)

TEIs have been introduced into the SOL assessments over time with the first items field tested for math in Spring 2011. TEIs were first field tested for reading, writing, and science in Spring 2012. TEIs will be field tested for history in a future administration. These items allow students to demonstrate content knowledge in different ways than they have been able to with MC items alone. For example, students can plot points on a coordinate plane to provide a response to a math item. They can select several components of a food web in science. They can identify relevant regions on a map for history. The Virginia Department of Education continues to field test these item types on SOL tests to measure content with greater fidelity and to a greater depth of knowledge. TEIs comprise approximately 15% of the SOL assessment and are an important component of Virginia's commitment to developing items that best measure the intended response processes.

10.3 Validity Evidence Based on Internal Structure

10.3.1 Internal Consistency

Section 9.1 detailed the statistics used to evaluate the internal consistency of the SOL assessments. These reliability statistics include coefficient alpha and stratified alpha. Reliability of the SOL assessments is evaluated each year for the new core forms. Part II of the technical report includes these statistics for the overall group and broken out by gender and the two largest ethnic subgroups in Virginia—African Americans and Caucasians. The reliability values for the SOL assessments are quite high, indicating highly reliable assessments. The non-writing subjects have values at or above 0.85 for the total group. Writing reliability values are 0.80 and above for the total group. Similar reliability values are found for each of the subgroups. These values provide evidence that the SOL assessments are reasonably homogenous measures of each content domain (e.g., reading, math), as expected.

10.3.2 Differential Item Functioning (DIF)

As described in Section 3.4, each new SOL item is field tested before it is used on an operational assessment. As part of the field-test process, statistics are generated to verify that the items are functioning as intended. DIF is evaluated for males and females and for African American and Caucasian students. Items that exceed customary thresholds are flagged for additional scrutiny. If the Virginia Department of Education or teacher reviewers identify a potential concern with the item, it is eliminated from the pool of items used to measure students' knowledge of the SOL. This process helps to ensure that the items on the Virginia SOL assessments are measuring the content standards and not measuring other, unintended constructs or disadvantaging particular student subgroups.

10.3.3 Unidimensionality Evaluation

During the first administration of a new SOL test, developed based on revised content standards, an exploratory factor analysis is conducted to verify that the assessment measures one primary factor. For example, in the mathematics area, the mathematics assessments should be measuring

mathematics competence and not the combined effects of mathematics competence, reading and language proficiency, and the ability to work quickly. Often called the requirement for "test unidimensionality," evidence for the validity of the unifactor or unidimensionality assumption for an assessment can come from performing a factor analysis.

Data from student responses to test items were analyzed to look for relationships amongst the items and to identify the factor or factors the test items are measuring. An EFA will frequently identify multiple factors—although not all factors are of the same strength relative to their prevalence in the data. It is therefore important to review the eigenvalues associated with each factor as these provide an indication of the relative strength of each factor. Reviewing the "eigenvalue plot" that is obtained from analyzing the data is one method for conducting this evaluation. However, Divgi's index (Divgi, 1980; similar to a method proposed by Lord, 1980) provides a simple evaluation when testing for unidimensionality (one factor). This index provides the ratio of the difference between the eigenvalues associated with the first and second factors to the difference between the eigenvalues associated with the second and third factors. A value that is greater than 3.0 implies that the test in question is characterized by a dominant first dimension.

In every case, the first eigenvalue was substantially larger than the second and the second and the third eigenvalues were of similar magnitude. In addition, the results showed that all values of Divgi's index exceeded 3.0. These results suggest that the Virginia SOL mathematics, reading, writing, and science assessments across all grades and core forms are characterized by a dominant primary dimension, indicating that they are measuring a dominant trait or main factor.

10.4 Validity Evidence Based on Relationships to Other Variables

Additional validity evidence can be provided by linking scores from the assessment of interest to scores from other assessments or measures (e.g., course grades). For example, linking a reading assessment to another measure of reading would be expected to show a stronger relationship than linking a reading assessment to a mathematics assessment. During the 2013–2014 academic year, the SOL assessment results were not linked empirically to other assessments or scores that would provide validity evidence for SOL scores. However, Virginia plans to carry out additional research in this area to support the validity of the SOL assessment program in the coming years.

11. ALTERNATE AND ALTERNATIVE ASSESSMENTS

The commonwealth of Virginia offers the following alternative and alternate assessments:

- The Virginia Grade Level Alternative (VGLA) Program
- The Virginia Substitute Education Program (VSEP)
- The Virginia Modified Achievement Standards Test (VMAST)
- The Virginia Alternate Assessment Program (VAAP)

The purpose of these assessments is to evaluate the performance of students who are unable to participate in the Virginia SOL statewide testing program, even with accommodations.

Information about these assessments can be found in the *Virginia Alternative and Alternate Assessments Overview*.

12. RESOURCES

In addition to the information presented in this technical report (Part I and Part II), other resources are available that provide specific details on a variety of topics pertaining to the Virginia SOL assessments. These include testing implementation and examiner's manuals, Electronic Practice Assessment Tools (ePAT) applications, released versions of the SOL assessments, and practice items. These resources are available on the Virginia Department of Education website.

http://www.doe.virginia.gov/testing/test_administration/index.shtml

PART II: STATISTICAL SUMMARIES FOR SPRING 2014

1. OVERVIEW OF STATISTICAL SUMMARIES

This section contains an overview of the statistical summaries for the spring 2014 administration of the Virginia SOL assessments and VMAST mathematics and reading assessments. For more information about reliability, the CSEM, decision consistency, and decision accuracy, see Part I, Section 9, Reliability.

1.1 Administration Results

Three sets of tables are included in the Administration Results section. The first set shows the percentages of students who participated in online or paper-and-pencil administration in the spring 2014 administration. The second set shows the percentages of students in the proficient and advanced performance levels and the overall pass rate for each of the SOL assessments in the spring 2014 administration. The last set shows the raw score summary statistics for all newly constructed SOL assessments for the spring 2014 online administration.

1.2 Reliability Estimates for Non-Writing Assessments

Coefficient alpha reliability coefficients are provided overall, and by gender and ethnic subgroups (white and black) for all newly constructed core forms of the SOL assessments. Reliability was not recalculated for reused forms.

1.3 Reliability Estimates for Writing Assessments

The reliability of all the writing assessments was estimated using stratified alpha. Stratified alpha is provided for each combination of MC core and writing prompt for the administrations in grades 5, 8, and high school EOC. Analyses were done for the overall group and by subgroups based on gender and ethnicity (white and black).

Inter-rater reliability values are also provided for each prompt.

1.4 Decision Consistency and Accuracy Indices

Results are provided for the decision consistency and accuracy analyses for the 2014 new online SOL assessments. Although there is no general rule to determine the acceptable levels of decision accuracy and consistency needed for educational assessments, the Virginia SOL assessments have decision accuracy and consistency levels comparable to those that are reported in the Livingston and Lewis (1995) paper that describes the procedure. As expected, decision accuracy is generally higher than decision consistency.

1.5 Raw Score-to-Scale Score Conversion Tables and Conditional SEMs

RSSS conversions tables are provided, which include the CSEM at each scale score level for all newly constructed cores (1, 2, and 3) of the non-writing assessments. For the writing assessments, these tables are provided for each combination of MC core and writing prompt.

1.6 VMAST Results

Statistical summaries were also done for all newly constructed cores (1, 2, and 3) for VMAST grades 3–8 mathematics and reading as well as Algebra I and EOC reading assessments. The same analyses conducted for the SOL assessments, were also done for the VMAST assessments. For the 2014 spring administration, the results include the percentage of students who participated in VMAST administration, the percentages of students in the proficient and advanced performance levels, and the overall pass rate for each of the VMAST assessments, along with reliability estimates and decision consistency and accuracy analyses.

2. SPRING 2014 STATISTICAL SUMMARY

2.1 Administration Results

2.1.1 Participation by Mode of Administration

The following tables show the number of tests administered in the online and paper modes of administration. Each table shows the grade and subject area of the test, the total number of valid tests administered, and the percentages of tests that were administered online and on paper.

Table 2.1.1.1 Percentage of Tests Taken by Mode: Grades 3–8

Grade	Subject	Total Number	Mode	
			Online (%)	Paper (%)
3	Reading	91,074	99	1
	Mathematics	93,058	99	1
	Science	86,635	100	0
	History	87,735	100	0
4	Reading	92,083	99	1
	Mathematics	92,817	99	1
5	Reading	90,525	99	1
	Mathematics	84,899	99	1
	Science	92,179	99	1
	Writing	88,733	100	0
6	Reading	91,371	99	1

Grade	Subject	Total Number	Mode	
			Online (%)	Paper (%)
	Mathematics	82,063	99	1
7	Reading	91,852	99	1
	Mathematics	77,106	100	0
8	Reading	92,270	99	1
	Mathematics	62,718	99	1
	Science	83,188	99	1
	Writing	90,729	100	0

Table 2.1.1.2 Percentage of Tests Taken by Mode: Content-Specific History

Grade	Subject	Total Number	Mode	
			Online (%)	Paper (%)
CSH	Virginia Studies	92,010	99	1
	U.S. History to 1865	86,263	100	0
	U.S. History: 1865 to Present	85,185	100	0
	Civics and Economics	81,373	99	1

Table 2.1.1.3 Percentage of Tests Taken by Mode: End-of-Course

Grade	Subject	Total Number	Mode	
			Online (%)	Paper (%)
End-of-Course	Earth Science	78,224	99	1
	Biology	95,162	100	0
	Chemistry	62,306	100	0
	Algebra I	119,254	99	1
	Geometry	97,686	100	0
	Virginia & U.S. History	86,407	100	0
	World History I	77,780	99	1
	World History II	74,554	100	0
	World Geography	21,541	100	0
	English: Reading	84,879	99	1
	Algebra II	72,186	100	0
	Writing	79,225	99	1

Table 2.1.1.4 Percentage of Tests Taken by Mode: VMAST Mathematics and Reading

Grade	Subject	Total Number	Mode	
			Online (%)	Paper (%)
3	VMAST Reading	697	100	0
	VMAST Mathematics	746	100	0
4	VMAST Reading	1,158	100	0
	VMAST Mathematics	1,190	100	0
5	VMAST Reading	1,182	100	0
	VMAST Mathematics	1,315	100	0
6	VMAST Reading	765	100	0
	VMAST Mathematics	916	100	0
7	VMAST Reading	711	100	0
	VMAST Mathematics	874	100	0
8	VMAST Reading	790	100	0
	VMAST Mathematics	938	100	0
End of Course	VMAST Reading	202	100	0
	VMAST Mathematics	566	100	0

2.1.2 Percent of Students in each Performance Level

The results in this section are based on all tests that were taken with a valid score. The tables below show the grade and subject area, the total number of tests taken, the percentages passing at the proficient and advanced performance levels, and the overall passing rate. Tests taken on paper and online are combined in the calculation of the passing rates.

Table 2.1.2.1 Grades 3–8 Passing Rates

Grade	Subject	N-Count	Performance Level		Overall Pass Rate (%)
			Proficient (%)	Advanced (%)	
3	Reading	91,074	53.4	14.7	68.1
	Mathematics	93,058	51.1	15.1	66.2
	Science	86,635	58.6	23.7	82.3
	History	87,735	47.4	37.9	85.3
4	Reading	92,083	52.2	17.5	69.7
	Mathematics	92,817	53.8	25.9	79.6
5	Reading	90,525	53.0	20.0	73.0
	Mathematics	84,899	49.4	23.6	73.0
	Science	92,179	54.1	18.0	72.1
	Writing	88,733	48.2	22.5	70.7
6	Reading	91,371	58.0	14.7	72.6
	Mathematics	82,063	63.0	12.6	75.6
7	Reading	91,852	58.9	16.5	75.4
	Mathematics	77,106	51.1	13.2	64.3

Grade	Subject	N-Count	Performance Level		Overall Pass Rate (%)
			Proficient (%)	Advanced (%)	
8	Reading	92,270	59.0	10.6	69.6
	Mathematics	62,718	57.6	7.5	65.1
	Science	83,188	63.2	11.4	74.6
	Writing	90,729	52.7	16.8	69.6

Table 2.1.2.2 Content-Specific History Passing Rates

Subject	N-Count	Performance Level		Overall Pass Rate (%)
		Proficient (%)	Advanced (%)	
Virginia Studies	92,010	41.7	43.3	85.0
U.S. History to 1865	86,263	44.0	36.4	80.5
U.S. History: 1865 to Present	85,185	49.6	32.2	81.8
Civics and Economics	81,373	52.2	31.3	83.5

Table 2.1.2.3 End-of-Course Passing Rates

Subject	N-Count	Performance Level		Overall Pass Rate (%)
		Proficient (%)	Advanced (%)	
Earth Science	78,224	62.8	7.2	70.0
Biology	95,162	60.7	9.9	70.6
Chemistry	62,306	65.1	13.1	78.2
Algebra I	119,254	55.9	7.0	63.0
Geometry	97,686	53.4	10.6	64.0
Virginia & U.S. History	86,407	65.0	12.8	77.9
World History I	77,780	57.0	17.4	74.4
World History II	74,554	58.9	16.7	75.6
World Geography	21,541	65.9	10.3	76.2
English: Reading	84,879	66.7	8.6	75.3
Algebra II	72,186	53.4	18.7	72.1
Writing	79,225	57.6	21.8	79.4

Table 2.1.2.4 VMAST Grades 3–8 & End-of-Course Passing Rates

Grade	Subject	N-Count	Performance Level		Overall Pass Rate (%)
			Proficient (%)	Advanced (%)	
3	VMAST Reading	697	45.9	5.5	51.4
	VMAST Mathematics	746	38.9	4.6	43.4
4	VMAST Reading	1,158	52.6	5.6	58.2
	VMAST Mathematics	1,190	52.9	4.1	57.0
5	VMAST Reading	1,182	46.9	2.4	49.2

Grade	Subject	N-Count	Performance Level		Overall Pass Rate (%)
			Proficient (%)	Advanced (%)	
	VMAST Mathematics	1,315	26.9	2.5	29.4
6	VMAST Reading	765	42.4	1.2	43.5
	VMAST Mathematics	916	31.4	1.4	32.9
7	VMAST Reading	711	51.3	3.7	55.0
	VMAST Mathematics	874	45.1	0.6	45.7
8	VMAST Reading	790	41.1	3.5	44.7
	VMAST Mathematics	938	39.7	1.5	41.2
End-of-Course	VMAST Reading	202	48.5	2.0	50.5
	VMAST Mathematics	566	28.4	0.2	28.6

2.1.3 Raw Score Summary Statistics

Tables 2.1.3.1 through 2.1.3.6 show the raw score summary statistics for each newly constructed Virginia SOL online and VMAST assessments taken in the 2014 spring administration. Each table shows the grade and subject area of the test, number of examinees taking each test per core, as well as the number of test items, observed raw score mean, median, standard deviation, and minimum and maximum total raw scores.

Table 2.1.3.1 Summary Statistics for Grades 3–8 Reading and Mathematics Online

Subject	Grade	Core	Items	N	Mean	Med	SD	Min	Max
Reading	3	1	40	38,412	28.4	30	7.2	1	40
		2	40	38,592	27.8	29	7.6	2	40
	4	1	40	38,778	29.5	31	6.9	1	40
		2	40	39,004	28.4	30	7.5	1	40
	5	1	40	37,627	28.3	30	6.5	1	40
		2	40	38,869	28.6	30	7.5	3	40
	6	1	45	38,340	32.1	34	7.5	1	45
		2	45	38,705	32.4	34	8.2	2	45
	7	1	45	38,227	33.6	35	7.5	3	45
		2	45	38,964	32.4	34	7.6	1	45
	8	1	45	38,053	32.5	34	7.5	1	45
		2	45	39,276	31.6	33	7.9	1	45
Mathematics	3	1	40	46,941	29.6	31	7.0	1	40
		2	40	25,961	29.8	31	7.2	3	40
	4	1	50	47,282	36.7	39	9.3	1	50
		2	50	26,657	37.2	39	8.9	2	50
	5	1	50	44,735	37.8	40	9.0	4	50
		2	50	21,915	37.1	39	8.9	5	50
	6	1	50	40,026	34.6	36	9.7	1	50
		2	50	24,196	36.3	38	9.2	3	50
	7	1	50	37,618	35.0	37	9.3	3	50

Subject	Grade	Core	Items	N	Mean	Med	SD	Min	Max
		2	50	23,832	36.7	38	9.3	1	50
	8	1	50	30,266	34.6	36	9.4	1	50
		2	50	17,678	35.0	36	9.7	1	50

Note: Plain English is not included in the math results.

Table 2.1.3.2 Summary Statistics for Grades 3, 5, and 8 History and Science Online

Subject	Grade	Core	Items	N	Mean	Med	SD	Min	Max
History	3	1	40	34,649	31.8	34	6.7	1	40
		2	40	37,170	30.4	32	7.3	1	40
Science	3	1	40	46,321	30.2	32	6.9	3	40
		2	40	24,652	30.7	32	6.7	4	40
	5	1	40	47,764	28.8	30	6.7	1	40
		2	40	27,479	28.3	30	7.4	1	40
	8	1	50	43,103	34.3	35	9.0	1	50
		2	50	25,698	33.7	35	9.0	1	50

Table 2.1.3.3 Summary Statistics for Content-Specific History Online

Subject	Core	Items	N	Mean	Med	SD	Min	Max
Virginia Studies	1	40	36,438	30.6	32	7.0	3	40
	2	40	38,771	29.5	31	7.1	2	40
U.S. History to 1865	1	40	35,312	29.9	32	7.4	4	40
	2	40	35,732	29.2	31	7.8	1	40
U.S. History: 1865 to Present	1	40	36,122	30.9	32	6.6	4	40
	2	40	33,535	30.0	31	7.0	3	40
Civics and Economics	1	40	32,893	29.8	31	6.7	2	40
	2	40	33,584	28.7	30	7.2	3	40

Table 2.1.3.4 Summary Statistics for High School End-of-Course Online

Subject	Core	Items	N	Mean	Med	SD	Min	Max
Earth Science	1	50	27,685	32.7	34	9.3	3	50
	2	50	18,364	33.0	34	9.2	5	50
	3	50	6,393	30.5	31	9.4	6	50
Biology	1	50	38,496	34.7	36	8.8	1	50
	2	50	20,654	34.2	35	8.9	7	50
	3	50	9,956	32.3	33	9.4	5	50
Chemistry	1	50	28,696	33.6	34	8.8	5	50
	2	50	13,660	34.8	36	8.9	5	50
	3	50	5,954	32.7	34	9.4	4	50
Algebra I*	1	50	44,640	32.3	33	10.6	4	50
	2	50	24,728	29.5	30	10.8	3	50

Subject	Core	Items	N	Mean	Med	SD	Min	Max
	3	50	10,410	28.3	28	10.8	2	50
Geometry	1	50	38,898	32.7	33	10.0	3	50
	2	50	19,461	30.9	31	10.1	2	50
	3	50	9,357	28.9	29	9.7	5	50
Virginia & U.S. History	1	60	22,530	42.0	44	10.0	7	60
	2	60	20,990	42.6	44	10.0	8	60
	3	60	20,773	42.1	44	10.7	2	60
World History I	1	60	19,060	39.4	40	11.1	5	60
	2	60	19,519	42.7	45	11.7	3	60
	3	60	20,075	41.6	43	11.6	5	60
World History II	1	60	19,385	41.9	43	10.4	8	60
	2	60	19,771	43.5	45	10.8	3	60
	3	60	18,865	41.2	43	11.1	6	60
World Geography	1	60	8,737	41.7	43	10.3	6	60
	2	60	8,106	41.3	43	11.0	6	60
English: Reading	1	55	24,356	41.2	43	8.0	7	55
	2	55	19,108	42.5	44	7.9	8	55
	3	55	16,347	38.8	40	9.0	7	55
Algebra II	1	50	33,005	34.9	36	9.4	4	50
	2	50	14,877	33.0	34	9.4	5	50
	3	50	5,938	30.6	31	9.7	4	50

*Plain English is not included in the results.

Table 2.1.3.5 Summary Statistics for VMAST Grades 3–8 & End-of-Course Online

Subject	Grade	Core	Items	N	Mean	Med	SD	Min	Max
VMAST Reading	3	2	32	558	19.5	20	5.9	4	32
	4	2	32	969	18.6	19	5.7	5	31
	5	2	32	964	19.0	19	5.5	1	30
	6	2	36	617	21.8	22	5.9	6	35
	7	2	36	601	21.6	22	5.9	7	35
	8	2	36	639	22.0	23	5.9	6	35
	End of Course	3	44	74	25.4	25	6.7	12	40
VMAST Mathematics	3	2	32	616	18.0	18	6.0	4	31
	4	2	40	1,012	23.9	24	6.5	9	40
	5	2	40	1,105	22.0	22	7.0	2	39
	6	2	40	770	21.9	21	6.4	5	38
	7	2	40	763	21.1	21	5.9	5	35
	8	2	40	785	21.6	22	6.4	6	36
	End of Course	3	40	347	20.9	20	5.8	9	36

Table 2.1.3.6 shows the raw score summary statistics for grades 5, 8, and EOC Virginia SOL writing tests taken in the 2014 spring administration. The table presents the number of examinees tested for every grade/core/prompt combination, as well as the observed raw score mean, median, standard deviation, and minimum and maximum values. The maximum possible raw score for the grade 5 writing test is 46. It includes 22 MC questions and an essay item. The maximum possible raw score for the grade 8 writing test is 48. It includes 24 MC questions and an essay item. The maximum possible raw score for the EOC writing test is 54. It includes 30 MC questions and an essay item.

Table 2.1.3.6 Summary Statistics for Grades 5, 8, and End-of-Course Writing Tests

Grade	Core	Prompt	N	Mean	Med	SD	Min	Max
5	1	2502	5,591	33.2	34	6.6	10	46
		2509	5,544	33.4	34	6.6	9	46
		2510	5,682	33.4	34	6.6	8	46
		2519	5,621	33.5	34	6.8	8	46
		2522	5,618	34.1	35	6.9	10	46
		2532	5,637	34.2	35	6.9	8	46
		2549	5,681	34.1	35	6.9	7	46
	2	2502	3,923	33.0	34	6.7	9	46
		2509	3,928	33.2	34	6.4	9	46
		2510	3,880	33.4	34	6.5	9	46
		2519	3,890	33.4	34	6.6	8	46
		2522	3,992	33.8	35	6.8	9	46
		2532	3,972	33.8	34	6.6	10	46
		2549	3,979	33.8	34	6.8	9	46
	3	2502	2,447	34.7	35	6.4	13	46
		2509	2,472	34.3	35	6.7	10	46
		2510	2,445	34.2	35	6.6	11	46
		2519	2,576	34.7	35	6.6	10	46
		2522	2,428	34.8	36	6.7	12	46
		2532	2,448	34.9	36	6.6	11	46
		2549	2,438	35.0	36	6.7	9	46
8	1	2806	5,729	34.8	35	6.7	9	48
		2810	5,574	34.9	35	6.7	10	48
		2812	5,777	35.0	35	6.7	7	48
		2813	5,591	35.2	36	6.6	10	48
		2819	5,531	34.8	35	6.6	10	48
		2849	5,528	34.6	35	6.8	10	48
		2852	5,613	35.2	36	6.7	9	48
	2	2806	4,128	35.9	37	6.5	8	48
		2810	4,024	35.6	36	6.5	9	48
		2812	3,910	35.9	37	6.5	9	48
		2813	4,001	36.3	37	6.5	9	48
		2819	4,048	35.6	36	6.5	9	48

Grade	Core	Prompt	N	Mean	Med	SD	Min	Max
		2849	4,007	35.6	36	6.6	9	48
		2852	3,958	36.1	37	6.5	10	48
	3	2806	2,470	36.5	37	6.6	10	48
		2810	2,454	36.7	37	6.7	10	48
		2812	2,461	36.6	37	6.6	15	48
		2813	2,454	36.9	38	6.7	12	48
		2819	2,569	36.5	37	6.6	11	48
		2849	2,533	36.3	37	6.9	10	48
		2852	2,562	37.0	38	6.7	11	48
EOC	1	2101	4,779	40.9	42	7.1	9	54
		2102	4,757	41.0	42	6.9	10	54
		2107	4,730	40.9	42	7.0	9	54
		2115	4,968	41.1	42	6.9	10	54
		2121	4,858	41.1	42	6.9	10	54
		2122	4,810	41.1	42	7.0	10	54
		2126	4,799	41.2	42	6.9	10	54
	2	2101	3,277	40.4	41	7.5	12	54
		2102	3,339	40.6	41	7.2	13	54
		2107	3,314	40.2	41	7.4	13	54
		2115	3,386	40.8	42	7.3	13	54
		2121	3,414	40.6	41	7.5	10	54
		2122	3,370	40.8	41	7.4	12	54
		2126	3,332	40.8	41	7.2	16	54
	3	2101	2,054	40.4	41	7.7	16	54
		2102	1,990	40.9	42	7.5	11	54
		2107	2,029	40.8	41	7.5	11	54
		2115	2,059	40.8	41	7.4	15	54
		2121	2,095	40.6	41	7.4	15	54
		2122	2,110	40.7	41	7.4	10	54
		2126	2,081	40.7	41	7.5	10	54

2.2 Reliability Estimates for Multiple-Choice/Technology Enhanced Item Assessments

2.2.1 Overall Reliability Estimates

This section addresses the overall reliability estimates for each newly constructed SOL tests and VMAST administered in spring 2014. Each table shows the number of students used in the analyses and the associated Cronbach's Alpha reliability for each grade/core combination. In almost all cases, the Alphas were above the desired lower limit of 0.80 except for VMAST mathematics, where all Alphas meet the acceptable lower limit of 0.70.

Table 2.2.1.1 Cronbach's Alpha for Grades 3–8 Reading

Subject	Grade	Core	Online	
			N	Alpha
Reading	3	1	38,412	0.87
		2	38,592	0.88
	4	1	38,778	0.87
		2	39,004	0.88
	5	1	37,627	0.85
		2	38,869	0.89
	6	1	38,340	0.86
		2	38,705	0.89
	7	1	38,227	0.88
		2	38,964	0.87
	8	1	38,053	0.88
		2	39,276	0.88

Table 2.2.1.2 Cronbach's Alpha for Grades 3–8 Mathematics

Subject	Grade	Core	Online	
			N	Alpha
Mathematics	3	1	46,941	0.88
		2	25,961	0.89
	4	1	47,282	0.91
		2	26,657	0.91
	5	1	44,735	0.92
		2	21,915	0.91
	6	1	40,026	0.91
		2	24,196	0.91
	7	1	37,618	0.91
		2	23,832	0.92
	8	1	30,266	0.91
		2	17,678	0.92

Note: Plain English is not included in the math results.

Table 2.2.1.3 Cronbach's Alpha for Grades 3, 5, and 8 History and Science

Subject	Grade	Core	Online	
			N	Alpha
History	3	1	34,649	0.88
		2	37,170	0.89
Science	3	1	46,321	0.87

Subject	Grade	Core	Online	
			N	Alpha
		2	24,652	0.88
	5	1	47,764	0.86
		2	27,479	0.88
	8	1	43,103	0.90
		2	25,698	0.90

Table 2.2.1.4 Cronbach's Alpha for Content-Specific History Tests

Subject	Core	Online	
		N	Alpha
Virginia Studies	1	36,438	0.88
	2	38,771	0.88
United States History to 1865	1	35,312	0.89
	2	35,732	0.90
United States History: 1865 to Present	1	36,122	0.87
	2	33,535	0.88
Civics and Economics	1	32,893	0.87
	2	33,584	0.88

Table 2.2.1.5 Cronbach's Alpha for High School End-of-Course Tests

Subject	Core	Online	
		N	Alpha
Earth Science	1	27,685	0.90
	2	18,364	0.90
	3	6,393	0.90
Biology	1	38,496	0.89
	2	20,654	0.89
	3	9,956	0.90
Chemistry	1	28,696	0.89
	2	13,660	0.89
	3	5,954	0.90
Algebra I	1	44,640	0.93
	2	24,728	0.92
	3	10,410	0.92
Geometry	1	38,898	0.92
	2	19,461	0.91
	3	9,357	0.90
Virginia & United States History	1	22,530	0.90

Subject	Core	Online	
		N	Alpha
	2	20,990	0.90
	3	20,773	0.92
World History I	1	19,060	0.91
	2	19,519	0.93
	3	20,075	0.93
World History II	1	19,385	0.90
	2	19,771	0.92
	3	18,865	0.92
World Geography	1	8,737	0.90
	2	8,106	0.92
English: Reading/Lit. & Res.	1	24,356	0.87
	2	19,108	0.87
	3	16,347	0.89
Algebra II	1	33,005	0.91
	2	14,877	0.91
	3	5,938	0.91

Note: Plain English is not included in the Algebra I results.

Table 2.2.1.6 Cronbach's Alpha for VMAST Grades 3–8 & End-of-Course Mathematics and Reading

Subject	Grade	Core	Online	
			N	Alpha
VMAST Mathematics	3	2	616	0.82
	4	2	1,012	0.81
	5	2	1,105	0.83
	6	2	770	0.81
	7	2	763	0.76
	8	2	785	0.81
	End-of-Course	3	347	0.75
VMAST Reading	3	2	558	0.82
	4	2	969	0.80
	5	2	964	0.78
	6	2	617	0.79
	7	2	601	0.79
	8	2	639	0.80
	End-of-Course	3	74	0.79

2.2.2 Reliability Estimates by Gender

This section presents subgroup reliability results broken down by gender for SOL and VMAST tests administered in the spring of 2014. Each table shows the number of students used in the analyses and the associated Cronbach's Alpha for each grade/core/gender combination. For all SOL tests, the Alphas are above the desired lower limit of 0.80. For the VMAST mathematics and reading tests, the Alphas were above the acceptable lower limit of 0.70. Students not reporting their gender were excluded from these results.

Table 2.2.2.1 Cronbach's Alpha for Grades 3–8 Reading by Gender

Subject	Grade	Core	Online			
			Female		Male	
			N	Alpha	N	Alpha
Reading	3	1	18,739	0.87	19,673	0.88
		2	19,075	0.88	19,517	0.89
	4	1	19,126	0.87	19,652	0.87
		2	19,299	0.88	19,705	0.89
	5	1	18,851	0.84	18,776	0.85
		2	19,132	0.88	19,737	0.89
	6	1	18,916	0.85	19,424	0.87
		2	19,064	0.89	19,641	0.90
	7	1	18,763	0.87	19,464	0.88
		2	19,276	0.86	19,688	0.88
	8	1	18,674	0.87	19,379	0.88
		2	19,281	0.87	19,995	0.89

Table 2.2.2.2 Cronbach's Alpha for Grades 3–8 Mathematics by Gender

Subject	Grade	Core	Online			
			Female		Male	
			N	Alpha	N	Alpha
Mathematics	3	1	23,352	0.88	23,589	0.88
		2	12,813	0.89	13,148	0.89
	4	1	23,696	0.91	23,586	0.92
		2	13,248	0.90	13,409	0.91
	5	1	22,740	0.91	21,995	0.92
		2	10,952	0.90	10,963	0.91
	6	1	20,075	0.91	19,951	0.92
		2	12,106	0.91	12,090	0.92
	7	1	18,775	0.90	18,843	0.91
		2	11,692	0.91	12,140	0.92
	8	1	14,809	0.90	15,457	0.91
		2	8,407	0.91	9,271	0.92

Note: Plain English is not included in the math results.

Table 2.2.2.3 Cronbach's Alpha for Grade 3 History and Grades 3, 5, and 8 Science by Gender

Subject	Grade	Core	Online			
			Female		Male	
			N	Alpha	N	Alpha
History	3	1	17,245	0.88	17,404	0.88
		2	18,150	0.89	19,020	0.89
Science	3	1	22,956	0.87	23,365	0.88
		2	12,071	0.87	12,581	0.88
	5	1	24,047	0.85	23,717	0.86
		2	13,429	0.88	14,050	0.88
	8	1	21,447	0.89	21,656	0.90
		2	12,441	0.89	13,257	0.91

Table 2.2.2.4 Cronbach's Alpha for Content-Specific History Tests by Gender

Subject	Core	Online			
		Female		Male	
		N	Alpha	N	Alpha
Virginia Studies	1	18,227	0.88	18,211	0.89
	2	19,101	0.87	19,670	0.88
United States History to 1865	1	17,736	0.89	17,576	0.90
	2	17,511	0.89	18,221	0.90
United States History: 1865 to Present	1	17,807	0.87	18,315	0.87
	2	16,581	0.87	16,954	0.89
Civics and Economics	1	16,327	0.86	16,566	0.87
	2	16,500	0.88	17,084	0.88

Table 2.2.2.5 Cronbach's Alpha for High School End-of-Course Tests by Gender

Subject	Core	Online			
		Female		Male	
		N	Alpha	N	Alpha
Earth Science	1	13,621	0.89	14,064	0.90
	2	8,982	0.90	9,382	0.90
	3	3,064	0.89	3,329	0.90
Biology	1	19,159	0.89	19,337	0.90
	2	10,146	0.89	10,508	0.90
	3	4,879	0.89	5,077	0.90
Chemistry	1	15,050	0.89	13,646	0.90
	2	7,189	0.89	6,471	0.90
	3	3,168	0.89	2,786	0.91
Algebra I	1	21,972	0.92	22,668	0.93
	2	12,038	0.92	12,690	0.92
	3	5,103	0.92	5,307	0.92
Geometry	1	19,588	0.92	19,310	0.92
	2	9,627	0.91	9,834	0.92
	3	4,645	0.90	4,712	0.90
Virginia & United States History	1	11,378	0.90	11,152	0.90
	2	10,364	0.90	10,626	0.90
	3	10,387	0.91	10,386	0.92
World History I	1	9,430	0.91	9,630	0.92
	2	9,451	0.93	10,068	0.94
	3	9,840	0.92	10,235	0.93
World History II	1	9,964	0.90	9,421	0.91
	2	9,825	0.92	9,946	0.92
	3	9,593	0.91	9,272	0.92
World Geography	1	4,523	0.89	4,214	0.91
	2	4,104	0.91	4,002	0.92
English: Reading/Lit. & Res.	1	12,270	0.87	12,086	0.87
	2	9,325	0.87	9,783	0.88
	3	8,301	0.88	8,046	0.89
Algebra II	1	16,933	0.91	16,072	0.91
	2	7,923	0.90	6,954	0.91
	3	3,136	0.90	2,802	0.91

Note: Plain English is not included in the Algebra I results.

Table 2.2.2.6 Cronbach's Alpha for VMAST Grades 3–8 & End-of-Course by Gender

Subject	Grade	Core	Online			
			Female		Male	
			N	Alpha	N	Alpha
VMAST Mathematics	3	2	209	0.81	407	0.83
	4	2	404	0.80	608	0.82
	5	2	425	0.82	680	0.84
	6	2	282	0.81	488	0.81
	7	2	305	0.77	458	0.76
	8	2	305	0.78	480	0.82
	End-of-Course	3	128	0.77	219	0.74
VMAST Reading	3	2	181	0.80	377	0.83
	4	2	357	0.79	612	0.81
	5	2	344	0.78	620	0.78
	6	2	218	0.78	399	0.79
	7	2	225	0.78	376	0.80
	8	2	252	0.76	387	0.81
	End-of-Course	3	31	0.72	43	0.82

2.2.3 Reliability Estimates by Ethnic Group

Reliability results are broken down by ethnic group for SOL tests and VMAST administered in the spring of 2014. In Virginia, only the white and black ethnic groups have a large enough population to calculate reliability statistics. Each table shows the number of students used in the analyses and the associated Cronbach's Alpha for each grade/core/ethnic combination. In almost all instances, the Alphas were above the desired lower limit of 0.80, with the exception of VMAST. For VMAST, the Alphas were above the acceptable lower limit of 0.70. Students not reporting their ethnicity are excluded from these results.

Table 2.2.3.1 Cronbach's Alpha for Grades 3–8 Reading by Ethnic Group

Subject	Grade	Core	Online			
			Black		White	
			N	Alpha	N	Alpha
Reading	3	1	8,491	0.87	19,014	0.86
		2	9,398	0.87	18,842	0.88
	4	1	8,335	0.86	19,484	0.85
		2	9,170	0.88	19,249	0.86
	5	1	8,342	0.84	18,842	0.82
		2	9,287	0.88	19,333	0.87
	6	1	8,814	0.86	19,108	0.83
		2	9,206	0.89	19,317	0.88

Subject	Grade	Core	Online			
			Black		White	
			N	Alpha	N	Alpha
	7	1	8,883	0.87	19,501	0.85
		2	9,357	0.86	19,790	0.85
	8	1	9,075	0.86	19,420	0.85
		2	9,640	0.87	20,064	0.87

Table 2.2.3.2 Cronbach's Alpha for Grades 3–8 Mathematics by Ethnic Group

Subject	Grade	Core	Online			
			Black		White	
			N	Alpha	N	Alpha
Mathematics	3	1	12,438	0.88	23,716	0.86
		2	4,652	0.89	12,868	0.87
	4	1	11,765	0.92	24,085	0.90
		2	4,845	0.90	13,146	0.89
	5	1	11,484	0.91	22,429	0.90
		2	4,702	0.91	10,727	0.89
	6	1	11,124	0.91	19,529	0.90
		2	4,912	0.91	11,849	0.89
	7	1	9,607	0.90	19,673	0.89
		2	4,499	0.90	12,105	0.90
	8	1	9,389	0.90	14,561	0.90
		2	4,235	0.91	8,341	0.91

Note: Plain English is not included in the math results.

Table 2.2.3.3 Cronbach's Alpha for Grade 3 History and Grades 3, 5, and 8 Science by Ethnic Group

Subject	Grade	Core	Online			
			Black		White	
			N	Alpha	N	Alpha
History	3	1	8,261	0.88	18,275	0.86
		2	8,631	0.89	18,831	0.88
Science	3	1	12,133	0.87	24,024	0.85
		2	4,590	0.87	12,911	0.86
	5	1	12,003	0.83	24,250	0.83
		2	5,165	0.86	13,477	0.86
	8	1	10,822	0.87	22,714	0.88
		2	4,891	0.85	12,766	0.88

Table 2.2.3.4 Cronbach's Alpha for Content-Specific History Tests by Ethnic Group

Subject	Core	Online			
		Black		White	
		N	Alpha	N	Alpha
Virginia Studies	1	8,425	0.88	18,650	0.86
	2	8,803	0.87	19,631	0.86
United States History to 1865	1	8,233	0.88	17,951	0.88
	2	7,812	0.89	18,204	0.89
United States History: 1865 to Present	1	8,403	0.86	18,437	0.86
	2	6,976	0.87	17,708	0.87
Civics and Economics	1	7,902	0.84	16,785	0.85
	2	6,944	0.87	17,995	0.87

Table 2.2.3.5 Cronbach's Alpha for High School End-of-Course Tests by Ethnic Group

Subject	Core	Online			
		Black		White	
		N	Alpha	N	Alpha
Earth Science	1	7,921	0.87	14,484	0.88
	2	4,010	0.88	9,051	0.88
	3	2,182	0.87	3,179	0.88
Biology	1	8,838	0.86	19,846	0.87
	2	4,509	0.87	10,140	0.88
	3	3,102	0.86	5,225	0.89
Chemistry	1	4,968	0.87	15,504	0.88
	2	2,144	0.87	7,697	0.88
	3	1,406	0.87	3,573	0.90
Algebra I	1	9,110	0.90	22,990	0.92
	2	6,986	0.90	11,955	0.92
	3	3,323	0.90	5,541	0.92
Geometry	1	7,391	0.88	20,486	0.91
	2	4,985	0.88	9,869	0.91
	3	2,775	0.86	5,059	0.90
Virginia & United States History	1	5,703	0.89	12,813	0.89
	2	3,688	0.89	11,073	0.90
	3	5,045	0.91	10,178	0.90
World History I	1	5,217	0.89	10,581	0.91
	2	3,565	0.92	9,446	0.93
	3	5,502	0.92	9,025	0.92
World History II	1	4,430	0.88	11,434	0.90
	2	3,300	0.90	9,849	0.91
	3	4,275	0.90	9,250	0.91

Subject	Core	Online			
		Black		White	
		N	Alpha	N	Alpha
World Geography	1	2,043	0.88	4,881	0.90
	2	2,607	0.89	3,955	0.91
English: Reading/Lit. & Res.	1	6,150	0.86	12,613	0.86
	2	2,156	0.88	10,227	0.85
	3	5,415	0.86	8,120	0.87
Algebra II	1	5,399	0.89	17,925	0.90
	2	3,311	0.88	8,361	0.90
	3	1,476	0.88	3,629	0.91

Note: Plain English is not included in the Algebra I results.

Table 2.2.3.6 Cronbach's Alpha for VMAST Grades 3–8 & End-of-Course by Ethnic Group

Subject	Grade	Core	Online			
			Black		White	
			N	Alpha	N	Alpha
VMAST Reading	3	2	177	0.82	229	0.82
	4	2	295	0.80	386	0.82
	5	2	291	0.81	358	0.79
	6	2	188	0.77	221	0.80
	7	2	168	0.79	210	0.81
	8	2	174	0.78	229	0.82
	End-of-Course	3	21	0.78	39	0.78
VMAST Mathematics	3	2	187	0.81	201	0.83
	4	2	302	0.84	373	0.80
	5	2	336	0.81	412	0.84
	6	2	217	0.76	309	0.82
	7	2	224	0.75	296	0.77
	8	2	206	0.79	332	0.80
	End-of-Course	3	81	0.72	175	0.76

2.3 Reliability Estimates for Writing Assessments

2.3.1 Stratified Alpha

The tables below present Stratified Alpha reliability estimates in writing for grades 5, 8, and EOC. Results are provided for the overall sample, as well as by gender and ethnic group, for each combination of MC core and writing prompt.

For grade 5, Stratified Alpha ranged from 0.80 to 0.83. For grade 8, Stratified Alpha ranged from 0.84 to 0.86. For EOC, Stratified Alpha ranged from 0.85 to 0.88.

Table 2.3.1.1 Stratified Alpha for Grades 5, 8, and End-of-Course Writing

Grade	Core	Online		
		Prompt	N	Alpha
Writing 5	1	2502	5,591	0.81
		2509	5,544	0.81
		2510	5,682	0.81
		2519	5,621	0.82
		2522	5,618	0.83
		2532	5,637	0.83
		2549	5,681	0.83
	2	2502	3,923	0.82
		2509	3,928	0.80
		2510	3,880	0.81
		2519	3,890	0.81
		2522	3,992	0.83
		2532	3,972	0.82
		2549	3,979	0.83
	3	2502	2,447	0.81
		2509	2,472	0.82
		2510	2,445	0.82
		2519	2,576	0.81
		2522	2,428	0.83
		2532	2,448	0.83
		2549	2,438	0.83
Writing 8	1	2806	5,729	0.84
		2810	5,574	0.84
		2812	5,777	0.85
		2813	5,591	0.84
		2819	5,531	0.84
		2849	5,528	0.85
		2852	5,613	0.85
	2	2806	4,128	0.84
		2810	4,024	0.85
		2812	3,910	0.85
		2813	4,001	0.84
		2819	4,048	0.85
		2849	4,007	0.84
		2852	3,958	0.84
	3	2806	2,470	0.86
		2810	2,454	0.86
		2812	2,461	0.85

Grade	Core	Online		
		Prompt	**N**	**Alpha**
		2813	2,454	0.86
		2819	2,569	0.85
		2849	2,533	0.86
		2852	2,562	0.86
Writing End-of-Course	1	2101	4,779	0.86
		2102	4,757	0.85
		2107	4,730	0.86
		2115	4,968	0.85
		2121	4,858	0.85
		2122	4,810	0.86
		2126	4,799	0.85
	2	2101	3,277	0.87
		2102	3,339	0.87
		2107	3,314	0.87
		2115	3,386	0.87
		2121	3,414	0.88
		2122	3,370	0.87
		2126	3,332	0.87
	3	2101	2,054	0.88
		2102	1,990	0.88
		2107	2,029	0.88
		2115	2,059	0.88
		2121	2,095	0.88
		2122	2,110	0.87
		2126	2,081	0.88

Table 2.3.1.2 shows the reliability results for grades 5, 8, and EOC writing broken down by gender for each combination of MC core and writing prompt. For grade 5, Stratified Alpha ranged from 0.79 to 0.83 for females and from 0.80 to 0.84 for males. For grade 8, Stratified Alpha ranged from 0.82 to 0.86 for females and from 0.84 to 0.87 for males. For EOC, Stratified Alpha ranged from 0.83 to 0.88 for females and from 0.86 to 0.89 for males.

Table 2.3.1.2 Stratified Alpha for Grades 5, 8, and End-of-Course Writing by Gender

Grade	Core	Prompt	Online			
			Female		Male	
			N	Alpha	N	Alpha
Writing 5	1	2502	2,807	0.80	2,784	0.81
		2509	2,737	0.79	2,807	0.81
		2510	2,837	0.80	2,845	0.81
		2519	2,814	0.81	2,807	0.83
		2522	2,831	0.82	2,787	0.83
		2532	2,902	0.82	2,735	0.83
		2549	2,821	0.82	2,860	0.84
	2	2502	1,936	0.82	1,987	0.82
		2509	1,955	0.79	1,973	0.80
		2510	1,973	0.79	1,907	0.81
		2519	1,924	0.80	1,966	0.81
		2522	2,020	0.82	1,972	0.83
		2532	2,043	0.82	1,929	0.82
		2549	1,996	0.82	1,983	0.82
	3	2502	1,241	0.81	1,206	0.80
		2509	1,236	0.81	1,236	0.82
		2510	1,245	0.81	1,200	0.81
		2519	1,273	0.80	1,303	0.81
		2522	1,238	0.83	1,190	0.82
		2532	1,213	0.82	1,235	0.82
		2549	1,212	0.83	1,226	0.82
Writing 8	1	2806	2,840	0.83	2,889	0.84
		2810	2,760	0.84	2,814	0.84
		2812	2,882	0.84	2,895	0.84
		2813	2,755	0.83	2,836	0.84
		2819	2,751	0.83	2,780	0.84
		2849	2,784	0.84	2,744	0.84
		2852	2,804	0.83	2,809	0.85
	2	2806	2,082	0.82	2,046	0.85
		2810	1,929	0.84	2,095	0.84
		2812	1,912	0.83	1,998	0.84
		2813	1,960	0.83	2,041	0.84
		2819	1,990	0.84	2,058	0.84
		2849	2,004	0.83	2,003	0.84
		2852	1,961	0.84	1,997	0.84
	3	2806	1,212	0.85	1,258	0.86
		2810	1,236	0.85	1,218	0.86
		2812	1,242	0.84	1,219	0.86
		2813	1,212	0.85	1,242	0.86
		2819	1,293	0.85	1,276	0.85

Grade	Core	Prompt	Online			
			Female		Male	
			N	Alpha	N	Alpha
		2849	1,284	0.84	1,249	0.87
		2852	1,298	0.86	1,264	0.85
Writing End-of-Course	1	2101	2,376	0.85	2,403	0.86
		2102	2,333	0.84	2,424	0.86
		2107	2,298	0.84	2,432	0.87
		2115	2,465	0.83	2,503	0.86
		2121	2,449	0.84	2,409	0.86
		2122	2,387	0.85	2,423	0.87
		2126	2,361	0.84	2,438	0.86
	2	2101	1,618	0.87	1,659	0.88
		2102	1,619	0.86	1,720	0.87
		2107	1,689	0.87	1,625	0.88
		2115	1,706	0.87	1,680	0.88
		2121	1,686	0.87	1,728	0.88
		2122	1,688	0.87	1,682	0.88
		2126	1,680	0.86	1,652	0.88
	3	2101	995	0.87	1,059	0.88
		2102	986	0.87	1,004	0.89
		2107	1,006	0.88	1,023	0.88
		2115	1,051	0.86	1,008	0.88
		2121	1,064	0.86	1,031	0.88
		2122	1,059	0.87	1,051	0.88
		2126	1,042	0.87	1,039	0.89

Table 2.3.1.3 shows the reliability results for grades 5, 8, and EOC writing broken down by ethnic group for each combination of MC core and writing prompt. For grade 5, Stratified Alpha ranged from 0.80 to 0.83 for black students and from 0.77 to 0.82 for white students. For grade 8, Stratified Alpha ranged from 0.81 to 0.85 for black students and from 0.82 to 0.85 for white students. For EOC, Stratified Alpha for both black and white students ranged from 0.83 to 0.87.

Table 2.3.1.3 Stratified Alpha for Grades 5, 8, and End-of-Course Writing by Ethnic Group

Grade	Core	Prompt	Online			
			Black		White	
			N	Alpha	N	Alpha
Writing 5	1	2502	1,271	0.80	3,018	0.80
		2509	1,177	0.80	3,067	0.78
		2510	1,269	0.81	3,050	0.79
		2519	1,187	0.80	3,063	0.80
		2522	1,224	0.82	3,055	0.81

Grade	Core	Prompt	Online			
			Black		White	
			N	Alpha	N	Alpha
		2532	1,209	0.81	3,056	0.82
		2549	1,238	0.82	3,158	0.82
	2	2502	881	0.82	2,177	0.81
		2509	858	0.81	2,189	0.78
		2510	865	0.81	2,185	0.79
		2519	903	0.81	2,127	0.79
		2522	920	0.83	2,212	0.81
		2532	920	0.81	2,200	0.81
		2549	871	0.83	2,240	0.81
	3	2502	541	0.80	1,319	0.77
		2509	607	0.80	1,233	0.79
		2510	569	0.81	1,268	0.77
		2519	665	0.83	1,335	0.78
		2522	628	0.81	1,228	0.79
		2532	593	0.82	1,284	0.78
		2549	579	0.82	1,270	0.79
Writing 8	1	2806	1,264	0.81	3,178	0.83
		2810	1,249	0.81	2,992	0.83
		2812	1,244	0.82	3,201	0.84
		2813	1,241	0.81	3,131	0.82
		2819	1,220	0.82	3,097	0.83
		2849	1,164	0.82	3,097	0.84
		2852	1,188	0.82	3,150	0.83
	2	2806	1,009	0.82	2,250	0.84
		2810	974	0.83	2,230	0.84
		2812	941	0.83	2,184	0.84
		2813	944	0.82	2,201	0.84
		2819	1,030	0.83	2,215	0.84
		2849	975	0.82	2,239	0.84
		2852	932	0.83	2,233	0.83
	3	2806	659	0.84	1,289	0.83
		2810	620	0.83	1,314	0.85
		2812	633	0.83	1,289	0.84
		2813	639	0.85	1,302	0.83
		2819	634	0.84	1,380	0.84
		2849	612	0.85	1,351	0.84
		2852	659	0.83	1,380	0.84
Writing End-of-Course	1	2101	907	0.85	2,753	0.84
		2102	914	0.84	2,701	0.84
		2107	922	0.84	2,707	0.84
		2115	929	0.83	2,853	0.85
		2121	923	0.83	2,814	0.84

Grade	Core	Prompt	Online			
			Black		White	
			N	Alpha	N	Alpha
		2122	887	0.84	2,789	0.85
		2126	961	0.85	2,728	0.83
	2	2101	772	0.87	1,835	0.86
		2102	816	0.85	1,859	0.86
		2107	814	0.86	1,838	0.86
		2115	818	0.84	1,874	0.87
		2121	843	0.86	1,878	0.87
		2122	812	0.87	1,843	0.86
		2126	782	0.86	1,841	0.86
	3	2101	526	0.85	1,125	0.85
		2102	504	0.87	1,093	0.85
		2107	508	0.85	1,083	0.85
		2115	522	0.86	1,099	0.85
		2121	528	0.86	1,127	0.85
		2122	534	0.85	1,143	0.85
		2126	530	0.86	1,126	0.85

2.3.2 Inter-Rater Reliability

There were a total of 7 writing prompts (5 new and 2 old prompts) administered in the spring 2014 administration in grades 5, 8, and EOC writing. The following tables provide the inter-rater reliability for each prompt/trait combination. Across all grades, the perfect agreement rate was above 65% and the perfect plus adjacent agreement rate was 99% or higher.

Table 2.3.2.1 Inter-Rater Reliability for Grade 5 Writing Assessment: Prompts 2502, 2509, 2510, 2519, 2522, 2532, and 2549

Prompt	Trait	Online			
		N	Perfect Agree (%)	Adjacent (%)	Non-Adjacent (%)
2502	Comp/Written Expression	13,091	72	28	0
	Usage and Mechanics	13,091	67	32	1
2509	Comp/Written Expression	12,985	70	29	0
	Usage and Mechanics	12,985	68	31	1
2510	Comp/Written Expression	13,125	71	29	0
	Usage and Mechanics	13,125	67	32	1
2519	Comp/Written Expression	13,217	70	29	0
	Usage and Mechanics	13,217	67	32	1
2522	Comp/Written Expression	13,175	72	28	0
	Usage and Mechanics	13,175	68	31	1
2532	Comp/Written Expression	13,120	71	29	0

Prompt	Trait	Online			
		N	Perfect Agree (%)	Adjacent (%)	Non-Adjacent (%)
	Usage and Mechanics	13,120	70	30	0
2549	Comp/Written Expression	13,182	71	29	0
	Usage and Mechanics	13,182	67	32	1

Table 2.3.2.2 Inter-Rater Reliability for Grade 8 Writing Assessment: Prompts 2806, 2810, 2812, 2813, 2819, 2849, and 2852

Prompt	Trait	Online			
		N	Perfect Agree (%)	Adjacent (%)	Non-Adjacent (%)
2806	Comp/Written Expression	13,414	71	28	0
	Usage and Mechanics	13,414	66	33	1
2810	Comp/Written Expression	13,197	71	29	0
	Usage and Mechanic	13,197	66	34	1
2812	Comp/Written Expression	13,320	70	29	0
	Usage and Mechanic	13,320	66	34	1
2813	Comp/Written Expression	13,198	71	28	0
	Usage and Mechanic	13,198	67	32	1
2819	Comp/Written Expression	13,273	71	29	0
	Usage and Mechanic	13,273	65	34	1
2849	Comp/Written Expression	13,149	70	30	0
	Usage and Mechanic	13,149	67	33	1
2852	Comp/Written Expression	13,253	71	29	0
	Usage and Mechanic	13,253	66	34	1

Table 2.3.2.3 Inter-Rater Reliability for End-of-Course Writing Assessment: Prompts 2101, 2102, 2107, 2115, 2121, 2122, and 2126

Prompt	Trait	Online			
		N	Perfect Agree (%)	Adjacent (%)	Non-Adjacent (%)
2101	Comp/Written Expression	11,260	72	28	0
	Usage and Mechanics	11,260	67	32	1
2102	Comp/Written Expression	12,622	73	27	0
	Usage and Mechanics	12,622	68	32	1
2107	Comp/Written Expression	11,289	73	27	0
	Usage and Mechanics	11,289	66	33	1
2115	Comp/Written Expression	11,713	73	26	0
	Usage and Mechanics	11,713	67	32	1
2121	Comp/Written Expression	12,889	74	26	0
	Usage and Mechanics	12,889	68	31	1

Prompt	Trait	Online			
		N	Perfect Agree (%)	Adjacent (%)	Non-Adjacent (%)
2122	Comp/Written Expression	11,471	73	27	0
	Usage and Mechanics	11,471	68	32	1
2126	Comp/Written Expression	11,436	74	26	0
	Usage and Mechanics	11,436	68	32	0

2.4 Decision Consistency and Accuracy Indices

The number of examinees taking each Virginia SOL and VMAST assessment in the 2014 spring administration and the proportion of accurate classifications, false positives, false negatives, and consistent classifications are provided in this section. Classification indices were computed using the cut score that separates passing scores from failing scores.

Decision accuracy was at or above 91% and decision consistency was at or above 87% for all of the non-writing SOL tests. Decision accuracy was at or above 85% and decision consistency was at or above 79% for VMAST. Decision accuracy was at or above 88% and decision consistency was at or above 84% for all of the combinations of MC and prompts for writing SOL tests.

Table 2.4.1 Decision Consistency and Accuracy Indices for Grades 3–8 Reading and Mathematics Online Tests

Subject	Grade	Core	N	Accuracy	False Positive	False Negative	Consistency
Reading	3	1	38,412	0.91	0.04	0.05	0.88
		2	38,592	0.91	0.04	0.05	0.87
	4	1	38,778	0.91	0.04	0.05	0.87
		2	39,004	0.92	0.04	0.04	0.88
	5	1	37,627	0.91	0.04	0.05	0.87
		2	38,869	0.92	0.04	0.04	0.89
	6	1	38,340	0.92	0.04	0.04	0.89
		2	38,705	0.92	0.04	0.04	0.89
	7	1	38,227	0.93	0.03	0.04	0.90
		2	38,964	0.92	0.04	0.04	0.89
	8	1	38,053	0.92	0.04	0.04	0.88
		2	39,276	0.91	0.04	0.04	0.88
Mathematics	3	1	46,941	0.91	0.04	0.04	0.88
		2	25,961	0.91	0.04	0.04	0.88
	4	1	47,282	0.95	0.02	0.03	0.93
		2	26,657	0.95	0.02	0.03	0.92
	5	1	44,735	0.94	0.03	0.03	0.92
		2	21,915	0.93	0.03	0.03	0.91
	6	1	40,026	0.93	0.03	0.04	0.90

Subject	Grade	Core	N	Accuracy	False Positive	False Negative	Consistency
		2	24,196	0.95	0.02	0.03	0.93
	7	1	37,618	0.92	0.04	0.04	0.89
		2	23,832	0.93	0.04	0.04	0.90
	8	1	30,266	0.92	0.04	0.04	0.89
		2	17,678	0.93	0.03	0.04	0.90

Note: Plain English is not included in the math results.

Table 2.4.2 Decision Consistency and Accuracy Indices for Grade 3 History and Grades 3, 5, and 8 Science Online Tests

Subject	Grade	Core	N	Accuracy	False Positive	False Negative	Consistency
History	3	1	34,649	0.96	0.02	0.03	0.94
		2	37,170	0.94	0.02	0.03	0.92
Science	3	1	46,321	0.93	0.03	0.04	0.91
		2	24,652	0.95	0.02	0.03	0.92
	5	1	47,764	0.91	0.04	0.05	0.87
		2	27,479	0.92	0.04	0.04	0.89
	8	1	43,103	0.93	0.03	0.04	0.90
		2	25,698	0.93	0.03	0.04	0.90

Table 2.4.3 Decision Consistency and Accuracy Indices for Content-Specific History Online Tests

Subject	Core	N	Accuracy	False Positive	False Negative	Consistency
Virginia Studies	1	36,438	0.95	0.02	0.03	0.94
	2	38,771	0.94	0.03	0.03	0.92
US History to 1865	1	35,312	0.94	0.02	0.03	0.92
	2	35,732	0.94	0.03	0.03	0.91
US History: 1865 to Present	1	36,122	0.95	0.02	0.03	0.92
	2	33,535	0.93	0.03	0.04	0.91
Civics and Economics	1	32,893	0.95	0.02	0.03	0.93
	2	33,584	0.94	0.03	0.04	0.91

Table 2.4.4 Decision Consistency and Accuracy Indices for High School End-of-Course Online Tests

Subject	Core	N	Accuracy	False Positive	False Negative	Consistency
Earth Science	1	27,685	0.93	0.03	0.04	0.90
	2	18,364	0.93	0.03	0.04	0.90
	3	6,393	0.92	0.04	0.04	0.89
Biology	1	38,496	0.93	0.03	0.04	0.90
	2	20,654	0.93	0.03	0.04	0.90
	3	9,956	0.92	0.04	0.04	0.89
Chemistry	1	28,696	0.93	0.03	0.04	0.91
	2	13,660	0.95	0.02	0.03	0.92
	3	5,954	0.93	0.03	0.04	0.90
Algebra I	1	44,640	0.93	0.03	0.03	0.91
	2	24,728	0.92	0.04	0.04	0.89
	3	10,410	0.92	0.04	0.04	0.89
Geometry	1	38,898	0.93	0.03	0.04	0.90
	2	19,461	0.92	0.04	0.04	0.89
	3	9,357	0.91	0.04	0.05	0.87
Virginia & United States History	1	22,530	0.94	0.03	0.03	0.92
	2	20,990	0.95	0.02	0.03	0.93
	3	20,773	0.95	0.02	0.03	0.93
World History I	1	19,060	0.93	0.03	0.04	0.91
	2	19,519	0.95	0.02	0.03	0.93
	3	20,075	0.95	0.02	0.03	0.93
World History II	1	19,385	0.94	0.03	0.03	0.91
	2	19,771	0.94	0.03	0.03	0.92
	3	18,865	0.94	0.03	0.03	0.91
World Geography	1	8,737	0.94	0.03	0.03	0.91
	2	8,106	0.94	0.03	0.03	0.92
English: Reading/Lit. & Res.	1	24,356	0.94	0.02	0.03	0.92
	2	19,108	0.95	0.02	0.03	0.93
	3	16,347	0.93	0.03	0.04	0.90
Algebra II	1	33,005	0.93	0.03	0.04	0.90
	2	14,877	0.94	0.03	0.03	0.91

Subject	Core	N	Accuracy	False Positive	False Negative	Consistency
	3	5,938	0.92	0.04	0.04	0.89

Table 2.4.5 Decision Consistency and Accuracy Indices for VMAST Grades 3–8 and End-of-Course Mathematics and Reading

Subject	Grade	Core	N	Accuracy	False Positive	False Negative	Consistency
VMAST Mathematics	3	2	616	0.88	0.07	0.05	0.83
	4	2	1,012	0.86	0.07	0.07	0.81
	5	2	1,105	0.90	0.06	0.04	0.86
	6	2	770	0.88	0.07	0.05	0.83
	7	2	763	0.85	0.09	0.07	0.79
	8	2	785	0.86	0.08	0.06	0.81
	End-of-Course	3	347	0.90	0.07	0.04	0.85
VMAST Reading	3	2	558	0.88	0.07	0.06	0.83
	4	2	969	0.86	0.07	0.07	0.81
	5	2	964	0.85	0.08	0.06	0.80
	6	2	617	0.86	0.08	0.06	0.80
	7	2	601	0.86	0.07	0.07	0.81
	8	2	639	0.86	0.08	0.07	0.80
	End-of-Course	3	74	0.86	0.07	0.07	0.80

Table 2.4.6 Decision Consistency and Accuracy Indices for Grades 5, 8, and End-of-Course Writing Tests

Grade	Core	Prompt	N	Accuracy	False Positive	False Negative	Consistency
5	1	2502	5,591	0.88	0.05	0.06	0.84
		2509	5,544	0.89	0.05	0.06	0.85
		2510	5,682	0.88	0.05	0.06	0.84
		2519	5,621	0.89	0.05	0.06	0.84
		2522	5,618	0.90	0.05	0.06	0.85
		2532	5,637	0.90	0.05	0.06	0.86
		2549	5,681	0.90	0.05	0.05	0.85
	2	2502	3,923	0.89	0.05	0.06	0.84
		2509	3,928	0.89	0.05	0.06	0.84
		2510	3,880	0.89	0.05	0.06	0.84
		2519	3,890	0.88	0.05	0.06	0.84
		2522	3,992	0.89	0.05	0.06	0.84
		2532	3,972	0.88	0.06	0.06	0.84
		2549	3,979	0.89	0.05	0.06	0.84
	3	2502	2,447	0.89	0.05	0.06	0.85

Grade	Core	Prompt	N	Accuracy	False Positive	False Negative	Consistency
		2509	2,472	0.90	0.05	0.06	0.86
		2510	2,445	0.89	0.05	0.06	0.85
		2519	2,576	0.89	0.05	0.06	0.85
		2522	2,428	0.90	0.05	0.06	0.85
		2532	2,448	0.90	0.05	0.06	0.86
		2549	2,438	0.90	0.05	0.05	0.86
8	1	2806	5,729	0.89	0.05	0.06	0.84
		2810	5,574	0.89	0.05	0.06	0.85
		2812	5,777	0.90	0.05	0.05	0.86
		2813	5,591	0.89	0.05	0.05	0.85
		2819	5,531	0.90	0.05	0.05	0.86
		2849	5,528	0.90	0.05	0.05	0.86
		2852	5,613	0.90	0.05	0.05	0.85
	2	2806	4,128	0.90	0.05	0.05	0.85
		2810	4,024	0.90	0.05	0.05	0.85
		2812	3,910	0.91	0.04	0.05	0.87
		2813	4,001	0.90	0.05	0.05	0.85
		2819	4,048	0.90	0.05	0.05	0.85
		2849	4,007	0.89	0.05	0.06	0.85
		2852	3,958	0.90	0.05	0.05	0.85
	3	2806	2,470	0.91	0.04	0.05	0.87
		2810	2454	0.91	0.04	0.05	0.87
		2812	2,461	0.91	0.04	0.05	0.87
		2813	2,454	0.91	0.04	0.05	0.87
		2819	2,569	0.91	0.04	0.05	0.87
		2849	2,533	0.91	0.04	0.05	0.87
		2852	2,562	0.91	0.04	0.05	0.87
End-of-Course	1	2101	4,779	0.94	0.03	0.04	0.91
		2102	4,757	0.95	0.02	0.03	0.92
		2107	4,730	0.94	0.03	0.03	0.91
		2115	4,968	0.94	0.03	0.04	0.91
		2121	4,858	0.94	0.03	0.04	0.91
		2122	4,810	0.94	0.03	0.03	0.91
		2126	4,799	0.94	0.03	0.03	0.91
	2	2101	3,277	0.93	0.03	0.04	0.90
		2102	3,339	0.93	0.03	0.04	0.90
		2107	3,314	0.93	0.03	0.04	0.90
		2115	3,386	0.93	0.03	0.04	0.90
		2121	3,414	0.93	0.03	0.04	0.90
		2122	3,370	0.92	0.04	0.04	0.89
		2126	3,332	0.93	0.03	0.04	0.90
	3	2101	2,054	0.93	0.03	0.04	0.91
		2102	1,990	0.94	0.03	0.03	0.91

Grade	Core	Prompt	N	Accuracy	False Positive	False Negative	Consistency
		2107	2,029	0.94	0.03	0.03	0.92
		2115	2,059	0.94	0.03	0.03	0.92
		2121	2,095	0.94	0.03	0.03	0.92
		2122	2,110	0.94	0.03	0.03	0.91
		2126	2,081	0.94	0.03	0.03	0.92

2.5 Raw Score to Scale Score (RSSS) Conversion Tables and Conditional SEM

Table 2.5.1 RSSS Conversions for Grade 3 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	119	64	121	64
2	164	46	167	46
3	192	38	194	38
4	212	34	215	34
5	229	31	231	31
6	243	28	245	28
7	255	27	257	27
8	266	26	268	26
9	276	25	278	25
10	285	24	288	24
11	294	23	296	23
12	302	23	305	23
13	310	22	313	22
14	318	22	320	22
15	326	21	328	21
16	333	21	335	21
17	340	21	342	21
18	347	21	349	21
19	354	21	356	21
20	361	21	363	21
21	368	21	370	21
22	375	21	377	21
23	382	21	384	21
24	390	21	391	21
25	397	22	398	21
26	405	22	406	22
27	413	22	414	22
28	421	23	422	23
29	429	23	430	23

30	438	24	439	24
31	448	25	448	25
32	458	26	458	26
33	469	27	469	27
34	482	29	482	29
35	496	31	496	31
36	513	34	512	34
37	533	38	533	38
38	561	46	561	46
39	600		600	
40	600		600	

Table 2.5.2 RSSS Conversions for Grade 3 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	135	56	131	56
2	175	40	172	40
3	200	34	197	34
4	218	30	215	30
5	233	27	230	27
6	245	25	242	25
7	256	24	254	24
8	266	23	264	23
9	275	22	273	22
10	283	21	282	21
11	291	21	290	21
12	299	20	297	20
13	306	20	305	20
14	313	19	312	20
15	320	19	319	19
16	327	19	326	19
17	333	19	333	19
18	340	19	339	19
19	346	19	346	19
20	353	19	352	19
21	359	19	359	19
22	366	19	365	19
23	372	19	372	19
24	379	19	378	19
25	386	19	385	19
26	393	20	392	20
27	400	20	399	20
28	408	21	407	20
29	415	21	414	21
30	424	22	422	21
31	433	22	431	22
32	442	23	440	23
33	453	24	450	24
34	464	26	461	25
35	477	28	473	27
36	492	30	488	30
37	511	34	506	34
38	537	41	531	40
39	578	56	571	56
40	600		600	

Table 2.5.3 RSSS Conversions for Grade 3 Science

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	185	52	176	52
2	222	37	213	38
3	245	31	236	31
4	261	27	253	28
5	274	25	267	25
6	286	23	278	23
7	296	22	288	22
8	305	21	297	21
9	313	20	306	20
10	320	19	313	20
11	327	19	321	19
12	334	18	328	19
13	341	18	334	18
14	347	18	341	18
15	353	17	347	18
16	359	17	353	17
17	365	17	359	17
18	371	17	365	17
19	376	17	370	17
20	382	17	376	17
21	388	17	382	17
22	393	17	388	17
23	399	17	394	17
24	405	17	400	18
25	411	18	406	18
26	417	18	412	18
27	423	18	419	18
28	430	19	425	19
29	437	19	432	19
30	444	20	440	20
31	452	20	448	20
32	460	21	456	21
33	469	22	466	22
34	480	23	476	24
35	491	25	488	25
36	505	28	502	28
37	522	31	519	32
38	545	38	542	38
39	582	52	581	52
40	600		600	

Table 2.5.4 RSSS Conversions for Grade 3 History and Social Studies

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	165	58	168	58
2	207	42	210	42
3	232	35	235	35
4	251	31	254	31
5	265	28	268	28
6	278	26	281	26
7	289	24	292	24
8	299	23	302	23
9	308	22	311	22
10	316	22	319	21
11	324	21	327	21
12	331	20	334	20
13	339	20	341	20
14	345	20	348	20
15	352	19	355	19
16	358	19	361	19
17	365	19	368	19
18	371	19	374	19
19	377	19	380	19
20	383	19	386	19
21	389	19	392	19
22	396	19	398	19
23	402	19	405	19
24	408	19	411	19
25	415	19	418	19
26	421	20	424	20
27	428	20	431	20
28	435	20	438	20
29	443	21	446	21
30	450	21	453	22
31	459	22	462	22
32	468	23	471	23
33	477	24	481	24
34	488	26	492	26
35	501	28	504	28
36	516	31	519	31
37	534	35	538	35
38	559	42	563	42
39	600		600	
40	600		600	

Table 2.5.5 RSSS Conversions for Grade 4 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	112	62	123	62
2	157	45	168	45
3	184	37	195	37
4	204	33	216	33
5	220	30	232	30
6	234	28	246	28
7	246	26	258	26
8	257	25	269	25
9	267	24	279	24
10	276	23	289	23
11	285	23	297	23
12	293	22	306	22
13	301	22	314	22
14	309	21	321	21
15	316	21	329	21
16	323	21	336	21
17	331	21	343	21
18	338	21	350	21
19	345	21	357	20
20	352	21	364	20
21	359	21	371	20
22	366	21	378	20
23	373	21	385	21
24	380	21	392	21
25	388	21	399	21
26	396	22	406	21
27	404	22	414	22
28	412	23	421	22
29	420	23	430	23
30	430	24	438	23
31	439	25	447	24
32	450	26	457	25
33	461	27	468	26
34	474	29	480	28
35	488	31	494	30
36	505	34	510	33
37	526	38	530	37
38	554	45	558	45
39	599	62	600	
40	600		600	

Table 2.5.6 RSSS Conversions for Grade 4 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	165	54	161	54
2	204	39	199	39
3	227	32	223	32
4	245	29	240	28
5	258	26	254	26
6	270	24	265	24
7	280	23	275	23
8	290	22	285	21
9	298	21	293	20
10	306	20	300	20
11	313	19	307	19
12	320	19	314	19
13	326	18	320	18
14	332	18	327	18
15	338	18	332	17
16	344	17	338	17
17	350	17	343	17
18	355	17	349	17
19	360	17	354	17
20	365	17	359	16
21	371	16	364	16
22	376	16	369	16
23	381	16	374	16
24	386	16	379	16
25	390	16	384	16
26	395	16	389	16
27	400	16	394	16
28	405	16	399	16
29	410	16	404	16
30	415	16	409	16
31	421	17	414	17
32	426	17	419	17
33	431	17	424	17
34	437	17	430	17
35	442	17	436	18
36	448	18	441	18
37	454	18	448	18
38	460	19	454	19
39	467	19	461	19
40	474	20	468	20
41	482	20	476	21
42	490	21	484	22
43	499	23	493	23
44	509	24	503	24
45	521	26	515	26
46	535	28	529	29
47	552	32	547	33
48	575	39	570	39
49	600		600	
50	600		600	

Table 2.5.7 RSSS Conversions for Grade 5 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	107	66	101	66
2	155	48	150	48
3	184	40	180	40
4	206	35	202	36
5	224	32	220	33
6	239	30	235	30
7	252	28	249	29
8	264	27	261	27
9	275	26	272	26
10	285	25	282	25
11	294	24	292	25
12	303	24	301	24
13	312	23	310	23
14	320	23	318	23
15	329	23	326	23
16	337	23	334	22
17	344	22	342	22
18	352	22	350	22
19	360	22	357	22
20	367	22	365	22
21	375	22	372	22
22	383	22	379	22
23	391	22	387	22
24	398	23	395	22
25	407	23	402	22
26	415	23	410	23
27	423	24	418	23
28	432	24	427	24
29	441	25	436	24
30	451	25	445	25
31	461	26	455	26
32	472	27	465	27
33	484	28	477	28
34	497	30	489	30
35	512	32	504	32
36	530	35	521	35
37	552	40	542	39
38	581	48	571	47
39	600		600	
40	600		600	

Table 2.5.8 RSSS Conversions for Grade 5 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	141	55	136	55
2	180	39	176	40
3	204	33	200	33
4	221	29	217	29
5	235	26	231	26
6	247	24	243	24
7	257	23	254	23
8	266	22	263	22
9	274	21	271	21
10	282	20	279	20
11	289	19	286	20
12	296	19	293	19
13	302	18	300	19
14	308	18	306	18
15	314	18	312	18
16	320	17	318	18
17	326	17	324	17
18	331	17	329	17
19	336	17	334	17
20	342	17	340	17
21	347	17	345	17
22	352	17	350	17
23	357	17	355	17
24	362	17	360	17
25	367	17	366	17
26	372	17	371	17
27	378	17	376	17
28	383	17	381	17
29	388	17	386	17
30	393	17	392	17
31	399	17	397	17
32	404	18	402	17
33	410	18	408	17
34	416	18	414	18
35	422	18	420	18
36	429	19	426	18
37	435	19	432	19
38	442	20	439	19
39	450	20	446	20
40	457	21	453	20
41	466	22	461	21
42	475	23	470	22
43	485	24	479	23
44	496	25	490	25
45	509	27	502	27
46	524	30	516	29
47	543	34	534	33
48	568	40	558	40
49	600		598	55
50	600		600	

Table 2.5.9 RSSS Conversions for Grade 5 Science

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	136	60	150	60
2	180	43	193	43
3	206	36	219	36
4	225	32	238	32
5	241	29	253	29
6	254	27	266	27
7	266	26	277	25
8	276	24	287	24
9	286	23	296	23
10	295	23	305	22
11	304	22	313	22
12	312	22	321	21
13	319	21	328	21
14	327	21	335	20
15	334	21	342	20
16	341	20	349	20
17	348	20	356	20
18	355	20	362	20
19	362	20	369	20
20	368	20	375	20
21	375	20	382	20
22	382	20	388	20
23	389	20	395	20
24	396	20	402	20
25	403	21	409	20
26	410	21	416	21
27	418	21	423	21
28	426	22	431	21
29	434	22	439	22
30	443	23	447	23
31	452	24	456	23
32	462	25	466	24
33	472	26	476	26
34	484	27	488	27
35	498	29	502	29
36	514	32	518	32
37	534	36	538	36
38	560	44	564	44
39	600		600	
40	600		600	

Table 2.5.10 RSSS Conversions for Grade 6 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	139	59	129	59
2	181	42	171	42
3	206	35	197	35
4	225	31	216	31
5	240	28	231	28
6	253	26	244	26
7	264	25	255	25
8	274	23	265	24
9	283	22	274	23
10	291	22	283	22
11	299	21	291	21
12	306	20	298	21
13	313	20	305	20
14	320	20	312	20
15	326	19	318	19
16	333	19	325	19
17	339	19	331	19
18	345	19	337	19
19	351	18	343	19
20	356	18	349	18
21	362	18	355	18
22	368	18	361	18
23	374	18	366	18
24	379	18	372	18
25	385	18	378	18
26	391	18	384	19
27	397	19	390	19
28	403	19	396	19
29	409	19	402	19
30	415	19	409	19
31	422	20	415	20
32	429	20	422	20
33	436	20	430	21
34	443	21	437	21
35	451	22	445	22
36	459	22	454	23
37	468	23	463	24
38	478	25	474	25
39	489	26	485	27
40	502	28	499	29
41	517	31	515	32
42	535	35	535	36
43	561	42	562	44
44	600		600	
45	600		600	

Table 2.5.11 RSSS Conversions for Grade 6 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	219	42	217	42
2	249	30	248	31
3	267	25	266	25
4	280	22	280	22
5	291	20	291	20
6	300	19	300	19
7	308	17	309	18
8	315	17	316	17
9	321	16	322	16
10	327	15	329	16
11	332	15	334	15
12	337	14	340	15
13	342	14	345	14
14	347	14	350	14
15	352	14	354	14
16	356	13	359	14
17	360	13	363	13
18	364	13	368	13
19	368	13	372	13
20	372	13	376	13
21	376	13	380	13
22	380	13	384	13
23	384	13	388	13
24	388	13	391	13
25	392	13	395	13
26	396	13	399	13
27	399	13	403	13
28	403	13	407	13
29	407	13	411	13
30	411	13	415	13
31	415	13	419	13
32	419	13	423	13
33	423	13	427	13
34	428	13	431	13
35	432	14	436	14
36	437	14	440	14
37	441	14	445	14
38	446	15	450	14
39	452	15	455	15
40	457	15	461	15
41	463	16	467	16
42	470	17	473	17
43	477	18	480	18
44	485	19	488	19
45	494	20	497	20
46	505	22	508	22
47	519	25	522	25
48	537	30	540	30
49	567	42	570	42
50	600		600	

Table 2.5.12 RSSS Conversions for Grade 7 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	126	59	139	59
2	168	42	181	42
3	194	35	206	35
4	213	31	225	31
5	228	28	240	28
6	241	26	253	26
7	253	25	264	25
8	263	24	274	23
9	272	23	283	22
10	280	22	291	22
11	288	21	299	21
12	296	21	307	20
13	303	20	314	20
14	310	20	321	20
15	316	19	327	19
16	323	19	334	19
17	329	19	340	19
18	335	19	346	19
19	341	18	352	18
20	347	18	358	18
21	353	18	364	18
22	358	18	369	18
23	364	18	375	18
24	370	18	381	18
25	376	18	387	18
26	382	18	393	18
27	388	19	399	19
28	394	19	405	19
29	400	19	411	19
30	406	19	417	19
31	413	19	424	19
32	419	20	430	20
33	426	20	437	20
34	434	21	445	21
35	441	21	453	21
36	450	22	461	22
37	459	23	470	23
38	469	24	480	24
39	480	26	491	26
40	492	28	503	28
41	507	31	518	31
42	526	35	537	35
43	551	42	562	42
44	593	59	600	
45	600		600	

Table 2.5.13 RSSS Conversions for Grade 7 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	154	51	147	51
2	191	37	183	37
3	213	31	206	31
4	229	27	222	27
5	243	25	235	25
6	254	23	246	23
7	263	22	256	21
8	272	20	265	20
9	280	20	273	20
10	287	19	280	19
11	294	18	287	18
12	301	18	293	18
13	307	17	299	17
14	313	17	305	17
15	318	17	311	17
16	324	16	316	16
17	329	16	321	16
18	334	16	327	16
19	339	16	332	16
20	344	16	337	16
21	349	16	342	16
22	354	15	347	16
23	358	15	351	16
24	363	15	356	16
25	368	15	361	16
26	372	15	366	16
27	377	15	371	16
28	382	15	375	16
29	386	16	380	16
30	391	16	385	16
31	396	16	390	16
32	401	16	396	16
33	406	16	401	16
34	411	16	406	17
35	417	17	412	17
36	422	17	418	17
37	428	17	424	18
38	434	18	430	18
39	440	18	437	19
40	447	19	444	19
41	454	19	451	20
42	462	20	459	21
43	471	21	468	22
44	480	23	478	23
45	491	24	490	25
46	504	27	503	27
47	520	31	520	31
48	542	37	542	37
49	579	51	580	52
50	600		600	

Table 2.5.14 RSSS Conversions for Grade 8 Reading

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	138	56	143	56
2	179	40	183	40
3	203	34	208	34
4	221	30	226	30
5	236	27	240	27
6	248	25	252	25
7	259	24	263	24
8	268	23	272	22
9	277	22	281	21
10	285	21	289	21
11	293	20	297	20
12	300	20	304	20
13	307	19	311	19
14	314	19	317	19
15	320	19	323	18
16	326	18	329	18
17	333	18	335	18
18	339	18	341	18
19	344	18	347	18
20	350	18	352	18
21	356	18	358	18
22	362	18	364	18
23	368	18	369	18
24	373	18	375	18
25	379	18	380	18
26	385	18	386	18
27	391	18	392	18
28	397	18	397	18
29	403	19	403	18
30	410	19	410	18
31	416	19	416	19
32	423	20	422	19
33	430	20	429	20
34	437	20	436	20
35	445	21	444	21
36	453	22	452	21
37	462	23	461	22
38	472	24	470	24
39	483	25	481	25
40	496	27	493	27
41	510	30	507	30
42	529	34	525	34
43	553	41	550	40
44	594	56	590	56
45	600		600	

Table 2.5.15 RSSS Conversions for Grade 8 Mathematics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	196	43	190	43
2	227	31	222	31
3	245	26	241	26
4	259	23	255	23
5	270	21	267	21
6	280	19	277	20
7	288	18	285	19
8	296	17	293	18
9	302	17	300	17
10	308	16	307	16
11	314	15	313	16
12	320	15	319	15
13	325	15	324	15
14	330	14	329	15
15	335	14	335	14
16	340	14	339	14
17	344	14	344	14
18	349	14	349	14
19	353	13	353	14
20	357	13	358	14
21	361	13	362	13
22	365	13	366	13
23	370	13	370	13
24	374	13	375	13
25	378	13	379	13
26	382	13	383	13
27	386	13	387	13
28	390	13	391	13
29	394	13	395	13
30	398	13	400	13
31	402	13	404	14
32	407	13	408	14
33	411	14	413	14
34	415	14	417	14
35	420	14	422	14
36	425	14	427	14
37	430	15	432	15
38	435	15	437	15
39	440	15	443	16
40	446	16	449	16
41	452	16	455	17
42	459	17	462	17
43	466	18	469	18
44	474	19	478	19
45	483	21	487	21
46	494	23	499	23
47	508	26	513	26
48	526	31	532	31
49	557	43	563	43
50	600		600	

Table 2.5.16 RSSS Conversions for Grade 8 Science

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	190	47	194	47
2	224	34	227	34
3	244	28	248	28
4	260	25	263	25
5	272	23	275	22
6	282	21	285	21
7	292	20	294	20
8	300	19	302	19
9	307	18	310	18
10	314	18	317	17
11	321	17	323	17
12	327	17	329	16
13	333	16	335	16
14	339	16	340	16
15	344	16	346	15
16	349	15	351	15
17	354	15	356	15
18	359	15	361	15
19	364	15	365	15
20	369	15	370	15
21	374	15	375	14
22	378	14	379	14
23	383	14	384	14
24	387	14	388	14
25	392	14	393	14
26	396	14	397	14
27	401	14	402	14
28	405	14	406	14
29	410	14	411	14
30	414	14	415	14
31	419	14	420	15
32	423	15	425	15
33	428	15	429	15
34	433	15	434	15
35	438	15	439	15
36	443	15	445	16
37	448	16	450	16
38	454	16	456	16
39	460	16	461	17
40	466	17	468	17
41	472	18	474	18
42	479	18	482	19
43	487	19	490	20
44	496	20	498	21
45	506	22	509	22
46	517	24	521	24
47	532	28	535	28
48	552	33	556	33
49	585	46	589	46
50	600		600	

Table 2.5.17 RSSS Conversions for United States History to 1865

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	161	60	167	60
2	204	43	210	43
3	230	36	236	36
4	250	32	255	31
5	265	29	270	29
6	278	27	283	27
7	290	25	295	25
8	300	24	305	24
9	310	23	314	23
10	319	22	323	22
11	327	22	331	22
12	335	21	339	21
13	342	21	346	21
14	350	21	353	20
15	357	20	360	20
16	364	20	367	20
17	371	20	373	20
18	377	20	380	19
19	384	20	386	19
20	391	20	393	19
21	397	20	399	19
22	404	20	406	20
23	411	20	412	20
24	418	20	419	20
25	425	20	426	20
26	432	21	433	20
27	439	21	440	21
28	447	21	447	21
29	455	22	455	22
30	464	23	464	22
31	473	23	473	23
32	482	24	482	24
33	493	25	493	25
34	504	27	504	27
35	518	29	518	29
36	534	32	534	32
37	553	36	553	36
38	579	43	580	44
39	600		600	
40	600		600	

Table 2.5.18 RSSS Conversions for United States History 1865 to the Present

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	164	57	153	57
2	205	41	194	42
3	230	34	219	35
4	248	30	238	31
5	263	28	253	28
6	276	26	266	26
7	287	24	277	25
8	297	23	287	23
9	306	22	297	22
10	315	22	305	22
11	323	21	314	21
12	330	21	321	21
13	338	20	329	20
14	345	20	336	20
15	352	20	343	20
16	359	19	350	19
17	365	19	357	19
18	372	19	363	19
19	378	19	370	19
20	385	19	376	19
21	391	19	383	19
22	398	19	389	19
23	404	19	396	19
24	411	20	403	20
25	418	20	410	20
26	425	20	417	20
27	432	20	424	20
28	440	21	431	21
29	448	21	439	21
30	456	22	448	22
31	465	23	456	23
32	474	23	466	24
33	484	25	476	25
34	495	26	487	26
35	508	28	500	28
36	523	31	516	31
37	542	35	535	35
38	567	41	560	42
39	600		600	
40	600		600	

Table 2.5.19 RSSS Conversions for Civics and Economics

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	183	55	179	55
2	223	39	219	39
3	247	33	243	33
4	265	29	261	29
5	279	27	275	26
6	291	25	287	25
7	302	23	298	23
8	312	22	308	22
9	321	21	317	21
10	329	21	325	21
11	337	20	333	20
12	345	20	340	20
13	352	19	347	19
14	359	19	354	19
15	366	19	361	19
16	372	19	368	19
17	379	19	374	18
18	385	18	380	18
19	392	18	387	18
20	398	18	393	18
21	404	18	399	18
22	411	19	406	18
23	417	19	412	19
24	424	19	419	19
25	431	19	425	19
26	437	19	432	19
27	445	20	439	20
28	452	20	446	20
29	460	21	454	20
30	468	21	462	21
31	477	22	471	22
32	486	23	480	23
33	496	24	490	24
34	507	25	501	25
35	520	27	513	27
36	535	30	528	29
37	553	33	546	33
38	578	40	570	40
39	600		600	
40	600		600	

Table 2.5.20 RSSS Conversions for Virginia Studies

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	134	68	130	68
2	183	49	179	49
3	213	41	209	41
4	234	36	231	36
5	252	33	248	33
6	267	30	263	30
7	280	29	276	29
8	292	27	288	27
9	302	26	298	26
10	312	25	308	25
11	322	25	317	25
12	331	24	326	24
13	339	24	335	24
14	347	23	343	23
15	355	23	351	23
16	363	23	359	23
17	371	22	366	22
18	378	22	374	22
19	385	22	381	22
20	393	22	388	22
21	400	22	396	22
22	408	22	403	22
23	415	22	411	22
24	423	23	418	23
25	430	23	426	23
26	438	23	434	23
27	447	24	442	24
28	455	24	451	24
29	464	25	459	25
30	473	25	469	25
31	483	26	479	26
32	494	27	489	27
33	506	29	501	29
34	519	30	514	30
35	533	33	529	33
36	551	36	546	36
37	573	41	568	41
38	600		598	49
39	600		600	
40	600		600	

Table 2.5.21 RSSS Conversions for EOC Reading

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	173	48	178	48	181	48
2	208	35	212	34	215	34
3	228	29	233	28	236	28
4	244	25	248	25	251	25
5	256	23	259	23	262	23
6	267	21	270	21	272	21
7	276	20	278	20	281	20
8	284	19	286	19	289	19
9	291	18	293	18	296	18
10	298	17	299	17	302	17
11	304	17	305	17	308	16
12	310	16	311	16	313	16
13	315	16	316	16	319	16
14	320	16	321	15	324	15
15	325	15	326	15	329	15
16	330	15	331	15	333	15
17	335	15	335	14	338	14
18	340	15	340	14	342	14
19	344	14	344	14	346	14
20	348	14	348	14	350	14
21	353	14	352	14	354	14
22	357	14	356	14	358	14
23	361	14	360	14	362	14
24	365	14	364	14	366	14
25	369	14	368	14	370	13
26	373	14	372	13	374	13
27	377	14	376	13	378	13
28	381	14	380	13	381	13
29	385	14	383	13	385	13
30	389	14	387	14	389	14
31	393	14	391	14	393	14
32	397	14	395	14	397	14
33	401	14	399	14	401	14
34	405	14	403	14	405	14
35	409	14	407	14	409	14
36	414	14	411	14	413	14
37	418	14	416	14	418	14
38	423	15	420	14	422	15
39	427	15	424	15	427	15
40	432	15	429	15	431	15
41	437	16	434	15	436	15
42	442	16	439	16	441	16
43	448	16	444	16	447	16
44	454	17	450	17	453	17
45	460	17	456	17	459	17
46	466	18	462	18	465	18
47	474	19	469	19	472	19
48	481	20	477	20	480	20
49	490	21	486	21	489	21
50	501	23	496	23	499	23
51	513	25	508	25	512	25
52	528	29	522	28	527	29
53	549	35	543	34	548	35
54	583	48	577	48	582	48
55	600		600		600	

Table 2.5.22 RSSS Conversions for EOC Earth Science

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	219	43	217	43	223	43
2	251	31	248	31	254	31
3	270	26	267	26	272	26
4	284	23	280	23	286	23
5	295	21	291	21	297	21
6	305	19	300	19	306	19
7	313	18	309	18	314	18
8	320	17	316	17	322	17
9	327	16	322	16	328	16
10	333	16	328	16	334	16
11	339	15	334	15	340	15
12	344	15	339	15	345	15
13	349	14	344	14	350	14
14	354	14	349	14	355	14
15	359	14	354	14	359	14
16	363	14	358	14	364	14
17	367	13	363	14	368	13
18	372	13	367	13	372	13
19	376	13	371	13	377	13
20	380	13	375	13	381	13
21	384	13	379	13	385	13
22	388	13	383	13	388	13
23	391	13	387	13	392	13
24	395	13	391	13	396	13
25	399	13	395	13	400	13
26	403	13	399	13	404	13
27	407	13	403	13	408	13
28	411	13	407	13	412	13
29	414	13	411	13	416	13
30	418	13	415	13	420	13
31	422	13	419	13	424	13
32	426	13	423	13	428	13
33	431	13	428	14	432	13
34	435	14	432	14	436	14
35	439	14	437	14	441	14
36	444	14	442	14	445	14
37	448	14	447	15	450	14
38	453	15	452	15	455	15
39	459	15	457	15	461	15
40	464	16	463	16	466	16
41	470	16	469	17	473	16
42	476	17	476	17	479	17
43	484	18	483	18	487	18
44	491	19	492	19	495	19
45	501	20	501	21	504	21
46	511	22	513	23	515	23
47	525	26	527	26	529	26
48	543	31	546	31	548	31
49	574	43	577	43	579	43
50	600		600		600	

Table 2.5.23 RSSS Conversions for EOC Biology

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	205	46	205	46	208	46
2	238	33	237	33	240	33
3	257	27	257	27	260	27
4	272	24	271	24	274	24
5	283	22	283	22	286	22
6	293	20	293	20	295	20
7	301	19	301	19	304	19
8	309	18	309	18	311	18
9	315	17	316	17	318	17
10	322	16	322	17	324	16
11	327	16	328	16	330	16
12	333	16	334	16	336	16
13	338	15	340	15	341	15
14	343	15	345	15	346	15
15	348	15	350	15	351	15
16	353	14	354	15	356	14
17	357	14	359	14	360	14
18	362	14	364	14	364	14
19	366	14	368	14	369	14
20	370	14	373	14	373	14
21	374	14	377	14	377	14
22	379	14	381	14	381	14
23	383	14	385	14	385	14
24	387	14	390	14	389	13
25	391	14	394	14	393	13
26	395	14	398	14	398	13
27	399	14	402	14	402	14
28	403	14	406	14	406	14
29	408	14	411	14	410	14
30	412	14	415	14	414	14
31	416	14	419	14	418	14
32	421	14	424	14	423	14
33	425	14	429	14	427	14
34	430	15	433	15	431	14
35	435	15	438	15	436	15
36	440	15	443	15	441	15
37	445	16	448	15	446	15
38	451	16	454	16	451	16
39	456	16	459	16	457	16
40	463	17	465	17	463	17
41	469	18	472	17	469	17
42	477	19	479	18	476	18
43	485	20	487	19	483	19
44	494	21	495	20	492	20
45	504	22	505	22	501	22
46	517	25	517	24	513	24
47	532	28	532	27	527	27
48	553	34	551	33	547	33
49	587	46	584	46	579	46
50	600		600		600	

Table 2.5.24 RSSS Conversions for EOC Chemistry

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	202	46	219	45	217	45
2	235	33	251	32	249	32
3	256	28	270	27	269	27
4	271	24	284	23	283	24
5	283	22	296	21	294	21
6	293	21	305	20	304	20
7	302	19	313	19	312	19
8	311	18	321	18	320	18
9	318	18	328	17	327	17
10	325	17	334	16	333	16
11	331	17	340	16	339	16
12	337	16	345	15	344	15
13	343	16	350	15	349	15
14	348	15	355	15	354	15
15	354	15	360	14	359	14
16	359	15	364	14	364	14
17	364	15	369	14	368	14
18	368	14	373	14	373	14
19	373	14	377	14	377	14
20	378	14	382	14	381	14
21	382	14	386	13	385	14
22	387	14	390	13	390	13
23	391	14	394	13	394	13
24	395	14	398	13	398	13
25	400	14	402	13	402	13
26	404	14	406	13	406	13
27	409	14	410	13	410	13
28	413	14	414	13	414	13
29	417	14	418	13	418	14
30	422	14	422	14	422	14
31	426	14	426	14	427	14
32	431	14	430	14	431	14
33	436	14	435	14	435	14
34	440	15	439	14	440	14
35	445	15	444	14	445	15
36	450	15	449	15	450	15
37	456	15	454	15	455	15
38	461	16	459	15	460	16
39	467	16	465	16	466	16
40	473	17	470	16	472	17
41	480	17	477	17	478	17
42	487	18	484	18	485	18
43	495	19	491	19	493	19
44	504	20	500	20	502	20
45	514	22	509	21	512	22
46	526	24	521	24	523	24
47	541	27	535	27	538	27
48	561	33	554	32	558	33
49	593	45	587	45	591	45
50	600		600		600	

Table 2.5.25 RSSS Conversions for EOC Algebra I

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	239	39	242	39	240	39
2	267	28	270	28	268	28
3	284	23	287	23	285	23
4	297	21	299	21	298	21
5	307	19	309	19	307	19
6	315	17	318	17	316	17
7	323	16	325	16	323	16
8	329	16	332	15	330	15
9	335	15	338	15	336	15
10	341	14	343	14	341	14
11	346	14	348	14	346	14
12	351	14	353	13	351	13
13	356	13	357	13	356	13
14	360	13	362	13	360	13
15	365	13	366	13	364	13
16	369	13	370	12	368	12
17	373	12	374	12	372	12
18	377	12	377	12	376	12
19	381	12	381	12	380	12
20	385	12	385	12	384	12
21	388	12	388	12	387	12
22	392	12	392	12	391	12
23	396	12	395	12	395	12
24	399	12	399	12	398	12
25	403	12	402	11	402	12
26	407	12	406	12	405	12
27	410	12	409	12	409	12
28	414	12	413	12	413	12
29	418	12	416	12	416	12
30	422	12	420	12	420	12
31	425	12	423	12	424	12
32	429	12	427	12	428	12
33	433	12	431	12	431	12
34	437	13	434	12	435	13
35	441	13	438	12	440	13
36	446	13	442	13	444	13
37	450	13	447	13	448	13
38	455	14	451	13	453	14
39	460	14	456	14	458	14
40	465	14	461	14	463	14
41	471	15	466	15	469	15
42	477	16	472	15	475	16
43	484	16	479	16	482	16
44	491	17	486	17	489	18
45	499	19	494	19	498	19
46	510	21	504	21	508	21
47	522	23	517	23	521	24
48	539	28	534	28	538	28
49	567	39	562	39	566	39
50	600		600		600	

Table 2.5.26 RSSS Conversions for EOC Geometry

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	217	44	225	44	224	44
2	249	32	256	31	255	31
3	268	26	274	26	274	26
4	282	23	288	23	288	23
5	294	21	299	21	299	21
6	303	20	308	19	308	19
7	312	18	316	18	316	18
8	319	18	323	17	323	17
9	326	17	330	16	330	16
10	333	16	336	16	336	16
11	338	16	341	15	342	15
12	344	15	347	15	347	15
13	349	15	352	14	352	15
14	354	15	356	14	357	14
15	359	14	361	14	362	14
16	364	14	366	14	366	14
17	368	14	370	14	370	14
18	373	14	374	13	375	13
19	377	14	378	13	379	13
20	381	13	382	13	383	13
21	386	13	386	13	387	13
22	390	13	390	13	391	13
23	394	13	394	13	395	13
24	398	13	398	13	399	13
25	402	13	402	13	403	13
26	406	13	406	13	407	13
27	410	13	410	13	411	13
28	414	13	414	13	415	13
29	418	13	418	13	419	13
30	423	13	423	13	423	13
31	427	14	427	14	427	14
32	431	14	431	14	432	14
33	436	14	436	14	436	14
34	440	14	440	14	441	14
35	445	14	445	14	445	14
36	450	15	450	15	450	15
37	455	15	455	15	455	15
38	460	15	460	15	461	15
39	466	16	466	16	466	16
40	471	16	472	16	472	16
41	478	17	478	17	479	17
42	485	18	485	18	486	18
43	492	18	492	19	494	19
44	501	20	501	20	502	20
45	510	21	511	21	512	21
46	522	23	522	23	524	24
47	536	26	536	26	539	27
48	555	32	555	32	559	32
49	587	44	587	44	591	44
50	600		600		600	

Table 2.5.27 RSSS Conversions for EOC Algebra II

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	161	55	168	55	167	55
2	201	40	207	40	207	40
3	225	33	231	33	231	33
4	242	29	249	29	249	29
5	256	26	263	26	263	27
6	268	24	275	25	276	25
7	278	23	286	23	286	23
8	288	22	295	22	296	22
9	296	21	304	21	305	21
10	304	20	312	20	313	20
11	311	19	319	20	320	20
12	318	19	326	19	327	19
13	324	18	333	19	334	19
14	331	18	339	18	340	18
15	337	18	346	18	346	18
16	342	17	352	18	352	18
17	348	17	357	18	358	18
18	353	17	363	17	364	17
19	359	17	369	17	369	17
20	364	17	374	17	375	17
21	369	17	379	17	380	17
22	374	17	385	17	385	17
23	379	16	390	17	390	17
24	384	16	395	17	395	17
25	389	16	400	17	401	17
26	394	16	406	17	406	17
27	399	17	411	17	411	17
28	404	17	416	17	416	17
29	409	17	421	17	421	17
30	415	17	427	17	427	17
31	420	17	432	17	432	17
32	425	17	438	17	437	17
33	431	17	443	18	443	17
34	437	18	449	18	449	18
35	442	18	455	18	454	18
36	448	18	461	18	460	18
37	455	19	468	19	467	19
38	461	19	475	19	473	19
39	468	20	482	20	480	20
40	476	20	489	21	487	20
41	484	21	497	21	495	21
42	492	22	506	22	504	22
43	502	23	516	23	513	23
44	513	25	527	25	523	24
45	525	27	539	27	535	26
46	539	29	554	30	549	29
47	557	33	572	33	567	33
48	582	40	597	40	591	40
49	600		600		600	
50	600		600		600	

Table 2.5.28 RSSS Conversions for EOC Virginia and U.S. History

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	193	46	204	46	198	46
2	226	33	237	33	230	33
3	245	27	256	27	250	27
4	260	24	270	24	264	24
5	271	22	282	22	276	22
6	281	20	291	20	285	20
7	289	19	300	19	293	19
8	296	18	307	18	301	18
9	303	17	314	17	308	17
10	309	16	320	16	314	16
11	315	16	326	16	319	16
12	320	15	331	15	325	15
13	325	15	336	15	330	15
14	330	15	341	15	334	15
15	334	14	346	14	339	14
16	339	14	350	14	343	14
17	343	14	354	14	348	14
18	347	14	358	14	352	14
19	351	13	362	13	356	13
20	355	13	366	13	360	13
21	359	13	370	13	364	13
22	363	13	374	13	367	13
23	366	13	377	13	371	13
24	370	13	381	13	375	13
25	374	13	385	13	378	13
26	377	13	388	13	382	13
27	381	13	392	13	385	13
28	384	13	395	13	389	13
29	388	13	399	13	392	13
30	391	13	402	13	396	13
31	395	13	405	13	399	13
32	398	13	409	13	403	13
33	402	13	412	13	406	13
34	406	13	416	13	410	13
35	409	13	420	13	414	13
36	413	13	423	13	417	13
37	417	13	427	13	421	13
38	420	13	430	13	425	13
39	424	13	434	13	428	13
40	428	13	438	13	432	13
41	432	14	442	13	436	14
42	436	14	446	14	440	14
43	440	14	450	14	445	14

44	445	14	454	14	449	14
45	449	14	459	14	454	14
46	454	15	463	15	458	15
47	459	15	468	15	463	15
48	464	15	473	15	468	16
49	469	16	479	16	474	16
50	475	17	484	16	480	17
51	482	17	490	17	486	17
52	488	18	497	18	493	18
53	496	19	505	19	500	19
54	504	20	513	20	509	20
55	514	22	523	22	519	22
56	526	24	534	24	530	24
57	540	27	549	27	545	27
58	560	33	568	33	565	33
59	593	46	600		598	46
60	600		600		600	

Table 2.5.29 RSSS Conversions for EOC World History I

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	195	47	190	47	191	47
2	229	34	224	34	225	34
3	249	28	244	28	246	28
4	264	25	259	25	261	25
5	276	23	271	23	273	23
6	286	21	281	21	283	21
7	295	20	290	20	292	20
8	303	19	298	19	300	19
9	310	18	305	18	307	18
10	317	17	312	17	313	17
11	323	17	318	17	319	17
12	328	16	323	16	325	16
13	334	16	329	16	330	16
14	339	15	334	15	335	15
15	344	15	339	15	340	15
16	348	15	343	15	345	15
17	353	14	348	14	349	14
18	357	14	352	14	354	14
19	361	14	356	14	358	14
20	365	14	360	14	362	14
21	369	14	365	14	366	14
22	373	13	368	14	370	13
23	377	13	372	13	374	13
24	381	13	376	13	378	13
25	385	13	380	13	381	13
26	389	13	384	13	385	13
27	392	13	387	13	389	13
28	396	13	391	13	392	13
29	400	13	395	13	396	13
30	403	13	398	13	400	13
31	407	13	402	13	403	13
32	410	13	406	13	407	13
33	414	13	409	13	410	13
34	418	13	413	13	414	13
35	421	13	417	13	418	13
36	425	13	420	13	421	13
37	429	13	424	13	425	13
38	433	13	428	13	429	13
39	437	14	432	14	433	13
40	441	14	436	14	437	14
41	445	14	440	14	441	14
42	449	14	444	14	445	14
43	453	14	448	14	449	14

44	457	14	453	14	453	14
45	462	15	457	15	458	15
46	467	15	462	15	462	15
47	472	15	467	15	467	15
48	477	16	472	16	473	16
49	482	16	478	16	478	16
50	488	17	484	17	484	17
51	495	18	490	18	490	18
52	502	18	497	18	497	18
53	509	19	504	19	505	19
54	518	21	513	21	513	21
55	528	22	523	22	523	22
56	539	25	534	25	535	25
57	554	28	549	28	550	28
58	574	34	569	34	570	34
59	600		600		600	
60	600		600		600	

Table 2.5.30 RSSS Conversions for EOC World History II

Raw Score	Online					
	Core 1		Core 2		Core 3	
	SS	SEM	SS	SEM	SS	SEM
0	0		0		0	
1	190	50	182	50	182	50
2	226	36	217	36	218	36
3	247	29	238	29	239	30
4	262	26	253	26	254	26
5	274	23	265	23	267	23
6	284	22	276	22	277	22
7	293	20	284	20	286	20
8	301	19	292	19	294	19
9	308	18	299	18	301	18
10	315	17	306	17	307	18
11	321	17	312	17	313	17
12	326	16	317	16	319	16
13	331	16	322	16	324	16
14	336	15	327	15	330	16
15	341	15	332	15	334	15
16	346	15	337	15	339	15
17	350	15	341	15	343	15
18	354	14	345	14	348	14
19	358	14	349	14	352	14
20	362	14	353	14	356	14
21	366	14	357	14	360	14
22	370	14	361	14	364	14
23	374	14	365	14	368	14
24	378	13	369	13	371	14
25	381	13	372	13	375	14
26	385	13	376	13	379	13
27	389	13	379	13	383	13
28	392	13	383	13	386	13
29	396	13	387	13	390	13
30	399	13	390	13	393	13
31	403	13	394	13	397	13
32	406	13	397	13	400	13
33	410	13	401	13	404	13
34	414	13	404	13	408	13
35	417	13	408	13	411	13
36	421	14	412	13	415	14
37	425	14	415	14	419	14
38	428	14	419	14	423	14
39	432	14	423	14	426	14
40	436	14	427	14	430	14
41	440	14	431	14	434	14
42	444	14	435	14	439	14
43	449	15	439	15	443	15

44	453	15	443	15	447	15
45	458	15	448	15	452	15
46	462	16	453	15	456	15
47	467	16	458	16	461	16
48	473	16	463	16	467	16
49	478	17	468	17	472	17
50	484	18	474	17	478	17
51	491	18	481	18	485	18
52	498	19	488	19	492	19
53	506	20	495	20	500	20
54	515	22	504	22	508	22
55	525	23	514	23	518	23
56	537	26	526	26	531	26
57	552	30	542	29	546	29
58	574	36	563	36	567	36
59	600		598	50	600	
60	600		600		600	

Table 2.5.31 RSSS Conversions for EOC World Geography

Raw Score	Online			
	Core 1		Core 2	
	SS	SEM	SS	SEM
0	0		0	
1	191	46	195	45
2	224	33	227	32
3	244	27	247	27
4	258	24	261	24
5	270	22	272	21
6	280	20	282	20
7	288	19	290	19
8	296	18	297	18
9	303	17	304	17
10	309	17	310	16
11	315	16	315	16
12	321	15	321	15
13	326	15	325	15
14	331	15	330	14
15	335	14	335	14
16	340	14	339	14
17	344	14	343	13
18	349	14	347	13
19	353	13	351	13
20	357	13	355	13
21	361	13	358	13
22	364	13	362	13
23	368	13	366	13
24	372	13	369	12
25	375	13	373	12
26	379	13	376	12
27	383	13	379	12
28	386	13	383	12
29	390	12	386	12
30	393	12	390	12
31	397	12	393	12
32	400	12	396	12
33	403	13	400	12
34	407	13	403	12
35	411	13	407	12
36	414	13	410	12
37	418	13	414	13
38	421	13	417	13
39	425	13	421	13
40	429	13	424	13
41	433	13	428	13
42	437	13	432	13
43	441	14	436	13

44	445	14	440	14
45	449	14	445	14
46	454	14	449	14
47	459	15	454	15
48	464	15	459	15
49	469	16	464	16
50	475	16	470	16
51	481	17	476	17
52	487	18	482	18
53	495	19	489	19
54	503	20	498	20
55	512	21	507	21
56	524	24	518	24
57	538	27	532	27
58	557	33	552	32
59	590	45	584	45
60	600		600	

Table 2.5.32 RSSS Conversions for Grade 3 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	160	60
2	203	43
3	229	36
4	249	32
5	265	29
6	278	27
7	290	26
8	301	25
9	311	24
10	321	23
11	330	23
12	338	22
13	347	22
14	355	22
15	363	22
16	371	22
17	379	22
18	388	22
19	396	22
20	404	22
21	413	23
22	422	23
23	432	24
24	442	25
25	453	26
26	465	27
27	479	29
28	495	32
29	515	36
30	542	43
31	585	60
32	600	

Table 2.5.33 RSSS Conversions for Grade 3 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	142	62
2	188	45
3	216	38
4	236	33
5	253	31
6	268	29
7	281	27
8	292	26
9	303	25
10	313	24
11	323	24
12	332	23
13	341	23
14	350	23
15	359	23
16	367	23
17	376	23
18	384	23
19	393	23
20	402	23
21	411	23
22	420	24
23	430	25
24	440	25
25	452	27
26	464	28
27	478	30
28	495	33
29	515	37
30	542	44
31	586	61
32	600	

Table 2.5.34 RSSS Conversions for Grade 4 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	169	61
2	213	44
3	239	37
4	259	32
5	276	30
6	289	28
7	301	26
8	313	25
9	323	24
10	332	24
11	342	23
12	350	23
13	359	22
14	367	22
15	375	22
16	384	22
17	392	22
18	400	22
19	409	23
20	417	23
21	426	23
22	436	24
23	446	25
24	456	26
25	468	27
26	481	28
27	495	30
28	512	33
29	533	37
30	561	45
31	600	
32	600	

Table 2.5.35 RSSS Conversions for Grade 4 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	192	49
2	228	36
3	250	30
4	266	26
5	279	24
6	291	22
7	301	21
8	309	20
9	318	19
10	325	19
11	332	18
12	339	18
13	346	17
14	352	17
15	358	17
16	364	17
17	369	16
18	375	16
19	380	16
20	386	16
21	392	16
22	397	16
23	403	16
24	408	16
25	414	17
26	420	17
27	426	17
28	432	17
29	438	18
30	445	18
31	452	19
32	460	20
33	469	21
34	478	22
35	489	24
36	502	26
37	517	29
38	539	35
39	574	49
40	600	

Table 2.5.36 RSSS Conversions for Grade 5 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	153	61
2	197	44
3	225	37
4	245	33
5	262	30
6	276	28
7	288	27
8	300	26
9	311	25
10	320	24
11	330	23
12	339	23
13	348	23
14	356	22
15	364	22
16	373	22
17	381	22
18	389	22
19	398	23
20	406	23
21	415	23
22	424	24
23	434	24
24	444	25
25	455	26
26	468	28
27	481	30
28	497	33
29	517	37
30	544	44
31	588	61
32	600	

Table 2.5.37 RSSS Conversions for Grade 5 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	86	69
2	136	50
3	166	41
4	188	36
5	206	33
6	221	31
7	235	29
8	247	28
9	258	27
10	268	26
11	277	25
12	286	24
13	295	24
14	303	24
15	311	23
16	319	23
17	327	23
18	335	23
19	342	23
20	350	23
21	357	23
22	365	23
23	373	23
24	380	23
25	388	23
26	396	24
27	405	24
28	413	24
29	423	25
30	432	26
31	442	27
32	453	28
33	465	29
34	479	31
35	494	33
36	512	36
37	534	41
38	564	50
39	600	
40	600	

Table 2.5.38 RSSS Conversions for Grade 6 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	178	52
2	216	37
3	238	31
4	255	28
5	269	25
6	280	23
7	290	22
8	299	21
9	308	20
10	316	20
11	323	19
12	330	19
13	337	18
14	343	18
15	350	18
16	356	18
17	362	18
18	368	18
19	374	18
20	380	18
21	387	18
22	393	18
23	400	18
24	406	19
25	413	19
26	421	20
27	429	20
28	437	21
29	446	22
30	456	23
31	468	25
32	481	28
33	498	31
34	521	37
35	558	52
36	600	

Table 2.5.39 RSSS Conversions for Grade 6 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	141	58
2	184	42
3	210	35
4	230	31
5	245	29
6	259	27
7	271	25
8	281	24
9	291	23
10	300	22
11	309	22
12	317	21
13	325	21
14	332	20
15	339	20
16	346	20
17	353	20
18	360	19
19	366	19
20	373	19
21	380	19
22	386	19
23	393	19
24	399	19
25	406	20
26	413	20
27	420	20
28	428	21
29	435	21
30	443	22
31	452	22
32	461	23
33	471	24
34	482	26
35	495	28
36	510	30
37	528	34
38	553	41
39	595	58
40	600	

Table 2.5.40 RSSS Conversions for Grade 7 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	163	59
2	206	43
3	232	36
4	251	32
5	267	29
6	280	27
7	291	25
8	302	24
9	312	23
10	321	22
11	329	22
12	337	21
13	345	21
14	352	21
15	360	20
16	367	20
17	374	20
18	381	20
19	388	20
20	395	20
21	402	20
22	409	21
23	417	21
24	424	21
25	432	22
26	441	22
27	450	23
28	459	24
29	469	25
30	481	27
31	494	29
32	509	31
33	528	35
34	554	43
35	597	59
36	600	

Table 2.5.41 RSSS Conversions for Grade 7 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	157	60
2	200	43
3	227	36
4	246	32
5	262	29
6	276	27
7	287	26
8	298	24
9	308	24
10	317	23
11	326	22
12	334	22
13	341	21
14	349	21
15	356	21
16	363	20
17	370	20
18	377	20
19	384	20
20	391	20
21	397	20
22	404	20
23	411	20
24	418	20
25	425	20
26	432	21
27	439	21
28	447	21
29	455	22
30	463	23
31	472	23
32	482	24
33	492	25
34	504	27
35	517	29
36	533	32
37	552	36
38	578	43
39	600	
40	600	

Table 2.5.42 RSSS Conversions for Grade 8 VMAST Reading

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	103	69
2	153	50
3	183	41
4	205	37
5	223	33
6	239	31
7	252	29
8	264	28
9	275	27
10	286	26
11	296	25
12	305	25
13	314	25
14	323	24
15	331	24
16	340	24
17	348	24
18	356	24
19	364	24
20	373	24
21	381	24
22	390	24
23	399	25
24	408	25
25	417	26
26	427	26
27	438	27
28	449	28
29	462	30
30	475	31
31	491	34
32	510	37
33	532	42
34	563	50
35	600	
36	600	

Table 2.5.43 RSSS Conversions for Grade 8 VMAST Mathematics

Raw Score	Online	
	Core 2	
	SS	SEM
0	0	
1	140	59
2	183	43
3	210	36
4	230	32
5	245	29
6	259	27
7	271	25
8	282	24
9	291	23
10	300	22
11	309	22
12	317	21
13	325	21
14	332	21
15	340	20
16	347	20
17	354	20
18	360	20
19	367	20
20	374	20
21	381	20
22	388	20
23	394	20
24	401	20
25	409	20
26	416	21
27	424	21
28	431	22
29	440	22
30	449	23
31	458	24
32	468	25
33	480	26
34	492	28
35	507	31
36	525	34
37	549	39
38	582	49
39	600	
40	600	

Table 2.5.44 RSSS Conversions for EOC VMAST Reading

Raw Score	Online	
	Core 3	
	SS	SEM
0	0	
1	167	56
2	207	40
3	231	33
4	249	29
5	263	27
6	275	25
7	286	23
8	295	22
9	304	21
10	312	21
11	319	20
12	326	19
13	333	19
14	340	19
15	346	18
16	352	18
17	358	18
18	363	18
19	369	18
20	375	17
21	380	17
22	386	17
23	391	17
24	397	17
25	402	17
26	408	18
27	414	18
28	420	18
29	426	18
30	432	18
31	438	19
32	445	19
33	452	20
34	459	20
35	467	21
36	475	22
37	485	23
38	495	25
39	507	26
40	521	29
41	539	33
42	563	40
43	600	
44	600	

Table 2.5.45 RSSS Conversions for EOC VMAST Algebra I

Raw Score	Online	
	Core 3	
	SS	SEM
0	0	
1	167	53
2	205	38
3	228	31
4	245	28
5	258	25
6	270	23
7	280	22
8	289	21
9	297	20
10	305	19
11	312	19
12	318	18
13	325	18
14	331	18
15	337	18
16	343	17
17	349	17
18	354	17
19	360	17
20	366	17
21	371	17
22	377	17
23	383	17
24	389	17
25	394	18
26	401	18
27	407	18
28	413	19
29	420	19
30	427	20
31	435	20
32	443	21
33	452	22
34	463	24
35	474	25
36	488	28
37	505	32
38	528	38
39	566	53
40	600	

Table 2.5.46 RSSS Conversions for Grade 5 Writing Core 1

Raw Score	Core 1													
	Prompt 2502		Prompt 2509		Prompt 2510		Prompt 2519		Prompt 2522		Prompt 2532		Prompt 2549	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	4		4		4		4		5		3		4	
2	8		8		8		8		9		7		9	
3	12		12		12		12		14		10		13	
4	16		16		15		16		18		13		17	
5	20		20		19		20		23		17		22	
6	24	131	24	132	23	132	24	132	27	133	20	131	26	132
7	111	64	112	64	112	65	112	64	117	66	106	63	115	64
8	153	45	155	45	155	45	154	45	162	46	147	44	158	45
9	178	37	180	38	181	38	179	37	188	38	172	37	183	37
10	197	33	198	33	199	34	198	33	207	34	190	33	201	33
11	212	31	214	31	215	31	213	31	222	31	205	31	216	31
12	226	29	228	30	229	30	227	29	236	29	219	30	230	29
13	239	29	240	29	241	29	239	28	248	28	232	29	242	28
14	251	28	252	28	253	28	251	28	259	27	244	28	253	27
15	262	28	264	28	265	28	263	28	270	27	256	28	264	27
16	274	27	275	27	276	27	274	27	280	26	268	28	275	27
17	285	27	286	27	287	27	285	27	290	26	279	27	285	26
18	296	27	297	27	298	26	296	27	300	25	290	27	296	26
19	306	26	308	26	308	26	306	26	310	25	301	26	306	26
20	317	26	318	26	318	26	317	26	319	25	311	26	315	25
21	326	26	328	26	328	25	326	25	328	24	321	25	325	25
22	336	25	338	25	337	25	336	25	337	24	330	25	334	24
23	345	25	347	25	346	25	345	25	346	24	339	25	343	24
24	355	25	357	25	355	24	354	24	354	24	348	24	351	24
25	364	24	366	24	364	24	363	24	362	23	357	24	360	24
26	372	24	375	24	373	24	372	24	371	23	366	24	368	24
27	381	24	383	24	382	24	380	24	379	23	374	24	377	24
28	390	24	392	24	390	24	389	24	387	23	383	24	385	24
29	399	24	401	24	399	24	398	24	395	23	392	24	394	24
30	408	25	410	24	408	24	406	24	403	24	401	24	403	24
31	417	25	419	25	417	25	415	24	412	24	410	25	412	25
32	426	25	428	25	426	25	424	25	421	24	419	25	421	25
33	436	26	438	26	435	25	434	25	429	24	429	26	430	25
34	446	26	448	26	445	26	443	26	438	25	438	26	440	26
35	457	27	458	27	456	27	454	26	448	25	449	27	450	26
36	468	28	470	28	467	28	464	27	458	26	460	27	461	27
37	480	29	482	29	479	29	475	28	468	26	471	28	472	27
38	493	30	495	30	492	30	487	29	479	27	483	29	483	28
39	507	31	509	31	505	31	500	30	490	28	496	30	496	29
40	522	32	524	33	520	32	514	31	503	30	509	31	509	30
41	538	34	541	34	537	34	529	33	517	32	525	33	524	32
42	557	36	560	37	555	36	546	35	533	35	542	35	541	35
43	578	40	582	41	577	40	567	39	553	39	563	39	561	39
44	600		600		600		595	47	581	47	590	47	588	47
45	600		600		600		600		600		600		600	
46	600		600		600		600		600		600		600	

Table 2.5.47 RSSS Conversions for Grade 5 Writing Core 2

Raw Score	Core 2													
	Prompt 2502		Prompt 2509		Prompt 2510		Prompt 2519		Prompt 2522		Prompt 2532		Prompt 2549	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	5		5		5		5		6		4		5	
2	10		10		10		10		11		9		11	
3	15		15		15		15		17		13		16	
4	19		19		19		20		22		17		21	
5	24		24		24		25		28		22		27	
6	29	130	29	131	29	131	30	131	33	132	26	129	32	131
7	115	63	115	63	116	64	116	63	121	65	109	62	118	63
8	156	44	157	45	157	45	157	44	164	45	149	44	160	44
9	180	37	181	37	182	37	181	37	189	37	173	37	184	37
10	198	33	199	33	200	33	199	33	207	33	191	33	202	33
11	213	30	214	31	215	31	213	30	222	30	206	31	216	30
12	226	29	227	29	228	29	226	29	235	29	219	29	229	29
13	238	28	240	28	241	28	239	28	247	27	231	28	241	27
14	249	27	251	27	252	27	250	27	258	26	243	28	252	27
15	260	27	262	27	263	27	261	27	268	26	255	27	263	26
16	271	27	273	27	274	26	272	27	278	25	266	27	273	26
17	282	26	283	26	284	26	282	26	287	25	276	27	283	26
18	292	26	294	26	294	26	292	26	297	25	287	26	292	25
19	302	26	304	26	304	26	302	26	306	25	297	26	302	25
20	312	25	314	26	314	25	312	25	315	24	307	25	311	25
21	322	25	323	25	323	25	322	25	324	24	316	25	320	24
22	331	25	333	25	332	25	331	25	332	24	326	25	329	24
23	340	25	342	25	341	24	340	24	341	24	334	24	338	24
24	349	24	351	24	350	24	349	24	349	23	343	24	346	24
25	358	24	360	24	359	24	358	24	357	23	352	24	354	24
26	367	24	369	24	367	24	366	24	365	23	360	24	363	24
27	375	24	378	24	376	24	375	24	373	23	369	24	371	24
28	384	24	386	24	384	24	383	24	381	23	377	24	380	24
29	393	24	395	24	393	24	392	24	390	23	386	24	388	24
30	402	25	404	25	402	24	401	24	398	24	395	24	397	24
31	411	25	413	25	411	25	410	25	407	24	404	25	406	25
32	421	25	423	25	420	25	419	25	415	24	413	25	415	25
33	430	26	432	26	430	26	428	25	424	25	423	26	425	25
34	441	26	442	26	440	26	438	26	433	25	433	26	434	26
35	451	27	453	27	450	27	448	26	443	25	443	27	445	27
36	463	28	465	28	462	28	459	27	453	26	454	27	456	27
37	475	29	477	29	474	29	470	28	463	27	466	28	467	28
38	488	30	490	30	487	30	483	29	474	27	478	29	479	29
39	502	31	504	32	501	31	496	30	486	28	491	30	491	29
40	518	33	520	33	516	33	510	31	498	30	505	31	505	31
41	535	34	537	35	533	34	525	33	513	32	520	33	520	32
42	553	36	556	37	551	37	542	35	529	34	538	35	536	35
43	575	40	579	41	573	40	563	39	549	39	559	39	557	39
44	600		600		600		591	47	576	47	586	47	584	47
45	600		600		600		600		600		600		600	
46	600		600		600		600		600		600		600	

Table 2.5.48 RSSS Conversions for Grade 5 Writing Core 3

Raw Score	Core 3													
	Prompt 2502		Prompt 2509		Prompt 2510		Prompt 2519		Prompt 2522		Prompt 2532		Prompt 2549	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	4		4		4		4		4		3		4	
2	8		8		8		8		9		7		8	
3	12		12		12		12		13		10		13	
4	15		15		15		15		17		13		17	
5	19		19		19		19		22		17		21	
6	23	131	23	131	23	132	23	131	26	132	20	130	25	132
7	110	64	110	64	111	64	111	64	116	65	105	63	113	64
8	151	45	152	45	153	45	152	45	159	46	145	44	155	45
9	176	37	177	37	178	37	177	37	185	38	170	37	180	37
10	194	33	195	33	196	33	195	33	203	33	187	33	198	33
11	209	30	211	31	212	31	210	30	219	30	202	30	213	30
12	222	29	224	29	225	29	223	29	231	29	216	29	226	29
13	234	28	236	28	237	28	235	28	243	27	228	28	237	27
14	246	27	247	27	248	27	246	27	254	26	239	28	248	27
15	257	27	258	27	259	27	257	27	264	26	251	27	259	26
16	267	27	269	27	270	26	268	26	274	25	262	27	269	26
17	278	26	279	26	280	26	278	26	284	25	272	27	279	26
18	288	26	289	26	290	26	288	26	293	25	283	26	288	25
19	298	26	300	26	300	26	298	26	302	25	293	26	298	25
20	308	26	309	26	309	25	308	25	311	24	303	25	307	25
21	318	25	319	25	319	25	318	25	320	24	312	25	316	24
22	327	25	329	25	328	25	327	25	328	24	322	25	325	24
23	336	25	338	25	337	24	336	25	337	24	331	24	334	24
24	345	24	347	25	346	24	345	24	345	24	339	24	342	24
25	354	24	356	24	355	24	354	24	354	23	348	24	351	24
26	363	24	365	24	364	24	363	24	362	23	357	24	359	24
27	372	24	374	24	372	24	371	24	370	23	365	24	368	24
28	381	24	383	24	381	24	380	24	378	23	374	24	376	24
29	390	24	392	24	390	24	388	24	386	24	382	24	385	24
30	398	25	401	25	399	24	397	24	395	24	391	24	393	24
31	408	25	410	25	408	25	406	25	403	24	400	25	402	25
32	417	25	419	25	417	25	415	25	412	24	410	25	412	25
33	427	26	429	26	426	26	425	25	421	25	419	26	421	25
34	437	26	439	26	436	26	435	26	430	25	429	26	431	26
35	448	27	450	27	447	27	445	26	440	25	440	27	441	26
36	459	28	461	28	458	28	455	27	449	26	451	27	452	27
37	471	29	473	29	470	29	467	28	460	27	462	28	463	28
38	484	30	486	30	483	30	479	29	471	27	474	29	475	29
39	499	31	500	32	497	31	492	30	482	28	487	30	488	29
40	514	33	516	33	512	33	506	31	495	30	501	31	501	31
41	531	34	533	35	529	34	521	33	509	32	517	33	516	32
42	550	37	553	37	548	37	539	35	525	34	534	35	533	35
43	571	40	575	41	570	40	560	39	545	39	555	39	553	39
44	599	47	600		598	47	587	47	571	46	582	47	580	46
45	600		600		600		600		600		600		600	
46	600		600		600		600		600		600		600	

Table 2.5.49 RSSS Conversions for Grade 8 Writing Core 1

Raw Score	Core 1													
	Prompt 2806		Prompt 2810		Prompt 2812		Prompt 2813		Prompt 2819		Prompt 2849		Prompt 2852	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	13		13		12		12		12		13		13	
2	26		26		24		24		24		27		25	
3	39		40		37		36		36		40		38	
4	52		53		49		48		48		53		51	
5	65		66		61		60		60		67		63	
6	78	113	79	113	73	114	72	112	72	114	80	114	76	113
7	152	54	155	55	150	56	146	54	148	56	156	55	151	55
8	187	38	191	39	188	40	181	38	185	39	192	39	186	38
9	208	31	212	32	211	33	202	32	207	32	214	32	207	32
10	223	28	227	28	228	29	217	28	223	29	229	28	223	28
11	236	26	240	26	241	27	230	26	236	27	242	26	236	26
12	247	24	251	24	253	25	241	25	248	25	253	24	247	25
13	257	24	261	23	263	24	252	24	258	24	263	23	257	24
14	266	23	270	23	273	23	262	24	268	23	272	23	266	23
15	275	23	279	22	283	23	271	23	277	23	281	22	275	23
16	284	22	287	22	291	22	280	23	286	23	289	22	284	22
17	292	22	296	22	300	22	289	22	295	22	298	22	292	22
18	301	22	304	21	308	22	298	22	303	22	306	21	301	22
19	309	21	312	21	316	21	306	22	311	21	314	21	308	21
20	317	21	319	21	324	21	314	21	319	21	321	21	316	21
21	324	21	327	21	332	21	321	21	327	21	329	21	324	21
22	332	21	334	20	339	21	329	21	334	21	336	20	331	20
23	339	20	341	20	347	20	336	20	342	20	343	20	338	20
24	346	20	348	20	354	20	343	20	349	20	351	20	345	20
25	353	20	355	20	361	20	350	20	356	20	358	20	352	20
26	361	20	362	20	368	20	358	20	363	20	365	20	359	20
27	368	20	369	20	375	20	365	20	370	20	371	20	366	20
28	375	20	376	20	382	20	372	20	378	20	378	20	374	20
29	382	21	384	21	389	20	379	21	385	21	386	20	381	21
30	390	21	391	21	396	20	387	21	392	21	393	21	388	21
31	397	21	399	21	403	21	394	21	400	21	400	21	396	21
32	405	22	406	21	410	21	402	21	408	22	408	21	404	21
33	414	22	415	22	418	21	410	22	416	22	416	22	412	22
34	422	22	423	22	426	22	419	22	425	22	424	22	420	22
35	431	23	432	23	434	22	427	22	434	23	433	22	429	23
36	440	23	441	23	443	23	436	23	443	23	442	23	438	23
37	450	24	450	24	452	23	446	23	453	24	451	23	447	23
38	460	24	460	24	462	24	455	24	463	25	460	24	457	24
39	470	25	470	25	472	24	465	24	474	25	471	24	467	24
40	481	25	481	25	482	25	475	25	486	26	481	25	478	25
41	492	26	493	26	494	26	486	26	498	27	492	26	489	26
42	505	27	505	27	506	27	498	27	511	28	504	27	501	27
43	518	29	518	28	520	29	511	28	526	30	518	28	514	28
44	533	31	533	31	536	31	526	31	542	32	533	31	529	31
45	551	34	551	34	555	35	544	34	562	35	551	34	547	34
46	575	41	575	41	580	42	569	41	587	42	575	41	571	41
47	600		600		600		600		600		600		600	
48	600		600		600		600		600		600		600	

Table 2.5.50 RSSS Conversions for Grade 8 Writing Core 2

Raw Score	Core 2													
	Prompt 2806		Prompt 2810		Prompt 2812		Prompt 2813		Prompt 2819		Prompt 2849		Prompt 2852	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	12		12		11		11		11		13		12	
2	24		25		23		23		22		25		24	
3	37		37		34		34		34		38		36	
4	49		49		45		45		45		50		47	
5	61		62		57		57		56		63		59	
6	73	113	74	114	68	114	68	113	67	114	75	114	71	113
7	148	55	150	55	146	56	142	54	144	56	151	56	147	55
8	184	38	187	39	184	40	177	38	181	39	188	39	183	39
9	204	31	208	32	207	33	198	32	203	32	209	32	204	32
10	220	28	223	28	223	29	214	28	219	29	225	28	219	28
11	232	26	236	26	236	27	226	26	232	26	237	26	232	26
12	243	24	247	24	248	25	237	25	243	25	248	24	242	24
13	252	23	256	23	258	24	248	24	253	24	258	23	252	23
14	261	23	265	22	268	23	257	23	263	23	267	22	261	23
15	270	22	274	22	277	22	266	23	272	22	275	22	270	22
16	278	22	282	21	285	22	275	22	280	22	283	22	278	22
17	286	21	290	21	293	22	283	22	288	22	291	21	286	21
18	294	21	297	21	301	21	291	21	296	21	299	21	294	21
19	302	21	305	21	309	21	299	21	304	21	307	21	302	21
20	310	21	312	20	317	21	307	21	312	21	314	21	309	21
21	317	21	319	20	324	21	314	21	319	21	322	20	317	20
22	324	20	326	20	331	20	322	20	327	20	329	20	324	20
23	331	20	333	20	339	20	329	20	334	20	336	20	331	20
24	338	20	340	20	346	20	336	20	341	20	343	20	338	20
25	345	20	347	20	353	20	343	20	348	20	350	20	344	20
26	352	20	354	20	360	20	350	20	355	20	356	20	351	20
27	359	20	361	20	366	20	356	20	362	20	363	20	358	20
28	366	20	368	20	373	20	363	20	369	20	370	20	365	20
29	374	20	375	20	380	20	371	20	376	20	377	20	372	20
30	381	21	382	21	387	20	378	21	384	21	384	20	380	21
31	388	21	390	21	395	20	385	21	391	21	392	21	387	21
32	396	21	397	21	402	21	393	21	399	21	399	21	395	21
33	404	22	405	22	410	21	401	22	407	22	407	21	403	22
34	413	22	414	22	417	22	409	22	415	22	415	22	411	22
35	422	23	423	23	426	22	418	23	424	23	424	22	420	23
36	431	23	432	23	434	23	427	23	434	24	433	23	429	23
37	441	24	441	24	443	23	437	23	444	24	442	24	438	24
38	451	24	451	24	453	24	446	24	454	25	452	24	448	24
39	461	25	462	25	463	25	456	24	465	26	462	25	458	25
40	473	26	473	26	474	26	467	25	477	27	473	25	469	25
41	484	26	485	26	486	27	478	26	490	28	485	26	481	26
42	497	27	497	27	499	28	490	27	504	29	497	27	493	27
43	511	29	511	29	513	29	504	28	519	30	510	29	506	29
44	526	31	526	31	529	32	518	31	535	32	525	31	521	31
45	544	34	544	34	548	35	537	34	555	35	543	34	540	34
46	568	41	568	41	573	42	561	41	580	42	567	41	564	41
47	600		600		600		600		600		600		600	
48	600		600		600		600		600		600		600	

Table 2.5.51 RSSS Conversions for Grade 8 Writing Core 3

Raw Score	Core 3													
	Prompt 2806		Prompt 2810		Prompt 2812		Prompt 2813		Prompt 2819		Prompt 2849		Prompt 2852	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	12		12		11		11		11		13		12	
2	24		25		23		23		22		25		24	
3	37		37		34		34		34		38		36	
4	49		49		45		45		45		50		47	
5	61		62		57		57		56		63		59	
6	73	113	74	114	68	114	68	113	67	114	75	114	71	113
7	148	55	150	56	146	57	142	55	144	56	151	56	147	55
8	184	38	187	39	184	40	178	38	181	39	188	39	183	39
9	205	32	208	32	207	33	198	32	203	32	210	32	204	32
10	220	28	224	28	224	29	214	28	219	29	225	28	219	28
11	232	26	236	26	237	27	227	26	232	26	238	26	232	26
12	243	24	247	24	249	25	238	25	244	25	249	24	243	24
13	253	23	257	23	259	24	248	24	254	24	258	23	253	23
14	262	23	266	22	268	23	258	23	263	23	267	23	262	23
15	271	22	274	22	277	23	267	23	272	23	276	22	271	22
16	279	22	283	22	286	22	276	22	281	22	284	22	279	22
17	287	22	290	21	294	22	284	22	289	22	292	21	287	21
18	295	21	298	21	302	21	292	22	297	21	300	21	295	21
19	303	21	306	21	310	21	300	21	305	21	308	21	303	21
20	311	21	313	21	318	21	308	21	313	21	315	21	310	21
21	318	21	320	20	325	21	315	21	321	21	323	20	318	20
22	325	20	328	20	333	20	323	20	328	20	330	20	325	20
23	333	20	335	20	340	20	330	20	335	20	337	20	332	20
24	340	20	342	20	347	20	337	20	342	20	344	20	339	20
25	347	20	348	20	354	20	344	20	349	20	351	20	346	20
26	354	20	355	20	361	20	351	20	356	20	358	20	352	20
27	361	20	362	20	368	20	358	20	363	20	364	20	359	20
28	368	20	369	20	374	20	365	20	370	20	371	20	366	20
29	375	20	376	20	381	20	372	20	377	20	378	20	373	20
30	382	21	383	21	388	20	379	21	385	21	385	20	381	21
31	390	21	391	21	396	20	387	21	392	21	393	21	388	21
32	397	21	399	21	403	21	394	21	400	21	400	21	396	21
33	405	22	407	22	411	21	402	22	408	22	408	21	404	22
34	414	22	415	22	418	22	411	22	417	22	416	22	412	22
35	423	23	424	23	427	22	419	23	425	23	425	22	421	23
36	432	23	433	23	435	23	428	23	435	24	434	23	430	23
37	442	24	442	24	444	23	438	23	445	24	443	23	439	24
38	452	24	452	24	454	24	447	24	455	25	453	24	449	24
39	462	25	463	25	464	25	457	24	466	26	463	25	459	25
40	474	26	474	26	475	26	468	25	478	27	474	25	470	25
41	485	26	486	26	487	27	479	26	491	28	485	26	482	26
42	498	27	498	27	500	28	491	27	505	29	498	27	494	27
43	512	29	512	29	514	29	504	28	520	30	511	29	507	29
44	527	31	527	31	530	32	520	31	536	32	526	31	522	31
45	545	34	545	34	549	35	538	34	556	35	545	34	541	34
46	569	41	569	41	574	42	562	41	582	42	568	41	565	41
47	600		600		600		600		600		600		600	
48	600		600		600		600		600		600		600	

Table 2.5.52 RSSS Conversions for EOC Writing Core 1

Raw Score	Core 1													
	Prompt 2101		Prompt 2102		Prompt 2107		Prompt 2115		Prompt 2121		Prompt 2122		Prompt 2126	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	15		14		15		15		14		14		15	
2	29		28		29		29		28		28		29	
3	44		43		44		44		42		43		44	
4	59		57		59		58		56		57		59	
5	73		71		73		73		70		71		73	
6	88	107	85	107	88	108	87	107	84	107	85	107	88	107
7	161	53	157	53	162	54	159	53	156	53	157	52	160	52
8	197	37	193	37	199	38	194	37	192	37	192	37	195	37
9	218	30	214	30	221	31	215	30	213	31	212	30	215	30
10	233	27	229	27	236	27	229	26	228	27	227	26	230	26
11	245	24	241	25	249	25	241	24	240	25	239	24	242	24
12	255	23	252	23	259	23	252	23	251	23	249	23	252	23
13	264	22	261	22	268	22	261	22	260	22	258	22	261	22
14	273	21	270	21	277	21	269	21	269	21	267	21	269	21
15	281	20	278	21	284	20	277	21	277	21	275	21	277	20
16	288	20	286	21	292	20	285	20	285	21	283	20	285	20
17	296	20	294	20	299	19	293	20	293	20	290	20	292	20
18	303	20	302	20	306	19	300	20	301	20	298	20	300	20
19	310	19	309	20	312	19	307	20	308	20	305	20	307	20
20	317	19	317	20	319	19	314	19	315	20	312	20	314	19
21	324	19	324	20	326	19	321	19	322	19	319	19	321	19
22	331	19	331	19	332	18	328	19	329	19	326	19	327	19
23	337	19	338	19	338	18	335	19	336	19	333	19	334	19
24	344	19	344	19	344	18	341	19	343	19	340	19	340	18
25	350	18	351	19	351	18	348	18	349	19	346	18	347	18
26	356	18	357	18	357	18	354	18	356	18	352	18	353	18
27	363	18	364	18	363	18	360	18	362	18	358	18	359	18
28	369	18	370	18	369	18	366	18	368	18	365	18	365	18
29	375	18	376	18	375	18	372	18	374	18	371	18	371	18
30	381	18	382	18	381	18	378	18	380	18	377	18	377	18
31	387	18	388	18	387	18	384	18	386	18	383	18	383	18
32	393	18	394	18	393	18	391	18	392	18	389	18	390	18
33	399	18	400	18	399	18	397	18	399	18	396	19	396	19
34	406	19	406	19	405	19	403	19	405	19	402	19	402	19
35	412	19	413	19	412	19	410	19	411	19	409	19	409	19
36	419	19	420	19	419	19	417	19	418	19	416	19	416	19
37	425	19	426	19	426	19	424	20	425	19	423	20	423	20
38	432	20	434	20	433	20	431	20	432	20	430	20	430	20
39	440	20	441	20	440	20	438	20	439	20	437	20	437	20
40	447	20	449	20	448	21	446	20	446	20	445	21	445	21
41	455	21	457	21	456	21	454	21	454	21	453	21	453	21
42	463	21	465	21	464	21	462	21	462	21	461	21	461	21
43	471	21	473	22	473	22	471	22	470	21	470	22	470	22
44	480	22	482	22	482	22	479	22	479	22	479	22	479	22
45	489	22	492	23	491	23	489	22	488	22	488	22	488	23
46	498	23	502	23	501	23	498	23	498	23	498	23	498	23
47	508	23	512	24	511	24	508	24	508	24	508	24	508	24
48	518	24	524	25	522	25	519	25	519	25	519	25	519	25
49	530	26	536	26	534	26	531	26	532	27	531	26	531	26
50	543	28	550	28	547	28	545	28	546	29	545	28	545	28
51	560	31	567	32	564	32	562	32	563	32	562	32	562	32
52	582	38	589	38	586	38	584	38	586	38	584	38	584	38
53	600		600		600		600		600		600		600	
54	600		600		600		600		600		600		600	

Table 2.5.53 RSSS Conversions for EOC Writing Core 2

Raw Score	Core 2													
	Prompt 2101		Prompt 2102		Prompt 2107		Prompt 2115		Prompt 2121		Prompt 2122		Prompt 2126	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	17		16		17		16		16		16		17	
2	33		32		33		33		31		32		33	
3	50		48		50		49		47		48		50	
4	67		64		67		65		63		64		66	
5	83		80		83		82		78		80		83	
6	100	106	96	106	100	107	98	106	94	106	96	106	99	106
7	171	52	166	52	172	53	168	51	165	52	166	51	169	51
8	205	36	200	36	208	37	202	36	199	36	199	36	203	36
9	225	30	220	30	228	30	221	29	219	30	218	29	222	29
10	239	26	235	26	243	26	235	26	234	26	233	26	236	26
11	251	24	247	24	255	24	247	24	246	24	244	24	247	24
12	261	22	257	23	264	22	257	22	256	23	254	23	257	22
13	269	21	266	22	273	21	266	22	265	22	263	22	266	21
14	278	21	275	21	281	20	274	21	274	21	272	21	274	21
15	285	20	283	21	289	20	282	20	282	21	280	21	282	20
16	293	20	291	20	296	19	290	20	290	20	287	20	289	20
17	300	19	299	20	303	19	297	20	297	20	295	20	297	20
18	307	19	306	20	309	19	304	19	305	20	302	20	304	19
19	314	19	313	20	316	18	311	19	312	19	309	19	311	19
20	320	19	320	19	322	18	318	19	319	19	316	19	317	19
21	327	19	327	19	328	18	324	19	325	19	323	19	324	19
22	333	18	333	19	334	18	331	18	332	19	329	18	330	18
23	339	18	340	18	340	18	337	18	338	18	335	18	336	18
24	345	18	346	18	346	18	343	18	344	18	341	18	342	18
25	351	18	352	18	352	17	349	18	350	18	347	18	348	18
26	357	18	358	18	357	17	355	18	356	18	353	18	354	17
27	363	17	364	17	363	17	360	17	362	18	359	17	359	17
28	368	17	369	17	368	17	366	17	368	17	364	17	365	17
29	374	17	375	17	374	17	372	17	373	17	370	17	371	17
30	379	17	380	17	379	17	377	17	379	17	376	17	376	17
31	385	17	386	17	385	17	383	17	384	17	381	18	382	17
32	391	17	392	17	391	17	388	18	390	18	387	18	387	18
33	396	18	397	18	396	18	394	18	396	18	393	18	393	18
34	402	18	403	18	402	18	400	18	402	18	399	18	399	18
35	408	18	409	18	408	18	406	18	408	18	405	18	405	18
36	414	18	415	18	414	18	413	18	414	18	412	19	412	19
37	421	19	422	19	421	19	419	19	420	19	418	19	418	19
38	427	19	428	19	428	19	426	19	427	19	425	19	425	19
39	434	19	435	20	435	20	433	20	433	19	432	20	432	20
40	441	20	442	20	442	20	440	20	440	20	439	20	439	20
41	449	20	450	20	450	20	448	20	448	20	447	20	447	20
42	456	21	458	21	458	21	456	21	456	21	455	21	455	21
43	464	21	467	22	466	22	464	21	464	21	463	21	463	21
44	473	22	476	22	475	22	473	22	472	22	472	22	472	22
45	482	22	485	23	484	23	482	22	481	22	481	23	481	23
46	491	23	495	24	494	23	491	23	491	23	491	23	491	23
47	501	24	506	24	504	24	502	24	502	24	501	24	501	24
48	512	25	517	25	515	25	513	25	513	25	512	25	513	25
49	524	26	530	27	528	26	525	26	525	27	524	26	525	26
50	537	28	544	29	541	28	539	28	540	29	538	29	539	29
51	553	31	561	32	558	32	555	32	557	32	555	32	556	32
52	575	37	583	38	580	38	577	38	579	38	578	38	578	38
53	600		600		600		600		600		600		600	
54	600		600		600		600		600		600		600	

Table 2.5.54 RSSS Conversions for EOC Writing Core 3

Raw Score	Core 3													
	Prompt 2101		Prompt 2102		Prompt 2107		Prompt 2115		Prompt 2121		Prompt 2122		Prompt 2126	
	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM	SS	SEM
0	0		0		0		0		0		0		0	
1	17		16		17		16		16		16		17	
2	33		32		33		33		32		32		33	
3	50		48		50		49		48		48		50	
4	67		64		67		65		63		64		66	
5	83		80		83		82		79		80		83	
6	100	106	96	106	100	107	98	106	95	106	96	106	99	106
7	171	52	167	52	173	53	168	51	166	52	166	51	170	51
8	206	36	201	36	208	37	202	36	200	36	199	36	203	36
9	225	30	221	30	229	30	222	30	220	30	219	29	222	29
10	240	26	235	26	244	26	236	26	235	27	233	26	236	26
11	251	24	247	24	255	24	247	24	247	24	245	24	248	24
12	261	22	258	23	266	23	258	23	257	23	255	23	258	22
13	270	22	267	22	274	21	267	22	266	22	264	22	267	22
14	279	21	276	22	283	21	275	21	275	21	273	21	275	21
15	287	20	284	21	290	20	283	21	284	21	281	21	283	21
16	294	20	293	21	298	20	291	20	292	21	289	21	291	20
17	302	20	301	21	305	19	299	20	299	20	297	20	299	20
18	309	20	308	20	312	19	306	20	307	20	304	20	306	20
19	316	19	316	20	318	19	314	20	314	20	312	20	313	19
20	323	19	323	20	325	19	321	19	322	20	319	19	320	19
21	330	19	330	19	331	18	328	19	329	19	326	19	327	19
22	337	19	337	19	338	18	334	19	335	19	332	19	333	19
23	343	19	344	19	344	18	341	19	342	19	339	19	340	18
24	349	18	350	18	350	18	347	18	348	18	345	18	346	18
25	355	18	356	18	356	18	353	18	355	18	351	18	352	18
26	362	18	362	18	362	18	359	18	361	18	357	18	358	18
27	367	18	368	18	368	18	365	18	367	18	363	18	364	18
28	373	18	374	18	373	18	371	18	373	18	369	18	370	18
29	379	18	380	18	379	18	377	18	379	18	375	18	376	18
30	385	18	386	18	385	18	383	18	384	18	381	18	382	18
31	391	18	392	18	391	18	389	18	390	18	387	18	388	18
32	397	18	398	18	397	18	395	18	396	18	393	18	394	18
33	403	18	404	18	403	18	401	18	402	18	400	18	400	18
34	409	18	410	18	409	18	407	18	408	18	406	19	406	18
35	415	18	416	18	415	19	413	19	415	18	412	19	412	19
36	422	19	423	19	422	19	420	19	421	19	419	19	419	19
37	428	19	429	19	429	19	427	19	428	19	426	19	426	19
38	435	19	436	19	436	19	434	20	434	19	433	20	433	20
39	442	20	443	20	443	20	441	20	441	20	440	20	440	20
40	449	20	451	20	450	20	448	20	449	20	448	20	448	20
41	457	20	459	21	458	21	456	21	456	20	455	21	455	21
42	465	21	467	21	466	21	464	21	464	21	463	21	463	21
43	473	21	475	22	474	21	472	21	472	21	472	21	472	21
44	481	21	484	22	483	22	481	22	481	22	480	22	480	22
45	490	22	493	23	492	22	490	22	490	22	489	22	489	22
46	499	23	503	23	502	23	499	23	499	23	499	23	499	23
47	509	23	513	24	512	24	509	24	509	24	509	24	509	24
48	519	24	524	25	523	25	520	25	520	25	520	25	520	25
49	531	26	537	26	535	26	532	26	533	26	532	26	532	26
50	544	28	551	28	548	28	546	28	547	29	546	28	546	28
51	560	31	567	32	565	32	562	32	564	32	562	32	563	32
52	582	38	589	38	587	38	584	38	587	38	585	38	585	38
53	600		600		600		600		600		600		600	
54	600		600		600		600		600		600		600	

REFERENCES

American Educational Research Association (AERA), American Psychological Association (APA), & National Council on Measurement in Education (NCME). (2014). *Standards for educational and psychological testing.* Washington, DC: AERA.

Andrich, A., & Luo, G. (2004). *Modern measurement and analysis in social science*. Perth, Western Australia: Murdoch University.

Angoff, W.H. (1971). Scales, norms and equivalent scores. In R.L. Thorndike (Ed.), *Educational measurement* (2nd ed., pp. 508–600). Washington, DC: American Council on Education.

Brennan, R. L. (2004). *Manual for BB-CLASS: A computer program that uses the beta-binomial model for classification consistency and accuracy* (CASMA Research Report No. 9). Iowa City, IA: Center for Advanced Studies in Measurement and Assessment, University of Iowa. (Available from http://www.education.uiowa.edu/casma).

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297–334.

Cronbach, L.J., Schonemann, P., & McKie, D. (1965). Alpha coefficients for stratified-parallel tests. *Educational and Psychological Measurement, 25*, 291–312.

Divgi, D. R. (1980). *Dimensionality of binary items: Use of a mixed model.* Paper presented at the annual meeting of the National Council on Measurement in Education. Boston MA.

Dolan, R. P., & Hall, T. E. (2001). Universal design for learning: Implications for large-scale assessments. *Perspectives: International Dyslexia Association, 27*(4), 22–25. http://www.cast.org/udl/Dolan_IDA_Perspectives_2001.htm

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20*, 141–151.

Kolen, M. J., & Brennan, R. L. (2014). *Test equating, scaling, and linking: Methods and practices* (3rd Ed.). New York: Springer-Verlag.

Linacre, J. M. (2006). *WINSTEPS: Rasch measurement computer programs*. Chicago: Winsteps.

Livingston, S. A., & Lewis, C. (1995). Estimating the consistency and accuracy of classifications based on test scores. *Journal of Educational Measurement, 32*, 179–197.

Lord, F. M. (1980). *Applications of item response theory to practical testing problems.* New York: Erlbaum Associates.

Masters, G. N. (1982). A Rasch model for partial credit scoring. *Psychometrika*, 47, 149–174.

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational measurement* (3rd ed., pp. 13–103). New York: Macmillan.

Rasch, G. (1980). *Probabilistic models for some intelligence and attainment tests.* Chicago, IL: University of Chicago Press.

Suen, H. K. (1990). *Principles of test theories*. Hillsdale, NJ: Lawrence.

Webb, N. L. (2005). *Web alignment tool (WAT) training manual*. Madison, WI: University of Wisconsin, Wisconsin Center for Education Research.

Wright, B. D., & Stone, M. H. (1979). *Best test design.* Chicago, IL: MESA Press.